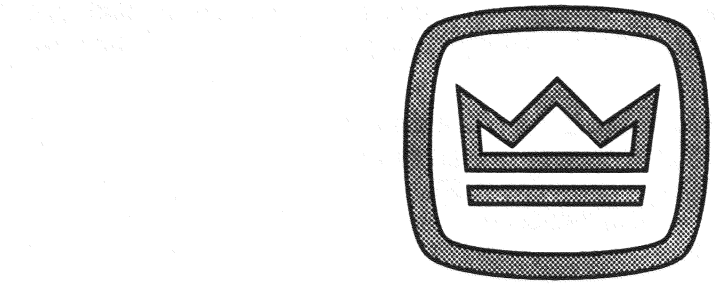

CROWN®

Macro-Tech® 5000VZ

POWER AMPLIFIER

SERVICE MANUAL

Mailing Address:
P.O. Box 1000
Elkhart, IN 46515-1000

Shipping Address:
57620 C.R. 105
Elkhart, IN 46517

130343-1
5/93

The information furnished in this manual does not include all of the details of design, production, or variations of the equipment. Nor does it cover every possible situation which may arise during installation, operation or maintenance. If you need special assistance beyond the scope of this manual, please contact your Crown Dealer or the Crown Technical Support Group.

Mail: P.O. Box 1000, Elkhart IN 46515-1000
Shipping: 57620 C.R. 105, Elkhart IN 46517
Phone: (219) 294-8200
(800) 342-6939
FAX: (219) 294-8301

CAUTION

TO PREVENT ELECTRIC SHOCK DO NOT REMOVE TOP OR BOTTOM COVERS. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL. DISCONNECT POWER CORD BEFORE REMOVING REAR INPUT MODULE.

AVIS

À PRÉVENIR LE CHOC ÉLECTRIQUE N'ENLEVEZ PAS LES COUVERTURES. RIEN DES PARTIES UTILES À L'INTÉRIEUR. DÉBRANCHER LA BORNE AVANT D'OUVRIR LA MODULE EN ARRIÈRE.

WARNING

TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE!

Table of Contents

PART I - Technical Information

1 Introduction 1-1
1.1 The Macro-Tech 5000VZ 1-2
1.2 Warranty 1-2
1.3 Specifications 1-3
1.3.1 Performance 1-3
1.3.2 Power 1-3
1.3.3 Controls 1-3
1.3.4 Indicators 1-3
1.3.5 Input/Output 1-3
1.3.6 Connectors 1-3
1.3.7 Construction 1-3

2 Maintenance 2-1
2.1 Cautions and Warnings 2-1
2.2 Troubleshooting 2-1
2.2.1 Pre-AC Checks 2-1
2.2.2 LED Checks 2-2
2.3 Checkout/Adjustment Procedures 2-4
2.3.1 Equipment Required 2-4
2.3.2 Initial Conditions 2-4
2.3.3 Test Procedures 2-4

3 Voltage Conversion 3-1

4 Circuit Theory 4-1
4.1 Overview 4-1
4.2 Grounded Bridge Theory 4-2
4.2.1 Grounded Bridge Operation 4-2
4.2.2 Output Stage Circuitry 4-3
4.3 VZ Power Supply 4-4
4.3.1 VZ Supply Operation 4-4
4.3.2 VZ Supply Circuitry 4-6
4.4 ODEP Theory 4-6
4.4.1 ODEP Operation 4-6
4.4.2 ODEP Circuitry 4-8
4.5 Front End Theory 4-8
4.5.1 Balanced Gain Stage 4-8
4.5.2 Variable Gain Stage 4-8
4.5.3 Error Amp 4-9
4.5.4 Compressor 4-9
4.5.5 Loudspeaker Offset Integration 4-9
4.5.6 Voltage Translator and LVA 4-9
4.5.7 Inverting Stages 4-10
4.6 Protection Systems 4-10
4.6.1 Soft-start 4-10
4.6.2 Over-voltage 4-12
4.6.3 DC/LFI 4-12
4.6.4 Common Mode Output Current 4-12
4.6.5 Output Thermal 4-13
4.6.6 Transformer Thermal 4-13
4.6.7 FET Thermal 4-13
4.6.8 Power Loss 4-13
4.6.9 Fan Control 4-13
4.7 Display 4-14
4.8 Mono Modes 4-14
4.8.1 Bridge Mono 4-14
4.8.2 Parallel Mono 4-14

PART II - Component Documentation

5 Parts 5-1
5.1 General Information 5-2
5.2 Standard and Special Parts 5-2
5.3 Ordering Parts 5-2
5.4 Shipment 5-2
5.5 Terms 5-2

6 Schematics 6-1

7 Exploded View Drawings 7-1

8 Circuit Board Artwork 8-1

Illustrations

Fig. 1.1 Macro-Tech 5000VZ 1-2
Fig. 2.1 ODEP Voltage Set Chart 2-6
Fig. 2.2 Bridged MONO 2-8
Fig. 2.3 ODEP Protection 2-10
Fig. 2.4 VZ Mode Switch Locations 2-10
Fig. 2.5 10kHz Square Wave 2-12
Fig. 2.6 Inductive Load 2-12
Fig. 3.1 Voltage/Frequency Conversion Chart 3-1
Fig. 3.2 Voltage/Frequency Conversion Physical Layout 3-2
Fig. 4.1 Simplified Grounded Bridge 4-2
Fig. 4.2 Simplified VZ Supply 4-4
Fig. 4.3 Simplified VZ Supply In Operation 4-5
Fig. 4.4 Simplified ODEP Circuitry 4-7
Fig. 4.5 Front End Circuitry Block Diagram 4-9
Fig. 4.6 Soft-start and Fan Control 4-11
Fig. 4.7 Soft-start Signal 4-12
Fig. 4.8 Over-all Protection Scheme 4-13
Fig. 4.9 MA-5000VZ Block Diagram 4-15

For mechanical artwork see Exploded Views, page 7-1. For module layouts see Modules, page 8-1.

PART I

Technical Information

Fig. 1.1 Macro-Tech 5000VZ

1 Introduction

This manual contains service information on the Crown Macro-Tech® 5000VZ™ power amplifier. It is designed to be used in conjunction with the Macro-Tech 5000VZ Owner's Manual. Some important information is, however, duplicated in this Service Manual in case the Owner's Manual is not readily available.

NOTE: THE INFORMATION IN THIS MANUAL IS INTENDED FOR USE BY AN EXPERIENCED TECHNICIAN ONLY!

1.1 THE MACRO-TECH 5000VZ

The Macro-Tech 5000VZ amplifier is a compact, audio power amplifier designed for professional use. Providing high power amplification from 20Hz-20KHz with minimum distortion, this unit features balanced ¼" phone and XLR inputs via the standard P.I.P.-FXQ, ODEP, SPI/IOC, and I Load/I Limit indication, bridged and parallel monophonic capability, switchable compression, switchable loudspeaker offset integration (LOI), switchable sensitivity, and is fully P.I.P. compatible. Also, this unit can easily be configured to any standard world line voltage, at 50 or 60Hz.

1.2 WARRANTY

Each Owner's Manual contains basic policies as related to the customer. For further assistance please contact the Crown Technical Support Group at:

Crown International, Inc.
Mailing: PO Box 1000
Elkhart, IN 46515-1000
or
Shipping: 57620 C.R. 105
Elkhart, IN 46517

Toll Free: (800) 342-6939
Phone: (219) 294-8000
FAX: (219) 294-8301

1.3 SPECIFICATIONS

Crown specifications are guaranteed for three years. Further, we guarantee that every Crown amplifier will *exceed* its published specs.

1.3.1 Performance

Note: Measurements made in Stereo, both channels driven into 8 ohms.

Frequency Response: ±0.1 dB from 20 Hz to 20 kHz at 1 watt.

Phase Response: ±10° from 10 Hz to 20 kHz at 1 watt.

Signal to Noise Ratio: At 26 dB gain, better than 105 dB (A-weighted) below full output.

Total Harmonic Distortion (THD): <0.05% from 20 Hz to 1 kHz, increasing linearly to 0.1% at 20 kHz at full output.

I.M. Distortion: <0.05% from 410 milliwatts to full output at 26 dB gain, with an 8 ohm load.

Slew Rate: >30 V per microsecond.

Damping Factor: >1000 from 10 Hz to 400 Hz.

1.3.2 Power

Output Power: (Max. average power at 1 kHz with 0.1% THD.)

Stereo–1300 W/channel into 8 ohms, 2000W/channel into 4 ohms, 2500 W/channel into 2 ohms, both channels driven.

Bridged Mono–4000 W into 8 ohms, 5000 W into 4 ohms.

Parallel Mono–4000 W into 2 ohms, 5000 W into 1 ohm.

Load Impedance: Rated for 16, 8, 4, 2 ohm use. Safe with all types of loads, even reactive ones.

Required AC Mains: 60 Hz, 120VAC with 30A service. Convertable to 100/120/200/208/230/240VAC at 50/60 Hz.

AC Line: "TT" style 3 wire 30A grounded connector (for 120VAC units).

1.3.3 Controls

Front Panel: A push on/off power switch; also, a signal level control for each channel.

Back Panel: A three-position switch which selects Stereo, Bridged-Mono, or Parallel-Mono mode, loudspeaker offset integration (LOI) on/off switch for each channel, a three-position switch selects 0.775 V, 1.4 V, or 26 dB voltage gain input sensitivity for each channel, a compressor switch selectable to fast, slow, or off for each channel, and a ground lift switch to isolate chassis from shield ground on the standard P.I.P.-FXQ.

Internal: Switches behind the front grill allow selection of normal VZ operation, lock to low voltage only, lock to high voltage only, and lock to low voltage under ODEP conditions.

1.3.4 Indicators

Amber **Enable** indicator shows on/off status of low-voltage power supply.

An amber **ODEP** indicator for each channel shows thermal reserve status. Normally on, this indicator will dim or go out in the event that a thermal condition causes signal limiting.

A green **SPI/IOC** indicator for each channel flashes dim green to show a signal is present at the input, and flashes brightly in the rare event distortion of any kind exceeds 0.05%, including input overload.

A bi-color (green/red) **ILOAD/ILIMIT** indicator for each channel flashes green with the output signal (when under a current load) and flashes red in the event of current limiting.

1.3.5 Input/Output

Input Impedance: Greater than 10 K ohms, balanced, and 5 K ohms, unbalanced.

Output Impedance: Less than 10 milliohms is series with less than 2 microhenries.

1.3.6 Connectors

Inputs: Balanced 1/4 inch phone jacks or XLRs with standard P.I.P.-FXQ module installed.

Outputs: Unique output bus with dual banana jacks on ¾ inch centers, and high current ring or spade lug barrier connectors.

1.3.7 Construction

Black splatter-coat steel chassis with specially-designed flow-through front to rear ventilation system with ODEP derived proportional forced air cooling.

Dimensions: 19 inch wide, 5.25 inch high, 16 inch deep behind front mounting surface.

Weight: 77 lbs net, 86 lbs gross.

Mounting: Standard EIA 310 front-panel rack mount with supports for supplemental rear corner mounting.

2 Maintenance

In most cases you will be using the test procedures in section 2.3 after conducting your repairs. Before initially powering up the amplifier you should review section 2.1 and take appropriate steps for personal and equipment safety. Section 2.2 will help to determine whether the amplifier should be safe to turn on. This section also includes some additional checks that should be made prior to starting the actual check-out. Italicized print in the test procedures (section 2.3) includes basic troubleshooting hints to augment procedures in section 2.2. These hints do not cover every possibility, but should be helpful for a variety of symptoms. After troubleshooting and repair (or as a part of), the final step is to thoroughly test the amplifier to be certain that it meets the factory specifications. Test procedures in section 2.3 will help you do this as well as aid you in locating the cause of problem(s).

2.1 CAUTIONS AND WARNINGS

DANGER: The outputs of this amplifier can produce LETHAL energy levels! Be very careful when making connections. Do not attempt to change output wiring until the amplifier has been off at least 10 seconds.
WARNING: This unit is capable of producing high sound pressure levels. Continued exposure to high sound pressure levels can cause permanent hearing impairment or loss. User caution is advised and ear protection is recommended when playing at high volumes.
WARNING: Do not expose this unit to rain or moisture.
WARNING: Only properly trained and qualified technicians should attempt to service this unit. There are no user serviceable parts inside.
WARNING: When performing service checks with the power off, discharge the main power supply filter capacitors fully before taking any measurements or touching any electrical components. A 100 ohm 10W resistor is recommended for this. Hold the resistor with pliers, as the resistor may become extremely hot.
WARNING: Under load, with a sine wave signal at full power into both channels, the amplifier may draw in excess of 60 amperes from the AC service mains.
WARNING: When performing tests in section 2.3, do not connect any load to the amplifier until instructed to do so. There is no danger to the amplifier in operating without any load (open outputs).
WARNING: Do not change the position of the Stereo/ Mono Switch when the amplifier is turned on. If the position of this switch is changed while the amplifier is powered, transients may permanantly damage your speakers.
WARNING: Heatsinks are not at ground potential. Touching either heatsink and ground, or touching both heatsinks will cause electrical shock.
CAUTION: Eye protection should be worn at all times when protective covers are removed and the amplifier is plugged in.
CAUTION: When performing tests in section 2.3 that require a load, the load must be resistive and must be capable of handling 3000W (per channel).
CAUTION: Disconnect power cord before installing or removing the P.I.P. module or any other cover or panel.

2.2 TROUBLESHOOTING

2.2.1 Pre-AC Checks

A number of checks can be made prior to powering up the unit. These should be done in order to prevent an unwanted disaster when turning the unit on. Once these checks are made power may be applied for further checks. Note: It will be necessary to remove top, rear, and bottom panels for complete access to all modules.

Step 1 is: acquire all information possible from the person(s) having the problem to determine the nature of the complaint. Ask questions like "Why was the amplifier brought in for repair?" "Does it do this right at turn on, does it take a while, or does it only happen sometimes?" If you observe nothing wrong, inquire tactfully how the unit was being used when the malfunction occurred to determine if it may have been misused, if the user misunderstood what happened, or if another system component may be at fault.

Step 2 is: always a complete visual inspection. A problem may be obvious just by looking. Things to look for include burned components, wires not connected, fan obstructions, loose hardware or connections, and soldering. Dirty air filters or plugged heatsinks greatly reduce amplifier efficiency and result in pre-mature ODEP limiting. The fan blades should spin freely. Burns and other physical damage should be repaired and components in the affected circuit areas should be checked carefully before continuing.

Whether a problem is identified by visual inspection or not, several checks should be performed prior to turning the amplifier on. These should be performed if catastrophic failure has been reported, no signal output with constant IOC is reported, or the condition of the amplifier is otherwise unknown but failure is suspected.

Channel 1 uses 100/300 series numbering and channel 2 uses 200/400 series numbering on the main module. 500 series numbering is used on the output and emitter modules, regardless of the channel. 700 and 800 series numbers are used on control, current sense, and terminator modules.

The third item on the "to do" list involves a number of electrical checks. Due to the protection features of the MA-5000VZ, it should be safe to turn-on under all circumstances, but these preliminary checks may allow a partial if not complete repair before power is ever applied. These checks are designed to find problems in the output stages. The ultimate guide should always be common sense.

To access all of the modules, simply remove the top cover, rear panel, and bottom cover. The main module will slide up and back for access to output module components by loosening four screws. The main module tray need not be removed in order to remove an output assembly, however, to perform component replacement on the main module the tray should be removed completely and the module removed from the tray. Note that the current sense module is actual comprised of two separate boards, connected by dual ribbon cables, hardwired at both ends. The smaller board is called current sense, the larger is, by itself, referred to as the terminator. Either name, however, may be applied to the pair. In section 8 they are covered as a single part, D 7994-3.

a.) Locate the flyback diodes D506, D507, D508, and D509 on the emitter modules and check for indications of a short. If a short is indicated, this means that an output device or driver transistor in parallel with that diode is shorted, usually not the diode itself. If a faulty output device is found, the entire output assembly may be replaced, or only the affected components. If an output device is found to be defective, emitter resistors should also be checked. If no output device is found defective, perform a quick check of driver, pre-driver, and bias transistors. Then, if no problem is found, move to power-on checks.

b.) Check driver and pre-driver transistors for shorts or opens. If a fault is found, do an in-circuit static check of all semiconductors on the output modules. If no output device and nothing upstream is found defective, move to power-on checks. Otherwise continue.

c.) If a failure has occurred anywhere in the output stages, check bias servo transistors on each (positive and negative) output module. Any failure associated with bias transistors may result in repeat failure of the affected channel even if all other defective components have been found and replaced.

d.) If a failure is found in any LVAs, checks should continue up onto the main module in the voltage translator stage.

e.) Failure within the power supply itself is very rare, however a cursory check of major items is always prudent. A 30A fuse should not blow unless a catastrophic failure has occurred in the output stage or power supply. The low voltage fuse should not blow unless a failure has occurred, probably in the supply itself. If a failure has occurred in the output stages, check the MOSFET switches and other VZ control components, such as bridge rectifiers.

2.2.2 LED Checks

When power-off checks are complete and any defects found are corrected during that phase, the next step is to apply power. The MA-5000VZ includes several LED indicators to assist you in troubleshooting an amplifier malfunction.

All indicators on the amplifier, both front panel and internal, are important. External indicators include Enable, ODEP, SPI/IOC, and ILOAD/ILIMIT. Internal indicators include DC/LF, Fault (output module), Standby, and Over-voltage/Transformer Thermal.

A chart on the following pages lists likely LED combinations and likely causes. In each case it is assumed that the LED circuit itself is operating properly. If a failure is suspected, compare amplifier indicators with the chart.

In order to ensure that the problems are assessed correctly, perform the LED checks under the following conditions: Before power is applied, ensure that the Stereo/Mono switch is in the STEREO position. Do NOT connect any signal source or load to the amplifier. Turn the amplifier on. After approximately 4 seconds the turn-on delay should time out. During the delay IOC indicators will usually be on and ODEP indicators should be off. After the delay times out relays click on, IOC indication should go off, and ODEP indicators should come on. If this does not occur, definitely refer to the chart that follows. Although this chart contains most likely failures, it does not cover every possibility. Common sense and a study of schematics and circuit theory (provided in section 4) should lead ultimately to a proper repair.

Indicator	Condition	Cause
ODEP	One OFF	At any time the main relay is off (open), the ODEP indicator is also held off. Any protective action which will result in amplifier shut-down will cause the ODEP indicator on the affected channel to be off. The ODEP indicator will also be off when the amplifier is into "full ODEP" limiting. Under the initial conditions described, the conditions in the left column will only occur when a there is a failure in one relay or relay control circuit, or if a failure has occurred in the ODEP circuit itself, or a thermal sensor for the ODEP circuit.
SPI/IOC	Both OFF	
ILOAD/ILIMIT	Both OFF	
STBY	Both OFF	
OV/THERM	Both OFF	
DC/LF	Both OFF	
OUTPUT MOD	Both OFF	
ODEP	One OFF	An ODEP indicator off coupled with one or both internal STBY indicators lit is most often caused by low line voltage. It may also be caused by placing a logical low on a RS (remote standby function) connection to the P.I.P. module. First verify AC mains voltage and check the amplifier to ensured it is wired for the appropriate AC mains. The RS port from the P.I.P. module is not likely to be at fault, but if an IQ-P.I.P. is installed, it may be necessary to replace it with a blank module (such as the P.I.P.-FXQ) for testing purposes.
SPI/IOC	Both OFF	
ILOAD/ILIMIT	Both OFF	
STBY	One/Both ON	
OV/THERM	Both OFF	
DC/LF	Both OFF	
OUTPUT MOD	Both OFF	
ODEP	Both OFF	Both ODEP indicators off coupled with both internal OV/THERM indicators lit is most often caused by high line voltage (>10% above what the amplifier is wired for). It is extremely unlikely that the thermal switches in both amplifier channels will be activated. First verify AC mains voltage and check the amplifier to ensured it is wired for the appropriate AC mains. If fans are running at full speed, a transformer thermal condition is probably being simulated by a failed IC such as U707.
SPI/IOC	Both OFF	
ILOAD/ILIMIT	Both OFF	
STBY	Both OFF	
OV/THERM	Both ON	
DC/LF	Both OFF	
OUTPUT MOD	Both OFF	
ODEP	One OFF	One ODEP indicator off coupled with one internal OV/THERM indicator lit will result from an open thermal switch in the toroid of the affected channel. Except for very early units with control module Q42930-0, fans should both be operating at high speed. If they are, a thermal switch is in fact open. If fans are off or nearly off (and control module is Q43096-9 or later), the problem is more likely a failed Q709 (Ch 1) or Q707 (Ch 2).
SPI/IOC	Both OFF	
ILOAD/ILIMIT	Both OFF	
STBY	Both OFF	
OV/THERM	One ON	
DC/LF	Both OFF	
OUTPUT MOD	Both OFF	
ODEP	One OFF	One ODEP indicator off coupled with IOC and DC/LF indications indicates a DC offset at the amplifier's output. The amplifier may attempt to cycle if a small offset is being caused by a malfunction. This may not be the direct result of an output device failure. It may rather be caused by a grossly mal-adjusted or faulty balance control within the amplifier. It may also be caused by any number of minor components failing in an unexpected manor. It may also be the result of an unbalanced ODEP circuit (±ODEP bias potentials unequal). If the DC/LF indication remains locked in, the OUTPUT MOD Fault circuit may be activated, but on occasion the DC/LF circuit will trigger faster causing this indication. Observe the output with a scope to determine if cycling action is in fact occurring.
SPI/IOC	One ON	
ILOAD/ILIMIT	Both OFF	
STBY	Both OFF	
OV/THERM	Both OFF	
DC/LF	One ON	
OUTPUT MOD	Both OFF	

Indicator	Condition	Cause
ODEP	Both OFF	Both ODEP indicators off coupled with both IOC and DC/LF indications indicates a DC offset at both of the amplifier's outputs. If possible, inquire if the user was operating the amplifier in a mono mode when the failure occurred. If so, then it is likely that output stage damage has occurred in both channels. If not, two unique problems may have occurred, or there may be an unexpected short on the terminator/current sense module. Other unexpected shorts may be possible. Mechanical integrity should be carefully checked.
SPI/IOC	Both ON	
ILOAD/ILIMIT	Both OFF	
STBY	Both OFF	
OV/THERM	Both OFF	
DC/LF	Both ON	
OUTPUT MOD	Both OFF	
ODEP	One OFF	An ODEP indicator off coupled with one internal OUTPUT MOD indicator lit may be accompanied with IOC and ILOAD/ILIMIT for the affected channel. Such a fault is latching and keeps the high voltage rails off. Such a fault is caused by conduction in both the positive and negative half of the output stage simultaneously. Under normal conditions this cannot occur at levels much above 100mW, assuming the amplifier is properly biased. Such a fault is usually the result of a failed output device, or possibly a failed bias network. It may also be caused by operating the amplifier at extremely high levels with ultra-sonics.
SPI/IOC	Either OFF/ON	
ILOAD/ILIMIT	Either OFF/ON	
STBY	Both OFF	
OV/THERM	Both OFF	
DC/LF	Both OFF	
OUTPUT MOD	One ON	
ODEP	Both OFF	Both ODEP indicators off with no other abnormal indication is almost impossible unless both relays fail, or the Power Loss IC (U111A) circuit has failed.
SPI/IOC	Both OFF	
ILOAD/ILIMIT	Both OFF	
STBY	Both OFF	
OV/THERM	Both OFF	
DC/LF	Both OFF	
OUTPUT MOD	Both OFF	

2.3 CHECKOUT/ADJUSTMENT PROCEDURES

The following instructions outline an orderly checkout and troubleshooting procedure. The purpose and arrangement of this procedure is to ensure proper operation after a repair has been completed. Before beginning these power-on tests review all cautions and warnings in section 2.1, and perform the checks listed in section 2.2. These checks will minimize the possibility of receiving a nasty surprise when turning on the MA-5000VZ.

WARNING!! Most adjustments are made with protective covers removed. This means prior to any AC power-off testing, discharge all power capacitors. Also, use extreme caution while making any internal adjustments when the unit is powered.

2.3.1 Equipment Required

The following is a list of standard equipment needed for manual performance of all tests listed in section 2.3.3:
Line Voltage Variac: 5kW or larger.
Oscilloscope: 2 Channel, 10MHz or better.
Digital Multimeter: Various measurements.
Watt Meter: For AC line draw.
ACVM: Peak reading RMS calibrated (all AC line voltage and amplifier output voltage checks).
I.M.D. Analyzer: 60Hz/7kHz in 4:1 ratio, accurate to 0.001% I.M.D.
T.H.D. Analyzer: Accurate to 0.001%.
Loads: 3000W continuous at 1 ohm.

2.3.2 Initial Conditions

The start of each step assumes all switches are pre-set to the following positions:
Dual Mono Switch: STEREO position.
Sensitivity Switches: Both to 0.775V position.
Compressor Switches: Both to OFF position.
LOI Switches: Both to OFF position.
VZ Mode Switches: Both to VZ position.
Level Controls: Both up (clockwise) fully.

2.3.3 Test Procedure

The following steps are arranged in order for best results and, for the most part, easiest use. Read each step carefully before proceeding. Read all precautions in section 2.1 before continuing. Use extreme caution and good common sense at all times. The preceding warnings and cautions are detailed for good reason.

WARNING: Do not connect any load to the MA-5000VZ power amplifier during these tests until specifically instructed to do so.

Type of Test or Adjustment	Input Signal and Load Parameters	Comments
1. Turn-on Delay	No Signal No Load	Check for a delay of approximately 4 seconds from the time the power push button is pressed until the IOC indication clears and ODEP indicators come on. *If the IOC fails to clear in one channel, check for presence of rail voltages and for a DC offset. Also check circuit board LED for indication of a fault - DC/LF, Output Module, and OV/TSW. Turn unit off, disconnect the power cord, discharge power supplies, and check for a failure in the output stage of the affected channel, or other applicable circuit area. If the fans lock in high speed after delay times out, check fan control components, ODEP output, and LM334Z devices on the output modules.*
2. DC Output Offset	No Signal No Load	With the input level controls turned fully clockwise, the DC offset for both channels should be less than ±10 millivolts. Note: There are no output offset adjustments for the MA-5000VZ. *A small DC offset may indicate an ODEP failure. A large DC offset usually indicates a failure in the output stage, though such an offset should have shut down the amplifier on a DC/LFI signal.*
3. Quiescent Power	No Signal No Load	While there is no published specification on quiescent power (at the time of this printing), it should be checked. A power draw with the fans off or operating slowly will normally be less than 150W (<1.5A). *Turn amplifier off immediately if quiescent power greatly exceeds expectation and search for power supply or output failure. If quiescent draw exceeds expectation by a "small" amount check bias immediately.*
4. High Side Bias	No Signal No Load	Bias voltage is set while the amplifier is at room temperature. If the amplifier is hot from prior testing for repair or other purposes, it should be set aside until it has cooled before continuing with this check. Bias, once factory set, normally will not require adjustment. For channel 1: Measure the voltage at TP1 pin 2 with respect to pin 4 (DO NOT measure from ground reference). The bias voltage should equal .350 VDC ± 10 millivolts. If the bias voltage needs to be adjusted, adjust R505 on the channel 1 output assembly for the correct bias voltage. For channel 2: Measure the voltage at TP2 pin 2 with respect to pin 4 (DO NOT measure from ground reference). The bias voltage should equal .350 VDC ± 10 millivolts. If the bias voltage needs to be adjusted, adjust R505 on the channel 2 output assembly for the correct bias voltage.

Type of Test or Adjustment	Input Signal and Load Parameters	Comments
5. Low Side Bias	No Signal No Load	Bias voltage is set while the amplifier is at room temperature. If the amplifier is hot from prior testing for repair or other purposes, it should be set aside until it has cooled before continuing with this check. Bias, once factory set, normally will not require adjustment. For channel 1: Measure the voltage at TP1 pin 15 with respect to pin 13 (DO NOT measure from ground reference). The bias voltage should equal .350 VDC ± 10 millivolts. If the bias voltage needs to be adjusted, adjust R556 on the channel 1 output assembly for the correct bias voltage. For channel 2: Measure the voltage at TP2 pin 13 with respect to pin 15 (DO NOT measure from ground reference). The bias voltage should equal .350 VDC ± 10 millivolts. If the bias voltage needs to be adjusted, adjust R556 on the channel 2 output assembly for the correct bias voltage.
6. O.D.E.P Null	No Signal No Load	ODEP Nulls are based on heatsink temperatures. To check and, if necessary, adjust ODEP bias voltages, heatsink temperatures must be measured. For positive ODEP: Measure TP1/TP2 pin 17 with respect to ground. Refer to the chart (Fig. 2.1) below. If measured voltage falls outside the listed range, the amplifier is too hot or too cold. Measure TP1/TP2 pin 11 with respect to ground. Observe the below listed ODEP Set Voltage with a negative polarity, ±0.1V. If necessary adjust R182/R282. For negative ODEP: Measure TP1/TP2 pin 17 with respect to ground. Refer to the chart (Fig. 2.1) below. If measured voltage falls outside the listed range, the amplifier is too hot or too cold. Measure TP1/TP2 pin 9 with respect to ground. Observe the below listed ODEP Set Voltage with a positive polarity, ±0.1V. If necessary adjust R191/ R291.

Voltage Measured	ODEP Set Voltage	Voltage Measured	ODEP Set Voltage
2.90 mV	12.96 V	3.00 mV	11.76 V
2.91 mV	12.64 V	3.01 mV	11.64 V
2.92 mV	12.72 V	3.02 mV	11.52 V
2.93 mV	12.60 V	3.03 mV	11.40 V
2.94 mV	12.48 V	3.04 mV	11.28 V
2.95 mV	12.36 V	3.05 mV	11.16 V
2.96 mV	12.24 V	3.06 mV	11.04 V
2.97 mV	12.12 V	3.07 mV	10.92 V
2.98 mV	12.00 V	3.08 mV	10.80 V
2.99 mV	11.88 V	3.09 mV	10.68 V

Fig. 2.1 ODEP Set Voltage Chart

WARNING: Many of the following checks are done by connecting a resistive load to the output of the amplifier. Use caution and follow check-out procedures carefully to ensure correct results. These tests require a resistive load capable of over 3000W continuous into as low as 1 ohm.

WARNING: The MA-5000VZ is capable of drawing in excess of 80 Amperes of current from 120VAC Mains when loaded to 2 ohms per channel and with both channels driven by a 1kHz sine wave.

CAUTION: 30A fuses should be replaced after completion of tests, as they will be stessed during high power tests. Special 30A test fuses may used during testing, if they are replaced with the stock fuses after the tests.

Type of Test or Adjustment	Input Signal and Load Parameters	Comments
7. CMR Null	1kHz Sq. Wave No Load	Insert a common mode 1kHz 0dBu square wave into channel 1 (phono tip & ring shorted or XLR pins 2 and 3 shorted). At the output jacks measure less than 16 mV. If necessary adjust R105. Repeat test for channel 2, adjust R205 if necessary.
8. LED Check	1kHz Sine/Sq Wave Various Loads	Turn the amplifier off and leave it off for about 10 seconds. Turn the amplifier on. Observe the ODEP lights come on after about 4 seconds. The SPI/IOC lights should go off (if on during delay) at this time. Input a 1kHz 2V_{RMS} sine wave into each channel and observe the SPI/IOC lights on brightly. Turn down the input level to about 0.5V_{RMS} and observe the SPI/IOC lights remain on, but dimly. Remove the input signal and load the amplifier to 8 ohms/Ch. Insert the 0.5Vrms signal again and note the I_{LOAD}/I_{LIMIT} indicators come on green. Change the load to 1 ohm/Ch, switch to a square wave (20% Duty Cycle), and increase input level to 2V_{RMS}. Note the I_{LOAD}/I_{LIMIT} indicators turn red. This check also constitutes the Current Limit Check.
9. Sensitivity	1kHz Sine Wave No Load	Set the sensitivity switches to the 26dB position, check both level controls full clockwise. Insert a .775V 1kHz sine wave and measure 15.04V-15.97V at the output of each channel. Set sensitivity to the 0.775V position and measure 96.4V-107.6V at the output of each channel. Set the sensitivity switches to 1.4V position and measure 53.0V-59.2V at the output of each channel. At completion of test return sensitivity switches to 0.775V position.

Type of Test or Adjustment	Input Signal and Load Parameters	Comments
10. LOI	Sine Wave 8 Ohms	Place sensitivity switches in 26dB position; check or place LOI (EPS) switches to OFF (BYPASS) position. Insert a 1kHz sine wave and adjust for 2.8VRMS (1W) output into 8 ohms. Adjust to 30Hz then to 20Hz, level should remain constant. Switch LOI (EPS) to ON (ENABLE). Check output at 30Hz at -2dB ±.1dB. Adjust frequency to 20Hz and measure output level at -11dB±.1dB. Return LOI/ESP and sensitivity switches to initial condition (section 2.3.1).
11. Bridge Mono	1kHz Sine Wave No Load	*Note: Always turn power to the amplifier off prior to changing the position of the Stereo/Mono Switch.* With the dual/mono switch in the bridge mono position, set the channel two input level control to full CCW. Insert a .775VRMS 1kHz signal into channel one input. There should be signal present on both channel outputs, equal in amplitude, with channel two 180 degrees out of polarity from channel one (see Fig. 2.2). Channel one input level control should control the output level for both channels. Return the amplifier to stereo operation.
12. Parallel Mono	1kHz Sine Wave No Load	*Note: Always turn power to the amplifier off prior to changing the position of the Stereo/Mono Switch.* With the dual/mono switch in the parallel mono position, insert a .775 VAC 1 kHz signal into channel one. There should be two signals with the same polarity present, equal in amplitude, at the outputs of channels one and two. Both of these signals will be controlled by the channel one input level control. Switch the stereo/ mono switch to stereo. There should be signal present only on the channel one output.

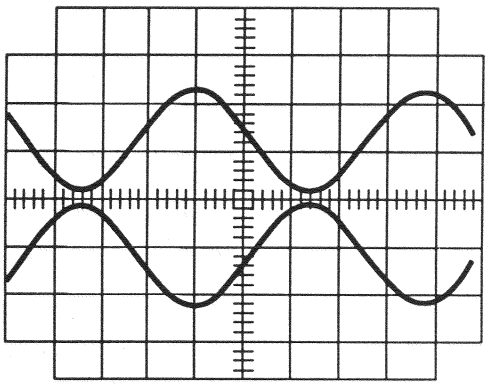

Fig. 2.2 Bridge MONO