



POWER AMPLIFIER SERVICE MANUAL

MICRO-TECH[®]-2400

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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 the Crown Technical Support Group.

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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 TO ACCESS GAIN SWITCH.

AVIS

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

WARNING

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

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Introduction

This manual contains service information on Crown power amplifiers. It is designed to be used in conjunction with the applicable Owner's Manual. However, some important information is 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!

SCOPE

This Service Manual includes several sections. These sections include Parts Information, Specifications, Voltage Conversion, Circuit Theory, Electrical Test Procedures, Non-Module Parts Lists, and Module Parts Lists. Schematics are attached. Note that component parts with circuit board comprise a complete module. Module part numbers are always associated with a specific circuit board, although an unpopulated circuit board may be built up with different parts to create different modules. Note that Crown does not sell blank (unpopulated) circuit boards.

Each of the compact audio power amplifiers are designed for professional or commercial use. Providing high power amplification from 20Hz to 20KHz with minimum distortion, they feature balanced inputs with bridged and parallel monophonic capability. Specific features vary depending on model family.

WARRANTY

Each Owner's Manual contains basic policies as related to the customer. In addition it should be stated that this service documentation is meant to be used only by properly trained service personnel. Because most Crown products carry a 3 Year Full Warranty (including round trip shipping within the United States), all warranty service should be referred to the Crown Factory or Authorized Warranty Service Center. See the applicable Owner's Manual for warranty details. To find the location of the nearest Authorized Service Center or obtain instructions for receiving Crown Factory Service please contact the Crown Technical Support Group (within North America) or your Crown/Amcron Importer (outside North America).

**Crown
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Parts Information

GENERAL INFORMATION

Later sections include both mechanical and electrical parts lists for this product. The parts listed are current as of the date printed. Crown reserves the right to modify and improve its products for the benefit of its customers.

PART NUMBERING SYSTEMS

As of the printing of this manual, Crown is using two numbering systems. The elder system always uses eight characters. The first character is a letter. Common letters used are C, D, H, M, P, and Q. The second through sixth characters are numbers. The numbers build sequentially (for each prefix letter) as new parts are added to our parts inventory system. (In some cases there will be a space then a four character number after the prefix letter; the space is considered a character.) The seventh character is usually a hyphen, though it may be a letter to indicate a revision or special note. The last character is called a check-digit, and is useful to Crown for internal tracking.

Crown is in the process of converting to a new part number system. Length may vary from eight to twelve characters. There is still a letter prefix, then five numbers. These five numbers identify a type of part. The seventh character is a hyphen. Remaining characters identify the details of the type of part identified by the first part of the number.

STANDARD AND SPECIAL PARTS

Many smaller electrical and electronic parts used by Crown are stocked by and available from electronic supply houses. However, some electronic parts that appear to be standard are actually special. A part ordered from Crown will assure an acceptable replacement. Structural items such as modules and panels are available from Crown only.

ORDERING PARTS

When ordering parts, be sure to give the product model, and include a description and part number (CPN/DPN) from the parts listing. Price quotes are available on request.

SHIPMENT

Shipment will be normally made by UPS or best other method unless you specify otherwise. Shipments are made to and from Elkhart, Indiana USA, only. Established accounts with Crown will receive shipment freight prepaid and will be billed. All others will receive

shipment on a C.O.D. or pre-payment (check or credit card) basis.

TERMS

Normal terms are pre-paid. Net-30 Days applies to only those firms having pre-established accounts with Crown. If pre-paying, the order must be packed and weighed before a total bill can be established, after which an amount due will be issued and shipment made upon receipt of pre-payment. New parts returned for credit are subject to a 10% re-stocking fee, and authorization from the Crown Parts Department must be obtained before returning parts for credit.

Crown is not a general parts warehouse. Parts sold by the Crown Parts Department are solely for servicing Crown/Amcron products. **Part prices and availability are subject to change without notice.**

Crown Parts Department

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Specifications

Unless noted otherwise, all specifications are based on driving an 8 ohm load per channel, both channels driven, the sensitivity switch in the 26dB position, the AC supply is 120VAC at 60Hz. Crown specifications are guaranteed through the warranty period (normally 3 years). Because our testing methods are more stringent than our published specifications, every Crown amplifier will exceed its published specifications.

POWER

Power

8 Ohm Stereo—520W/Ch
 4 Ohm Stereo—800W/Ch
 2 Ohm Stereo—1050W/Ch
 8 Ohm Bridge Mono—1585W
 4 Ohm Bridge Mono—2070W
 2 Ohm Parallel Mono—1530W
 1 Ohm Parallel Mono—2080W

Load Impedances: Rated for 16, 8, 4, 2, and 1 (parallel mono only) Ohm operation; safe with all types of loads, even totally reactive loads.

AC Mains: 120VAC at 60 Hz with standard three-wire grounded connector for North American units; 100VAC, 120VAC, 220VAC, and 240VAC at 50 or 60 Hz when equipped with universal transformers, applicable fan assembly, and other applicable hardware with country specific power cord.

PERFORMANCE

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

Phase Response: $\pm 10^\circ$ from 10 Hz to 20 kHz at 1 Watt.

Signal to Noise Ratio: A-weighted, better than 105 dB below full rated output. Better than 100 dB below full rated output from 20 Hz to 20 kHz.

Total Harmonic Distortion (THD): $< 0.05\%$ from 20 Hz to 1 kHz, increasing linearly to 0.1% at 20 kHz at 500W.

I.M. Distortion: $< 0.05\%$ from less than 164 milliwatts to 520 W at 26 dB gain.

Slew Rate: > 13 V per microsecond. (Slew rates are limited to useful levels for ultrasonic/RF protection.)

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

DC Offset: < 10 millivolts.

Input Impedance: Nominally 20K ohms balanced; 10K ohms unbalanced.

Output Impedance: < 10 milliohms in series with < 2 microhenries.

Protection Systems: Output Device Emulation Protection (ODEP) limits drive in the event of dangerous dynamic thermal conditions without interrupting power. Current limiting for shorted load protection. DC/LF and common mode output current Fault circuitry to mute audio. Delay of 4 seconds from turn on mutes amplifier to prevent dangerous turn-on transients. A high voltage circuit breaker in each main transformer primary and a low voltage power supply fuse in fan primary. Slew rate limiting to prevent RF burn out.

MECHANICAL

Input Connectors: Balanced 1/4 inch phone jacks. Optional XLR inputs with MT-XLR accessory.

Output Connectors: Color-coded 5-way binding posts on 3/4 inch centers; spaced 3/4 inch apart.

Front Panel Controls: A front panel rocker switch used to power the amplifier on and off.

Back Panel Controls: A three-position switch which selects Stereo, Bridge-Mono, or Parallel-Mono mode. A rotary potentiometer for each channel used to control output level. A ground lift switch used to isolate the phone jack input grounds from the chassis (AC) ground. And a push button circuit breaker for each channel used to protect the power supplies.

Internal Controls: A three-position switch selects 0.775V, 1.4V, or 26 dB voltage gain input sensitivity.

Indicators: Amber Enable indicator shows on/off status of low-voltage power supply. An Amber ODEP indicator for each channel shows the reserve energy status. If no reserve energy is available the indicator will dim in proportion to ODEP limiting.

Construction: Black splatter-coat steel chassis with specially designed flow-through ventilation system.

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

Dimensions: 19 inches wide, 3.5 inches high, 16 inches deep behind front mounting surface.

Weight: 46 lbs, 14 oz. Shipping; 55 lbs, 12 oz.

Voltage Conversion

The 120 Volt 60 Hz version, sold in the United States, is not voltage selectable. It does not have a voltage selection board. This version is to be used only with 120 Volts and only with 60Hz.

All other versions of the Micro Tech 2400 use a voltage selection board. The following chart indicates different configurations of jumpers for different voltages. Note that the circuit breakers, fuse and transmotor may need to be changed to accommodate different voltages. Versions with the voltage selection board may be used at 50 or 60 Hz.

VOLTAGE SELECTION BOARD

	100V	120V	200V	220V/230V	240V
Jumpers	P8—B B—E P9—F C—F	P8—A A—D P9—F C—F	P8—B C—E P9—F	P8—B C—D P9—F	P8—A C—D P9—F
Circuit Breakers CB100/CB200	C 9508-0 15 Amp		C 8041-3 7.5 Amp		
Fuse F1	A10285-10 1 Amp		A10285-7 .5 Amp		
Transmotor TF1	H43068-8	H43407-8	H43408-6		

Note: "P" locations are on the Fuse Board

Theory

OVERVIEW

It should be noted that over time Crown makes improvements and changes to their products for various reasons. This manual is up to date as of the time of writing. For additional information regarding these amplifiers, refer to the applicable Technical Notes provided by Crown for this product.

This section of the manual explains the general operation of a typical Crown power amplifier. Topics covered include Front End, Grounded Bridge, and ODEP. Due to variations in design from vintage to vintage (and similarities with other Crown products) the theory of operation remains simplified.

FEATURES

Micro Tech amplifiers utilize numerous Crown innovations including grounded bridge and ODEP technologies. Cooling techniques make use of the what is essentially air conditioner technology. Air flows bottom to top, and front to side. Air flows a short distance across a wide heatsink. This type of air flow provides significantly better cooling than the "wind tunnel" technology used by many other manufacturers. Output transistors are of the metal can type rather than plastic case. This allows for a significantly higher thermal margin for the given voltage and current ratings. All devices used are tested and graded to ensure maximum reliability. Another electronic technique used is negative feedback. Almost all power amplifiers utilize negative feedback to control gain and provide stability, but Crown uses multiple nested feedback loops for maximum stability and greatly improved damping. Most Crown amplifiers have damping in excess of 1000 in the bass frequency range. This feedback, along with our compensation and ultra-low distortion output topology, make Crown amplifiers superior.

Features specific to the Micro Tech Series' include two separate power transformers (one for each channel), a full time full speed fan which also serves as the low voltage transformer, slew rate limiting, and audio muting for delay or protective action. This amplifier can operate in either a Bridged or Parallel Mono mode as well as dual (stereo). A sensitivity switch allows selection of input voltage required for rated output. Level controls are mounted on the rear panel and are of the rotary type. Front panel indicators let the user know the status of the low voltage power supply (enable), and an ODEP indicator for each channel which shows the reserve energy status. In general, the

packaging of this model is designed for maximum watt/price/weight/size value with user friendly features.

For additional details refer to the specification section, or to the applicable Owner's Manual.

FRONT END OPERATION

The front end is comprised of three stages: Balanced Gain Stage (BGS), Variable Gain Stage (VGS), and the Error Amp. Figure 1 shows a simplified diagram of a typical front end with voltage amplification stages.

Balanced Gain Stage (BGS)

Input to the amplifier is balanced. The shield may be isolated from chassis ground by an RC network to interrupt ground loops via the Ground Lift Switch. The non-inverting (hot) side of the balanced input is fed to the non-inverting input of the first op-amp stage. The inverting (negative) side of the balanced input is fed to the inverting input of the first op-amp stage. A potentiometer is provided for common mode rejection adjustment. Electrically, the BGS is at unity gain. (From an audio perspective, however, this stage actually provides +6dB gain if a fully balanced signal is placed on its input.) The BGS is a non-inverting stage. It's output is delivered to the Variable Gain Stage.

Variable Gain Stage (VGS)

From the output of the BGS, the signal goes to the VGS where gain is determined by the position of the Sensitivity Switch, and level is determined by the level control. VGS is an inverting stage with the input being fed to its op-amp stage. Because gain after this stage is fixed at 26dB (factor of 20), greater amplifier sensitivity is achieved by controlling the ratio of feedback to input resistance. The Sensitivity Switch sets the input impedance to this stage and varies the gain such that the overall amplifier gain is 26 dB, or is adjusted appropriately for 0.775V or 1.4V input to attain rated output.

Error Amp

The inverted output from the VGS is fed to the non-inverting input of the Error Amp op-amp stage through an AC coupling capacitor and input resistor. Amplifier output is fed back via the negative feedback (NFb) loop resistor. The ratio of feedback resistor to input resistor fixes gain from the Error Amp input to the output of the amplifier at 26 dB. Diodes prevent overdriving the Error Amp. Because the Error Amp

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amplifies the difference between input and output signals, any difference in the two waveforms will produce a near open loop gain condition which in turn results in high peak output voltage. The output of the Error Amp, called the Error Signal (ES) drives the Voltage Translators.

VOLTAGE AMPLIFICATION

The Voltage Translator stage separates the output of the Error Amp into balanced positive and negative drive voltages for the Last Voltage Amplifiers (LVAs), translating the signal from ground referenced $\pm 15V$ to $\pm V_{CC}$ reference. LVAs provide the main voltage amplification and drive the High Side output stages. Gain from Voltage Translator input to amplifier output is a factor of 25.2.

Voltage Translators

A voltage divider network splits the Error Signal (ES) into positive and negative drive signals for the balanced voltage translator stage. These offset reference voltages drive the input to the Voltage Translator transistors. A nested NFB loop from the output of the amplifier mixes with the inverted signal riding on the offset references. This negative feedback fixes gain at the offset reference points (and the output of the Error Amp) at a factor of -25.2 with respect to the amplifier output. The Voltage Translators are arranged in a common base configuration for non-inverting voltage gain with equal gain. They shift the audio from the $\pm 15V$ reference to V_{CC} reference. Their outputs drive their respective LVA.

Also tied into the Voltage Translator inputs are ODEP limiting transistors and control/protection transistors.

The ODEP transistors steal drive as dictated by the ODEP circuitry (discussed later). The control/protection transistors act as switches to totally shunt audio to ground during the turn-on delay, or during a DC/LF or Fault protective action.

Last Voltage Amplifiers (LVAs)

The Voltage Translator stage channels the signal to the Last Voltage Amplifiers (LVA's) in a balanced configuration. The +LVA and -LVA, with their push-pull effect through the Bias Servo, drive the fully complementary output stage. The LVAs are configured as common emitter amplifiers. This configuration provides sufficient voltage gain and inverts the audio. The polarity inversion is necessary to avoid an overall polarity inversion from input jack to output jack, and it allows the NFB loop to control Error Amp gain by feeding back to its non-inverting input (with its polarity opposite to the output of the VGS). With the added voltage swing provided by the LVAs, the signal then gains current amplification through the Darlington emitter-follower output stage.

GROUNDING BRIDGE TOPOLOGY

Figure 2 is a simplified example of the grounded bridge output topology. It consists of four quadrants of three deep Darlington (composite) emitter-follower stages per channel: one NPN and one PNP on the High Side of the bridge (driving the load), and one NPN and one PNP on the Low Side of the bridge (controlling the ground reference for the rails). The output stages are biased to operate class AB+B for ultra low distortion in the signal zero-crossing region and high efficiency.

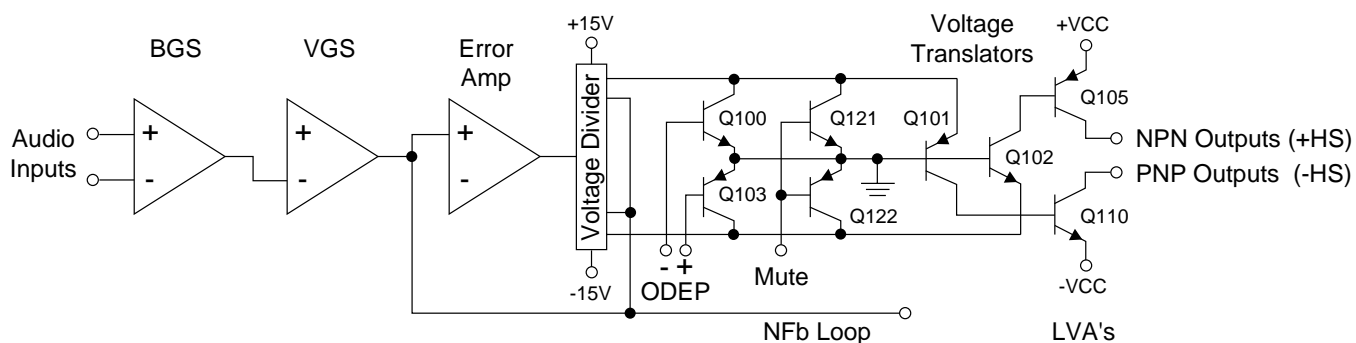


Figure 1. Typical Amplifier Front End and Voltage Amplification Stages.

Theory

High Side (HS)

The High Side (HS) of the bridge operates much like a conventional bipolar push-pull output configuration. As the input drive voltage becomes more positive, the HS NPN conducts and delivers positive voltage to the load. Eventually the NPN devices reach full conduction and +Vcc is across the load. At this time the HS PNP is biased off. When the drive signal is negative going, the HS PNP conducts to deliver -Vcc to the load and the HS NPN stage is off.

The output of the +LVA drives the base of predriver device. Together, the predriver and driver form the first two parts of the three-deep Darlington and are biased class AB. They provide output drive through the bias resistor, bypassing the output devices, at levels below about 100mW. An RLC network between the predriver and driver provide phase shift compensation and limit driver base current to safe levels. Output devices are biased class B, just below cutoff. At about 100mW output they switch on to conduct high current to the load. Together with predriver and driver, the output device provide an overall class AB+B output.

The negative half of the HS is almost identical to the positive half, except that the devices are PNP. One difference is that the PNP bias resistor is slightly greater in value so that PNP output devices run closer

to the cutoff level under static (no signal) conditions. This is because PNP devices require greater drive current.

HS bias is regulated by Q18, the Bias Servo. Q18 is a Vbe multiplier which maintains approximately 3.3V Vce under static conditions. The positive and negative halves of the HS output are in parallel with this 3.3V. With a full base-emitter on voltage drop across predrivers and drivers, the balance of voltage results in approximately .35V drop across the bias resistors in the positive half, and about .5V across the bias resistor in the negative half. Q18 conduction (and thus bias) is adjustable.

A diode string prevents excessive charge build up within the high conduction output devices when off. Flyback diodes shunt back-EMF pulses from reactive loads to the power supply to protect output devices from dangerous reverse voltage levels. An output terminating circuit blocks RF on output lines from entering the amplifier through its output connectors.

Low Side (LS)

The Low Side (LS) operates quite differently. The power supply bridge rectifier is not ground referenced, nor is the secondary of the main transformer. In other words, the high voltage power supply floats with respect to ground, but ±Vcc remain constant with

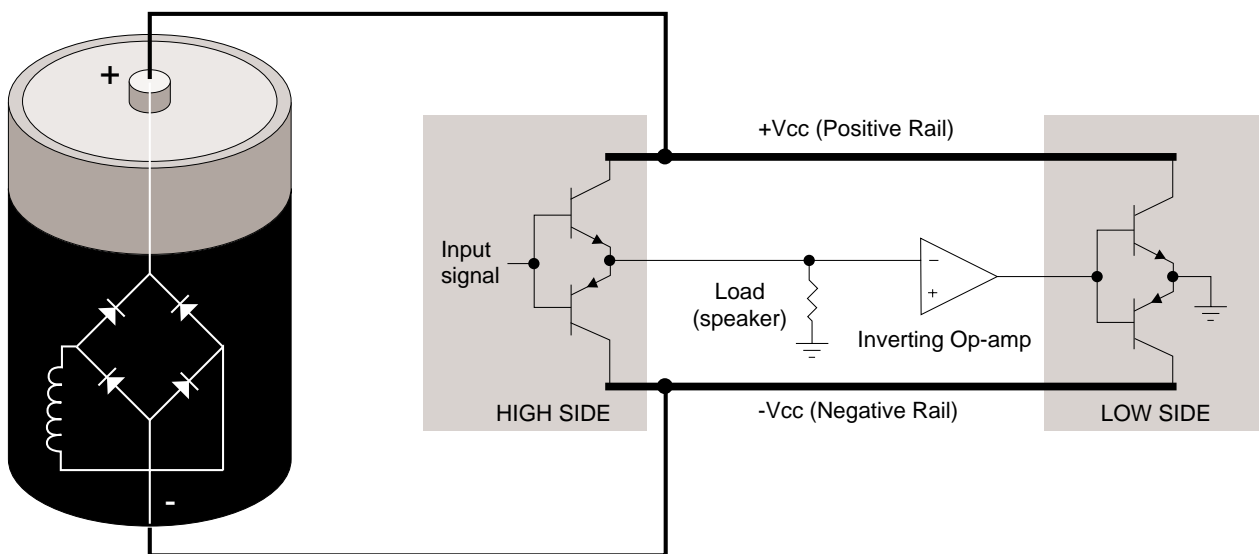


Figure 2. Crown Patented Grounded Bridge Topology

Theory

respect to each other. This allows the power supply to deliver +Vcc and -Vcc from the same bridge rectifier and filter as a total difference in potential, regardless of their voltages with respect to ground. The LS uses inverted feedback from the HS output to control the ground reference for the rails ($\pm V_{cc}$). Both LS quadrants are arranged in a three-deep Darlington and are biased AB+B in the same manner as the HS.

When the amplifier output swings positive, the audio is fed to an op-amp stage where it is inverted. This inverted signal is delivered directly to the bases of the positive (NPN) and negative (PNP) LS predrivers. The negative drive forces the LS PNP devices on (NPN off). As the PNP devices conduct, Vce of the PNP Darlington drops. With LS device emitters tied to ground, -Vcc is pulled toward ground reference. Since the power supply is not ground referenced (and the total voltage from +Vcc to -Vcc is constant) +Vcc is forced higher above ground potential. This continues until, at the positive amplifier output peak, -Vcc = 0V and +Vcc equals the total power supply potential with a positive polarity. If, for example, the power supply produced a total of 70V from rail to rail ($\pm 35V_{DC}$ measured from ground with no signal), the amplifier output would reach a positive peak of +70V.

Conversely, during a negative swing of the HS output where HS PNP devices conduct, the op-amp would output a positive voltage forcing LS NPN devices to conduct. This would result in +Vcc swinging toward ground potential and -Vcc further from ground potential. At the negative amplifier output peak, +Vcc = 0V and -Vcc equals the total power supply potential with a negative polarity. Using the same example as above, a 70V supply would allow a negative output peak of -70V. In summary, a power supply which produces a total of 70VDC rail to rail (or $\pm 35V_{DC}$ statically) is capable of producing 140V peak-to-peak at the amplifier output when the grounded bridge topology is used. The voltage used in this example are relatively close to the voltages of the PB-1/460CSL.

The total effect is to deliver a peak to peak voltage to the speaker load which is twice the voltage produced by the power supply. Benefits include full utilization of the power supply (it conducts current during both halves of the output signal; conventional designs require two power supplies per channel, one positive and one negative), and never exposing any output device to more than half of the peak to peak output voltage (which does occur in conventional designs).

Low side bias is established by a diode string which also shunts built up charges on the output devices. Bias is adjustable via potentiometer. Flyback diodes perform the same function as the HS flybacks. The output of the LS is tied directly to chassis ground via ground strap.

OUTPUT DEVICE EMULATION PROTECTION (ODEP)

To further protect the output stages, a specially developed ODEP circuit is used. It produces a complex analog output signal. This signal is proportional to the always changing safe-operating-area margin of the output transistors. The ODEP signal controls the Voltage Translator stage by removing drive that may exceed the safe-operating-area of the output stage.

ODEP senses output current by measuring the voltage dropped across LS emitter resistors. LS NPN current (negative amplifier output) and +Vcc are sensed, then multiplied to obtain a signal proportional to output power. Positive and negative ODEP voltages are adjustable via two potentiometers. Across $\pm ODEP$ are a PTC and a thermal sense (current source). The PTC is essentially a cutoff switch that causes hard ODEP limiting if heatsink temperature exceeds a safe maximum, regardless of signal level. The thermal sense causes the differential between +ODEP and -ODEP to decrease as heatsink temperature increases. An increase in positive output signal output into a load will result in -ODEP voltage dropping; an increase in negative output voltage and current will cause +ODEP voltage to drop. A complex RC network between the $\pm ODEP$ circuitry is used to simulate the thermal barriers between the interior of the output device die (immeasurable by normal means) and the time delay from heat generation at the die until heat dissipates to the thermal sensor. The combined effects of thermal history and instantaneous dynamic power level result in an accurate simulation of the actual thermal condition of the output transistors.

Theory

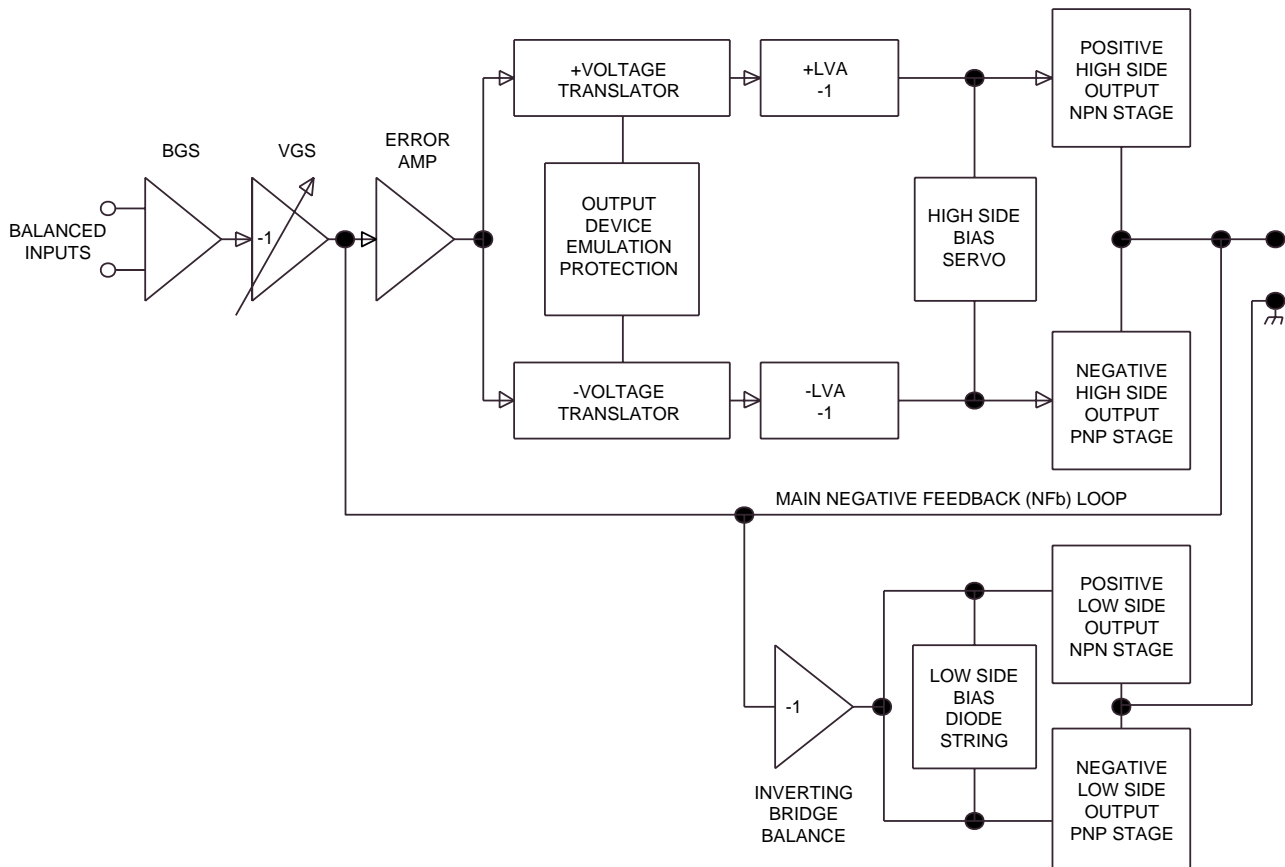


Figure 3. Typical Crown Amplifier Basic Block Diagram (One Channel Shown)

Electrical Checkout Procedures

GENERAL INFORMATION

The following test procedures are to be used to verify operation of this amplifier. DO NOT connect a load or inject a signal unless directed to do so by the procedure. These tests, though meant for verification and alignment of the amplifier, may also be very helpful in troubleshooting. For best results, tests should be performed in order.

All tests assume that AC power is from a regulated 120 VAC source. Test equipment includes an oscilloscope, a DMM, a signal generator, loads, and I.M.D. and T.H.D. noise test equipment.

STANDARD INITIAL CONDITIONS

Level controls fully clockwise.

Stereo/Mono switch in Stereo.

Sensitivity switch in 26 dB fixed gain position.

It is assumed, in each step, that conditions of the amplifier are per these initial conditions unless otherwise specified.

TEST 1: DC OFFSET

Spec: 0 VDC, ± 10 mV.

Initial Conditions: Controls per standard, inputs shorted.

Procedure: Measure DC voltage at the output connectors (rear panel). There is no adjustment for output offset. If spec is not met, there is an electrical malfunction. Slightly out of spec measurement is usually due to U104/U204 out of tolerance.

TEST 2: OUTPUT BIAS ADJUSTMENT

Spec: 300 to 320 mVDC.

Initial Conditions: Controls per standard, heatsink temperature less than 40°C.

Procedure: Measure DC voltages on the output module across R02, adjust R26 if necessary. Measure DC voltages on the output module across R21, adjust R23 if necessary. Repeat for second channel.

TEST 3: ODEP VOLTAGE ADJUSTMENT

Spec: Bias Per Chart, ± 0.1 V DC.

Initial Conditions: Controls per standard, heatsink at room temperature 20 to 30°C (68 to 86°F). Note: This adjustment should normally be performed within 2 minutes of turn on from ambient (cold) conditions. If possible measure heatsink temperature, if not measure ambient room temperature. Use this information when referencing the following chart.

°F	°C	V_{-ODEP}	V_{+ODEP}
66	18.9	-10.31	10.31
68	20.0	-10.26	10.26
70	21.1	-10.20	10.20
72	22.2	-10.14	10.14
74	23.3	-10.09	10.09
76	24.4	-10.03	10.03
77	25.0	-10.00	10.00
78	25.6	-9.97	9.97
80	26.7	-9.91	9.91
82	27.8	-9.86	9.86
84	28.9	-9.80	9.80
86	30.0	-9.74	9.74
88	31.1	-9.69	9.69
90	32.2	-9.63	9.63
92	33.3	-9.57	9.57
94	34.4	-9.51	9.51

-ODEP Procedure: Measure pin 6 of U100 and, if necessary, adjust R121 to obtain V_{-ODEP} as specified above. Measure pin 6 of U200 and, if necessary, adjust R221 to obtain V_{-ODEP} as specified above.

+ODEP Procedure: Measure pin 6 of U103 and, if necessary, adjust R132 to obtain V_{+ODEP} as specified above. Measure pin 6 of U203 and, if necessary, adjust R232 to obtain V_{+ODEP} as specified above.

TEST 4: AC POWER DRAW

Spec: 100 Watts maximum quiescent.

Initial Conditions: Controls per standard.

Procedure: With no input signal and no load, measure AC line wattage draw. If current draw is excessive, check for high AC line voltage or high bias voltage.

TEST 5: COMMON MODE REJECTION

Spec at 100 Hz: -70 dB.

Spec at 20 kHz: -50 dB.

Initial Conditions: Controls per standard.

Procedure: No load. Inject a 0 dBu 100 Hz sine wave into each channel, one channel at a time, with inverting and non-inverting inputs shorted together. At the output measure less than -44 dBu. Inject a 0 dBu 20 kHz sine wave into each channel, one channel at a time, with inverting and non-inverting inputs shorted together. At the output measure less than -24 dBu. Adjust R921 or R1021, if necessary, to obtain the required measurements.

Electrical Checkout Procedures

TEST 6: VOLTAGE GAIN

Spec 26dB Gain: Gain of $20.0 \pm 3\%$.

Spec 0.775V Sensitivity: $\pm 6\%$.

Spec 1.4V Sensitivity: $+12\%/-6\%$.

Initial Conditions: Controls per standard.

Procedure: No load connected. Inject a 0.775 VAC 1 kHz sine wave with the Sensitivity Switch in the 26 dB position. Measure 15.5 VAC ± 0.5 VAC at the amplifier output. Inject a 0.775 VAC 1 kHz sine wave with the Sensitivity Switch in the 0.775V position. Measure 64.5 VAC ± 3.9 VAC at the amplifier output. Inject a 1.4 VAC 1 kHz sine wave with the Sensitivity Switch in the 1.4V position. Measure 64.5 VAC $+7.7/-3.9$ VAC at the amplifier output. Return the Sensitivity Switch to the 26 dB position.

TEST 7: PHASE RESPONSE

Spec: $\pm 10^\circ$ from 10 Hz to 20 kHz at 1 Watt.

Initial Conditions: Controls per standard, 8 ohm load on each channel.

Procedure: Inject a 1 kHz sine wave and adjust for 1 Watt output (2.8 VAC). Check input and output signals against each other, input and output signals must be within 10° of each other.

TEST 8: LEVEL CONTROLS

Spec: Level controlled by level controls.

Initial Conditions: Controls per standard.

Procedure: No Load. Inject a 1 kHz sine wave. With level controls fully clockwise you should see full gain. As controls are rotated counterclockwise, observe similar gain reduction in each channel. When complete, return level controls to fully clockwise position.

TEST 9: CURRENT LIMIT

Spec: Current Limit at 38 Amps, ± 3 Amps

Initial Conditions: Controls per standard.

Procedure: Load each channel to 1 Ohm. Inject a 1 kHz differentiated (or 10% duty cycle) square wave. See figure 4. Increase output level until current limit occurs. Current limit should occur at 38 ± 3 Amps (38 Vpk) with output device V_{ce} less than 40 Vpk. Observe clean (no oscillations) current clipping.

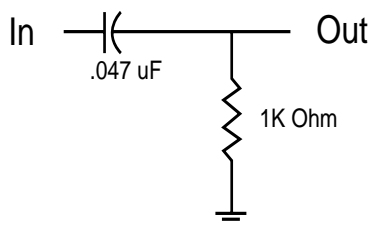


Figure 4. Differentiator Circuit

TEST 10: SLEW RATE & 10 KHZ SQUARE WAVE

Spec: 17 - 25 V/ μ S.

Initial Conditions: Controls per standard.

Procedure: Load each channel to 8 ohms. Inject a 10 kHz square wave to obtain 64 volts peak-to-peak at each output. Observe the slope of the square wave. It should typically measure 17 to 25 V/ μ S. Also, the square wave must not include overshoot, ringing, or any type of oscillation.

TEST 11: CROSSTALK

Spec: -60dB at 20 kHz.

Initial Conditions: Controls per standard. Terminate input of channel not driven with 600 ohms.

Procedure: 8 ohm load on each channel. Inject a 20 kHz sine wave into the Channel 1 input and increase output level to 62 VAC. Measure less than 62 mVAC at the output of Channel 2. Inject a 20 kHz sine wave into the Channel 2 input and increase output level to 62 VAC. Measure less than 62 mVAC at the output of Channel 1.

TEST 12: OUTPUT POWER

Spec at 8 Ohm Stereo: ≥ 520 W at 0.1% THD.

Spec at 4 Ohm Stereo: ≥ 800 W at 0.1% THD.

Spec at 2 Ohm Stereo: ≥ 934 W at 0.1% THD.

International 8 Ohm Stereo: ≥ 515 W at 0.1% THD.

International 4 Ohm Stereo: ≥ 745 W at 0.1% THD.

International 2 Ohm Stereo: ≥ 925 W at 0.1% THD.

Initial Conditions: Controls per standard.

Procedure: Load each channel to 8 ohms. Inject a 1 kHz sine wave and measure at least 64.5 VAC at the output of each channel. Load each channel to 4 ohms. Inject a 1 kHz sine wave and measure at least 56.6 VAC. Load each channel to 2 ohms. Inject a 1 kHz sine wave and measure at least 43.2 VAC. All power measurements must be at less than 0.1% THD.

TEST 13: REACTIVE LOADS

Spec: No oscillations. Safe with all types of loads.

Initial Conditions: Controls per standard.

Procedure Capacitive: Load each channel to 8 ohms in parallel with 2 μ F. Inject a 20 kHz sine wave with 55 VAC output for 10 seconds.

Procedure Inductive: Load each channel to 8 ohms in parallel with 159 μ Henries. Inject a 1 kHz sine wave with 35.8 VAC output for 10 seconds.

Procedure Torture: Load each channel with the primary (red and black leads) of a DC-300A transformer (D 5781-6). Inject a 15 Hz sine wave at sufficient output level to cause 3 to 5 flyback pulses, for 10 seconds.

Electrical Checkout Procedures

Procedure Short: Inject a 60 Hz sine wave at 5 VAC minimum output. After establishing signal, short the output for 10 seconds.

TEST 14: ODEP LIMITING

Spec: No oscillation on ODEP Limiting wave form; either channel controls limiting in Parallel Mono Mode.

Initial Conditions: Controls per standard; rag or other obstruction blocking fan so that it does not turn.

Procedure: Load the amplifier to 4 ohms on each channel. Inject a 60 Hz sine wave and adjust for 35 Vrms at the output. After a few minutes observe a wave form similar to Figure 5. Remove the input signal from both channels and allow the amplifier to cool for a few minutes. Switch the amplifier to Parallel Mono and remove the load from Channel 1. Inject the signal into Channel 1 and observe that ODEP limiting occurs at the output of both channels. Remove the load from Channel 2, and install the load on Channel 1. Again, observe that both channels limit. Return all amplifier controls to standard initial conditions. Remove the fan obstruction.

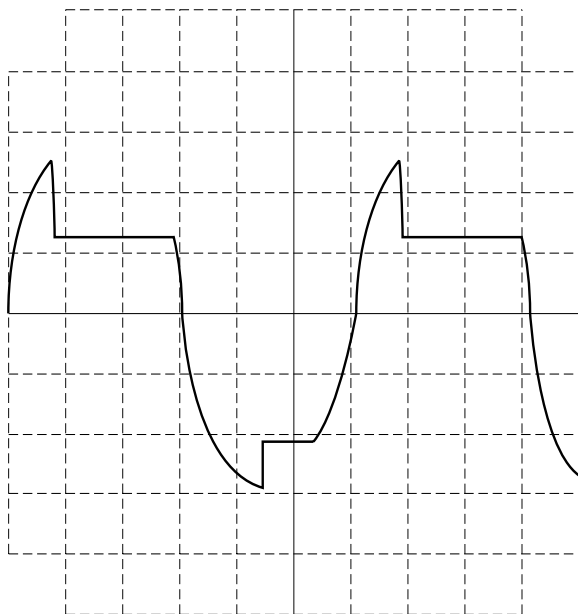


Figure 5. ODEP Limiting Wave Form

TEST 15: LF PROTECTION

Spec: Amplifier mutes for low frequency.

Initial Conditions: Controls per standard.

Procedure: No load. Inject a 0.5 Hz 6 volt peak-to-peak square wave, or a 2 Hz 6VAC sine wave into each channel and verify that each channel cycles into mute.

TEST 16: SIGNAL TO NOISE RATIO

Spec: 100 dB below rated 8 ohm power 20 Hz to 20 kHz. 105 dB A-Weighted.

Initial Conditions: Controls per standard. Short inputs.

Procedure: Load each channel to 8 ohms. Measure less than 645 μ V at the output of each channel (20 Hz-20 kHz bandpass filter).

TEST 17: TURN ON TRANSIENTS

Spec: No dangerous transients.

Initial Conditions: Controls per standard.

Procedure: From an off condition, turn on the amplifier and monitor the output noise at the time of turn on. Note: Turn on noise may increase significantly if the amplifier is cycled off and on.

TEST 18: TURN OFF TRANSIENTS

Spec: No dangerous transients.

Initial Conditions: Controls per standard.

Procedure: From an on condition, turn off the amplifier and monitor the output noise at the time of turn off. Note: Turn off noise may increase significantly if the amplifier is cycled off and on.

TEST 19: INTERMODULATION DISTORTION

Spec at 0 dB Output: 0.01%.

Spec at -35 dB Output: 0.05%.

Initial Conditions: Controls per standard.

Procedure: Load each channel to 8 ohms. Inject a SMPTE standard IM signal (60 Hz and 7 kHz sine wave mixed at 4:1 ratio). Set the 60 Hz portion of the sine wave to 51.5 Volt RMS. Set the 7 kHz portion to 25%. With an IM analyzer measure less than 0.01% IMD. Repeat test at -35 dB (reference 51.5 Volt RMS, 60 Hz portion) and measure less than 0.05% IMD.

TEST 20: CLIPPING

Spec: No protective action during test.

Initial Conditions: Controls per standard.

Procedure: Load each channel to 8 ohms. Inject a 1 kHz sine wave at each input and drive output 6 dB into clip for 10 seconds. The amplifier should not activate any protective circuits (ODEP, Fault, or LF Protection).

POST TESTING

After completion of testing, if all tests are satisfactory, the amplifier controls should be returned to the positions required by customer. If conditions are unknown or unspecified, factory settings are as follows:

Level Controls: 9 to 11 O'Clock.

Sensitivity Switch: 0.775V U.S., 1.4V International.

Stereo/Mono Switch: Stereo.

Ground Lift: Lift.

Power: Off.

Parts List (Non-Module)

SUPPLIMENTAL ITEMS

CPN	ITEM	QTY
D 4137-2	Nylon Thumbscrew Washer	4
C 3342-0	Feet, Black Self-Stick	4
A10087-71012	10-32 .75 Machine (Rack Screw)	4
K80603-2	MT Series Owners Manual	1

POWER SUPPLY

CPN	ITEM	QTY
D 7975-2	Power Cord (US Models)	1
A10793-0503G	Power Cord (European plug)	1
D 8633-6	Power Transformer (120V 60 Hz only)	2
D 8631-0	Power Transformer (Universal Volt)	2
C 9508-0	Circuit Breaker, 15A (100V-120V)	2
C 8041-3	Circuit Breaker, 7.5A (200V-240V)	2
A10285-10	Fuse, 1A 3AG (100V-120V)	1
A10285-7	Fuse, .5A AGC (200V-240V)	1
H43409-4	Transmotor (120V 60 Hz Only)	1
H43408-6	Transmotor (200V-240V Only)	1
H43068-8	Transmotor (100V Only)	1
H43407-8	Transmotor (120V 50 Hz)	1
A10101-19	Fiber Washer, 500ODX195ID (Universal Volt Only)	2
D 8299-6	Fish Paper Insulation (Universal Volt Only)	2
H43403-7	Universal Volt Wires (Universal Volt Only)	2
P10178-5	Terminal Jumper Board Ch 2 (Universal Volt Only)	1
P10432-6	Terminal Jumper Board Ch 1 (Universal Volt Only)	1
A10089-11032	10-32 x 2 PNHD Screw (Mounts Transformers)	8
A10094-8	#10 Int Tooth Lockwasher	8
A10099-7	#10 Nylon Shoulder Washer	8
C 7062-0	6-32 x 5/16 undercut Flthd Mscr (XMotor Asm)	2
C 9938-9	Fan Blade, 4.5 Inch CCW	1
D 8439-8	Fan Bracket	1
D 8639-3	6300µF 150V Electrolytic Capacitor	2
C 8752-5	35A 400V Bridge Rectifier	2
D 8438-0	Capacitor Bracket	2
D 6764-1	Shoulder Washer (Cap Asm)	4
C 9870-4	10-32 x .38 Screw (Cap Asm)	4
A10098-5	1/4" Belleville Spring Washer (Cap Asm)	4
A10095-4	#10 External Star Lockwasher (Cap Asm)	4
H43469-8	Blue Wires, Cap Asm	2
H43470-6	Red Wires, Cap Asm	2

OUTPUT ASSEMBLY (ONE PER CHANNEL)

CPN	ITEM	QTY (PER CHANNEL)
C 8187-4	NPN Output Device	6
C 8188-2	PNP Output Device	6
C 8573-5	PNP Driver Transistor, TO-3P (2SA1186)	2
C 8574-3	NPN Driver Transistor, TO-3P (2SC2837)	2

Parts List (Non-Module)

OUTPUT ASSEMBLY CONT. (ONE PER CHANNEL)

CPN	ITEM	QTY(PER CHANNEL)
D 7665-9	Clip, TO-3P Mounting	2
D 7666-7	Bracket, TO-3P Heatsink	2
C 8813-5	Q318/Q418 Bias Servo MPSA18/MPS8097	1
B 5842-8	Tubing, #23 TFE Thin Wall Red (For C 8813-5)	Request in Inches
C 5826-0	S100/S200 Thermal Sense LM334Z	1
B 5464-1	Tubing, #24 Teflon Thin Wall (For C 5826-0)	Request in Inches
D 8774-8	PTC Thermal Sensor 95DEGC	1
A10315-1	Screw, 6-32-.56 Hex Washer Head	12
C 9491-9	Screw, 6-32-.312 Taptite Pan Ph	29
D 7796-2	Silpad Insulator (Between Chassis and Heatsinks)	1
D 7797-0	Output Thru-Hole Pad Insulator	1
D 8197-2	Paper Shroud	1
C 9387-9	Rivet, Plastic	2
F12019-0	Diode Heatsink Slug (Under diodes on Module)	1
M21322J8	Heatsink, Copper 3/4" with fins	2

BACK PANEL ASSEMBLY

CPN	ITEM	QTY
M21417J6	Back Panel (US Model)	1
M21423J4	Back Panel (European Model)	1
F10787J3	Back Cover Plate	1
C 2823-0	Dual Binding Post Assembly	2
D 7600-6	Ground Strap, Dual Bannana	1
D 7975-2	20A Power Cord (US Models)	1
A10793-0503G	European Power Cord	1
F11160-3	Strain Relief for US Models	1
A10214-7	Strain Relief, European Model	1
A10086-70806	8-32 X .37 Round Head Machine Screw	2
A10094-6	#8 Internal Star Lockwasher	4
A11376-6130J	13 Inch Black 12 Gauge output wire	1
A11376-6235J	23.5 Inch Black 12 Gauge output wire	1
A11394-6160E	16 Inch Red 12 Gauge output wire	1
A11394-6235E	23.5 Inch Red 12 Gauge output wire	1
A11390-6130E	13 Inch Black 22 Gauge wire	1

CHASSIS FRONT ASSEMBLY

CPN	ITEM	QTY
A10090-70806	Screw, 8-32-.375 Mach Ph Oval (Grille)	3
A10090-70808	Screw, 8-32-.5 Mach Ph Oval (End Caps)	4
A10101-5	Washer, Nylon (Grille)	3
A10173-1	Clip, Grille Filter	3
D 6944-9	Air Filter	1
D 8052J8	End Cap	2
F12435J7	Grille	1
D 8635-1	MT-2400 Front Panel Overlay	1

Parts List (Non-Module)

MAIN CHASSIS ASSEMBLY

CPN	ITEM	QTY
D 8501-5	Cover, Top	1
D 8548-6	Cover, Bottom	1
A10110-70605	Screw, 6-32-.312 Taptite Ph (Covers)	16
M21447J3	Main Chassis	1

MISCELLANEOUS

CPN	ITEM	QTY
A10110-70812	8-32 x .750 Taptite Pnhd Screw	2
A10094-3	Washer, #6 Black Star	3
A10109-10822	Screw, 8-18-1.375 Pan Ph	2
A10192-1	Snap Bushing .5	4
C 6912-7	Tension Retainer Board Support	2
C 6913-5	Spacer Nut, 1 inch	2
C 6914-3	Spacer Nut, .75 inch	2
C 8812-7	5.5" Cable Tie	27
C 1813-2	7.5" Cable Tie & Clamp	2
C 5894-8	15" Cable Tie	1
D 7622-0	16.5" 16 Pin Ribbon Cable	1
C 7351-7	10-12 Ga Splice Connector	2
C 9491-9	Screw, 6-32 x .312 Pan Head	11
D 7784-8	Label, Sensitivity Switch	1
D 8251-7	Label, F1 Fuse Replacement	1
D 8069-4	Insulator, Fuse Board	1

Module Information

MODULE HISTORY

The Micro Tech 2400 amplifier was introduced in January of 1995. Since then there have been several updates and revisions, some of which called for new modules. The following is a list of all modules used up to this date, July 1995.

OUTPUT MODULES: (left and right are identical)

Q43354-2

Original Output Module, still in production. Uses P10429-2 board.

MAIN MODULES:

Q43328-6

Original Main Module on D 8679-9 board. Used until 6-14-95.

Q43399-7

Main Module on D 8827-4 board.

FUSE MODULE:

M46330-3

Fuse board on P10425-0 board.

DISPLAY MODULE:

Q43327-8

Display module on D 8030-5 board.

M46330-3 Fuse Module & Q43327-8 Display Module Parts List

M46330-3 FUSE MODULE

2	C 5060-6	PC Mount Fuse Clip
11	C 7817-7	Tab, AMP .25 Faston PC Mount
1	P10425-0	MT-2400 Fuse Board

For replacement fuse see Power Supply Parts List on page 16.

Q43327-8 DISPLAY MODULE

CAPACITORS

C503	C603	C 6806-1	.01 μ F
C507	C607	C 6809-5	220pF
C701		C 6802-0	.47 μ F
C702		C 6802-0	.47 μ F

DIODES

D701	C 3533-4	1N966B
D702	C 3533-4	1N966B

LED'S

E502	E602	C 4342-9	Amber, MV5153
E701		C 4342-9	Amber, MV5153

CONNECTOR

J3	C 4508-5	Socket, IC DIP 16 Pin
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TRANSISTORS

Q504	Q604	C 3625-8	2N4125
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RESISTORS

R508	R608	A10266-1351	1.3M
R509	R609	A10266-7551	7.5M
R510	R610	A10266-4751	4.7M
R511	R611	A10266-4741	470K
R512	R612	A10266-2221	2.2K
R513	R613	A10266-1522	1.5K .5W
R514	R614	A10266-1001	10 Ohm
	R615	A10266-1522	1.5K .5W
R702		A10266-5111	510 Ohm
R707		A10266-5111	510 Ohm

INTEGRATED CIRCUITS

U502	C 5070-5	TL072CP
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BOARD

1	D 8030-5	MT Display Board
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Q43354-2 Output Module Parts List (P10429-2 Board)

Q43354-2 Output Module for MT-2400. For Schematic See J0658-5

CAPACITORS

C01	C 8511-5	.047 μ F
C02	C 8426-6	.1 μ F
C03	C 8426-6	.1 μ F
C04	C 6806-1	.01 μ F
C05	C 6806-1	.01 μ F
C06	C 6806-1	.01 μ F
C07	C 6807-9	.001 μ F
C08	C 6810-3	180pF
C09	C 6809-5	220pF
C43	C 7697-3	.01 μ F 500V

DIODES

D01	C 2851-1	1N4004
D02	C 2851-1	1N4004
D03	C 2851-1	1N4004
D04	C 2851-1	1N4004
D05	C 2941-0	1N5402
D06	C 2941-0	1N5402
D07	C 2941-0	1N5402
D08	C 2941-0	1N5402
D09	C 2851-1	1N4004
D10	C 2851-1	1N4004
D11	C 2851-1	1N4004
D12	C 2851-1	1N4004
D13	C 2851-1	1N4004
D14	C 2851-1	1N4004

INDUCTORS

L00	C 6592-6	Output Coil
L01	C 3510-2	470 μ H
L02	C 3510-2	470 μ H

TRANSISTORS

Q17	C 8508-1	NPN 2SC3298B
Q19	C 8509-9	PNP 2SA1306B

Note: Q18, S100/200, Driver and Output Transistors are not included with the module. See the Output Assembly Parts List on pages 16 & 17.

RESISTORS

R00	A10266-7501	75
R01	A10266-1011	100
R02	C 7778-1	5.6 flame proof
R03	C 6486-2	.2 5W
R04	C 6486-2	.2 5W
R05	C 6486-2	.2 5W
R06	C 6486-2	.2 5W
R07	C 6486-2	.2 5W
R08	C 6486-2	.2 5W
R09	C 7779-9	22 flame proof
R10	A10266-1011	100
R11	C 7317-8	2.7 5W
R12	A10266-2R74	2.7 2W
R13	A10266-7501	75
R14	A10266-2R74	2.7 2W
R15	C 6486-2	.2 5W
R16	C 6486-2	.2 5W
R17	C 6486-2	.2 5W
R18	C 6486-2	.2 5W
R19	C 6486-2	.2 5W
R20	C 6486-2	.2 5W
R21	C 7778-1	5.6 flame proof
R22	C 7779-9	22 flame proof
R23	C 6844-2	250 Pot LS Bias
R24	A10266-1331	13K
R25	A10266-2221	2.2K
R26	C 6844-2	250 Pot HS Bias
R27	A10266-3911	390
R28	A10266-1331	13K
R29	A10266-5101	51
R30	A10265-10201	102
R41	A10266-2201	22
R42	A10266-2201	22
R43	A10266-2201	22

MISC.

Board	P10429-2	
Jumpers	C 5868-2	0 Ohm Jumper (11)
Clips	D 6414-3	Q17/19 Hold Down
P500 P600	C 9828-2	12 Pin Header

Q43328-6 Main Module Parts List (D8679-9 Board)

Q43328-6 MT-2400 ORIGINAL MAIN MODULE
 Use Schematic J 0658-5

CAPACITORS

C1	C 3913-8	470µF
C2	C 3913-8	470µF
C4	C 6802-0	.47µF
C5	C 6806-1	.01µF
C6	C 6806-1	.01µF
C7	C 8897-8	.1µF
C8	C 5362-6	2.2µF
C100	C200 C 5311-3	22µF
C101	C201 C 9464-6	10pF
C102	C202 C 8576-8	100µF
C103	C203 C 6805-3	.022µF
C104	C204 C 6805-3	.022µF
C105	C205 C 6812-9	47pF
C106	C206 C 6812-9	47pF
C107	C207 C 8897-8	.1µF
C108	C208 C 6814-5	12pF
C109	C209 C 8576-8	100µF
C110	C210 C 5362-6	2.2µF
C112	C212 C 9991-8	1µF
C113	C213 C 9992-6	47µF
C114	C214 C 8854-9	100µF
C115	C215 C 8854-9	100µF
C116	C216 C 9992-6	47µF
C117	C217 C 9991-8	1µF
C118	C218 C 6814-5	12pF
C119	C219 C 6802-0	.47µF
C122	C222 C 6811-1	100pF
C123	C223 C 6812-9	47pF
C124	C224 C 6812-9	47pF
C129	C229 C 6814-5	12pF
C130	C230 C 6813-7	27pF
C132	C232 C 6806-1	.01µF
C133	C233 C 6813-7	27pF
C134	C234 C 6805-3	.022µF
C135	C235 C 6805-3	.022µF
C136	C236 C 6808-7	470pF
C137	C237 C 6808-7	470pF
C138	C238 C 6813-7	27pF
C139	C239 C 6813-7	27pF
C140	C240 C 6812-9	47pF
C141	C241 C 6812-9	47pF
C144	C244 C 8576-8	100µF
C145	C245 C 6812-9	47pF
C146	C246 C 6812-9	47pF
C147	C247 C 6806-1	.01µF
C148	C248 C 6810-3	180pF
C149	C249 C 6808-7	470pF
C150	C250 C 6806-1	.01µF

C151	C251	C 6806-1	.01µF
C152	C252	C 6950-7	82pF 5%
C153	C253	C 8897-8	.1µF
C154	C254	A10434-104JD	.1µF 250V
C155	C255	C 8897-8	.1µF
C156	C256	C 8897-8	.1µF
C158	C258	C 6805-3	.022µF
C159	C259	C 6805-3	.022µF
C160	C260	C 8897-8	.1µF
C161	C261	C 8897-8	.1µF

DIODES

D1		C 2851-1	1N4004
D2		C 2851-1	1N4004
D3		C 2851-1	1N4004
D4		C 2851-1	1N4004
D5		C 2851-1	1N4004
D6		C 2851-1	1N4004
D7		C 2851-1	1N4004
D100	D200	C 3181-2	1N4148
D101	D201	C 3181-2	1N4148
D102	D202	C 3824-7	1N970B
D103	D203	C 3181-2	1N4148
D104	D204	C 3181-2	1N4148
D108	D208	C 3181-2	1N4148
D109	D209	C 3181-2	1N4148
D110	D210	C 3181-2	1N4148
D111	D211	C 5061-4	1N3070
D112	D212	C 3181-2	1N4148
D113	D213	C 3181-2	1N4148
D120	D220	C 3181-2	1N4148
D121	D221	C 3181-2	1N4148
D122	D222	C 3181-2	1N4148
D123	D223	C 5061-4	1N3070
D124	D224	C 3181-2	1N4148
D125	D225	C 3181-2	1N4148
D126	D226	C 5061-4	1N3070
D127	D227	C 5061-4	1N3070
D128	D228	C 5061-4	1N3070
D129	D229	C 3181-2	1N4148
D130	D230	C 3181-2	1N4148
D131	D231	C 3181-2	1N4148
D132	D232	C 3181-2	1N4148
D133	D233	C 3181-2	1N4148
D134	D234	C 3181-2	1N4148

LED's

E100	E200	C 9857-1	RED
E101	E201	C 9857-1	RED

Q43328-6 Main Module Parts List Cont. (D8679-9 Board)

RESISTOR NETWORKS

N101	N201	D 7944-8	Res. Net.
N102	N202	D 6082-8	Res. Net.

TRANSISTORS

Q100	Q200	D 2961-7	2N3859A
Q101	Q201	C 3578-9	MPSA93
Q102	Q202	C 3810-6	MPSA43
Q103	Q203	C 3786-8	PN4250
Q105	Q205	C 3578-9	MPSA93
Q106	Q206	C 3625-8	2N4125
Q107	Q207	C 3786-8	PN4250
Q108	Q208	C 5891-4	MTS105
Q109	Q209	D 2961-7	2N3859A
Q110	Q210	C 3810-6	MPSA43
Q112	Q212	C 3625-8	2N4125
Q113	Q213	C 3625-8	2N4125
Q115	Q215	D 2962-5	MPS8097
Q116	Q216	C 3786-8	PN4250
Q117	Q217	D 2961-7	2N3859A
Q118	Q218	D 2961-7	2N3859A
Q119	Q219	C 3625-8	2N4125
Q120	Q220	C 3625-8	2N4125
Q123	Q223	C 7458-0	2N4123
Q124	Q224	C 3625-8	2N4125
Q125	Q225	C 3786-8	PN4250
Q126	Q226	C 5891-4	MTS105
Q127	Q227	C 3625-8	2N4125
Q128	Q228	C 7458-0	2N4123
Q129	Q229	C 3625-8	2N4125
Q130	Q230	C 7458-0	2N4123
Q131	Q231	C 3625-8	2N4125
Q132	Q232	C 3625-8	2N4125
Q133	Q233	C 3625-8	2N4125
Q134	Q234	C 3625-8	2N4125
Q135	Q235	C 7458-0	2N4123
Q136	Q236	C 7458-0	2N4123
Q137	Q237	C 3625-8	2N4125

RESISTORS

R1		A10265-53621	53.6K 1%
R2		C 7340-0	24 5W
R3		C 7340-0	24 5W
R4		A10265-46421	46.4K 1%
R5		OPEN	
R7		A10266-4331	43K
R8		A10265-75021	75K 1%
R10		OPEN	
R17		A10265-75021	75K 1%
R18		A10266-4331	43K
R100	R200	C 7409-3	5K Lin. Vol.

R101	R201	A10265-49911	4.99K 1%
R102	R202	A10266-5111	510
R103	R203	A10265-10031	100K 1%
R104	R204	A10266-2721	2.7K
R105	R205	A10266-2721	2.7K
R106	R206	A10266-1231	12K
R107	R207	A10266-6831	68K
R108	R208	A10265-80601	806
R109	R209	A10266-5601	56
R110	R210	A10266-6831	68K
R111	R211	A10266-1231	12K
R112	R212	A10266-5131	51K
R113	R213	A10266-4721	4.7K
R114	R214	A10266-4721	4.7K
R115	R215	A10266-3341	330K
R116	R216	A10266-2751	2.7M
R117	R217	A10265-46421	46.4K 1%
R118	R218	A10265-28701	287 1%
R119	R219	A10265-68101	681 1%
R120	R220	A10265-28701	287 1%
R121	R221	C 5062-2	100K Pot
R122	R222	A10266-2741	270K
R123	R223	A10266-2732	27K .5W
R124	R224	A10266-6821	6.8K
R125	R225	C 8836-6	100 .5W FP
R126	R226	C 8836-6	100 .5W FP
R127	R227	A10266-6821	6.8K
R128	R228	A10266-1331	13K
R129	R229	A10265-10031	100K 1%
R130	R230	A10265-10031	100K 1%
R131	R231	A10266-1331	13K
R132	R232	C 5062-2	100K Pot
R133	R233	A10266-2741	270K
R134	R234	A10266-2732	27K .5W
R135	R235	A10266-1012	100 .5W
R136	R236	A10266-6821	6.8K
R137	R237	A10266-1012	100 .5W
R138	R238	A10266-6821	6.8K
R139	R239	A10265-80601	806 1%
R140	R240	A10266-5601	56
R141	R241	A10266-1541	150K
R142	R242	A10266-1541	150K
R143	R243	A10266-4711	470
R144	R244	A10266-4711	470
R145	R245	A10266-4711	470
R146	R246	A10266-1231	12K
R147	R247	C 8836-6	100 .5W FP
R148	R248	A10266-2721	2.7K
R149	R249	C 8836-6	100 .5W FP
R150	R250	A10266-2721	2.7K
R151	R251	A10266-1231	12K
R152	R252	A10265-11521	11.5K 1%

Q43328-6 Main Module Parts List Cont. (D8679-9 Board)

R153	R253	A10124-24	JUMPER	R921	R1021	C 9079-2	200 Pot	
R154	R254	A10266-5601	56	R922	R1022	A10265-68101	681 1%	
R155	R255	A10266-1321	1.3K	R923	R1023	A10265-35711	3.57K 1%	
R156	R256	A10266-1321	1.3K	R924	R1024	A10265-60401	604 1%	
R157	R257	A10266-1321	1.3K	R925	R1025	A10265-10031	100K 1%	
R158	R258	A10265-11321	11.3K	R926	R1026	A10265-60401	604 1%	
R159	R259	A10265-10011	1K 1%	R927	R1027	A10265-10031	100K 1%	
R160	R260	A10266-5601	56	R928	R1028	A10265-35711	3.57K 1%	
R161	R261	A10266-4701	47	R929	R1029	A10266-1241	120K	
R162	R262	A10266-4701	47	R930	R1030	A10266-1241	120K	
R163	R263	A10266-5601	56	R931	R1031	A10266-3921	3.9K	
R164	R264	A10266-4711	470	R932	R1032	A10265-10021	10K 1%	
R165	R265	A10266-4711	470	R933	R1033	A10266-4731	47K	
R166	R266	A10266-4711	470	R934	R1034	A10265-10021	10K 1%	
R167	R267	A10265-10011	1K 1%	R935	R1035	A10266-4731	47K	
R168	R268	A10265-10011	1K 1%	R936	R1036	A10265-10021	10K 1%	
R170	R270	A10265-10011	1K 1%	R937	R1037	A10265-10021	10K 1%	
R171	R271	A10265-10011	1K 1%	R938	R1038	A10265-10021	10K 1%	
R173	R273	A10266-5601	56	R939	R1039	A10266-4731	47K	
R174	R274	A10265-24921	24.9K 1%	R940	R1040	A10266-4731	47K	
R175	R275	A10265-78711	7.87K 1%	R941	R1041	A10266-4731	47K	
R176	R276	A10265-24921	24.9K 1%	R942	R1042	A10266-4731	47K	
R177	R277	A10265-19121	19.1K 1%					
R179	R279	A10266-1321	1.3K	SWITCHES				
R180	R280	A10266-4711	470	S2		C 7325-1	Ground Lift	
R181	R281	A10266-4721	4.7K	S3		C 7960-5	Sensitivity	
R182	R282	A10266-2201	22	S4		C 6781-6	Stereo/Mon	
R184	R284	A10266-4741	470K					
R186	R286	A10266-2751	2.7M	TEST POINTS				
R187	R287	A10266-3321	3.3K	TP1	TP2	C 6564-6	HDR	
R188	R288	A10266-3321	3.3K					
R189	R289	A10266-2731	27K	INTEGRATED CIRCUITS				
R190	R290	A10266-2051	2M	U1		C 5095-2	UA7815	
R193	R293	A10265-10021	10K 1%	U2		C 5096-0	UA7915	
R194	R294	A10265-10031	100K 1%	U100	U200	C 6911-9	UPA75	
R195	R295	A10266-3021	3K	U101	U201	C 6411-0	H11C2	
R196	R296	A10266-4721	4.7K	U102	U202	C 4345-2	LM339	
R197	R297	A10265-10021	10K 1%	U103	U203	C 6910-1	UPA76	
R198	R298	A10266-4721	4.7K	U104	U204	C 7558-7	MC33079P	
R199	R299	A10265-10021	10K 1%					
R300	R400	A10265-10031	100K 1%	MISC.				
R301	R401	A10265-10031	100K 1%	Board		D 8679-9		
R911	R1011	A10266-1521	1.5K	Socket		C 3450-1	14 Pin (4)	
R912	R1012	A10266-4711	470	U1X, U2X		C 9494-3	Heatsinks	
R913	R1013	A10265-10031	100K 1%	HW1-4		C 8812-7	5.5" Cbl Tie	
R914	R1014	A10266-5141	510K	HW5-9		C 9944-7	Nyl. Spacer	
R915	R1015	A10266-2201	22	J1		C 7593-4	5 Pin HDR	
R916	R1016	A10266-2201	22	J2		C 4508-5	16 Pin	
R917	R1017	A10266-10021	10K	J11		C 7526-4	3 Pin HDR	
R918	R1018	A10266-10021	10K	J100	J200	C 6777-4	Ph Jack, (2)	
R919	R1019	A10266-10021	10K	Cover		C 6778-2	Ph Jk CVR	
R920	R1020	A10266-10021	10K					

Q43328-6 Main Module Parts List Cont. (D8679-9 Board)

J500	J800	D 8681-5	10 In. RBN
J600	J700	D 8680-7	6 In. RBN
HW5-8		C 8812-7	5.5" Cbl Tie
Z1-Z5		OPEN	

Q43399-7 Main Module Parts List (D8827-4 Board)

Q43399-7 MT-2400 MAIN MODULE
 Use Schematic J 0691-6

CAPACITORS

C1	C 3913-8	470µF
C2	C 3913-8	470µF
C4	C 6802-0	.47µF
C5	C 6806-1	.01µF
C6	C 6806-1	.01µF
C7	C 8897-8	.1µF
C8	C 5362-6	2.2µF
C100 C200	C 5311-3	22µF
C101 C201	C 9464-6	10pF
C102 C202	C 8576-8	100µF
C103 C203	C 6805-3	.022µF
C104 C204	C 6805-3	.022µF
C105 C205	C 6812-9	47pF
C106 C206	C 6812-9	47pF
C107 C207	C 8897-8	.1µF
C108 C208	C 6814-5	12pF
C109 C209	C 8576-8	100µF
C110 C210	C 5362-6	2.2µF
C112 C212	C 8991-9	.47µF
C113 C213	C 8996-9	15µF
C114 C214	C 8854-9	100µF
C115 C215	C 8854-9	100µF
C116 C216	C 8986-9	15µF
C117 C217	C 8991-9	.47µF
C118 C218	C 6814-5	12pF
C119 C219	C 6802-0	.47µF
C122 C222	C 6811-1	100pF
C123 C223	C 6812-9	47pF
C124 C224	C 6812-9	47pF
C129 C229	C 6814-5	12pF
C130 C230	C 6813-7	27pF
C133 C233	C 6813-7	27pF
C134 C234	C 6805-3	.022µF
C135 C235	C 6805-3	.022µF
C136 C236	C 6808-7	470pF
C137 C237	C 6808-7	470pF
C138 C238	C 6813-7	27pF
C139 C239	C 6813-7	27pF
C140 C240	C 6812-9	47pF
C141 C241	C 6812-9	47pF
C144 C244	C 8576-8	100µF
C145 C245	C 6812-9	47pF
C146 C246	C 6812-9	47pF
C147 C247	C 6806-1	.01µF
C148 C248	C 6810-3	180pF
C149 C249	C 6808-7	470pF
C150 C250	C 6806-1	.01µF
C151 C251	C 6806-1	.01µF

C152	C252	C 6950-7	82pF 5%
C153	C253	C 8897-8	.1µF
C154	C254	A10434-104JD	.1µF 250V
C155	C255	C 8897-8	.1µF
C156	C256	C 8897-8	.1µF
C158	C258	C 6805-3	.022µF
C159	C259	C 6805-3	.022µF
C160	C260	C 8897-8	.1µF
C161	C261	C 8897-8	.1µF
C113X	C213X	OPEN	
C116X	C216X	OPEN	

DIODES

D1		C 2851-1	1N4004
D2		C 2851-1	1N4004
D3		C 2851-1	1N4004
D4		C 2851-1	1N4004
D5		C 2851-1	1N4004
D6		C 2851-1	1N4004
D7		C 2851-1	1N4004
D100	D200	C 3181-2	1N4148
D101	D201	C 3181-2	1N4148
D102	D202	C 3824-7	1N970B
D103	D203	C 3181-2	1N4148
D104	D204	C 3181-2	1N4148
D105	D205	C 2851-1	1N4004
D106	D206	C 2851-1	1N4004
D108	D208	C 3181-2	1N4148
D109	D209	C 3181-2	1N4148
D110	D210	C 3181-2	1N4148
D111	D211	C 5061-4	1N3070
D112	D212	C 3181-2	1N4148
D113	D213	C 3181-2	1N4148
D120	D220	C 3181-2	1N4148
D121	D221	C 3181-2	1N4148
D122	D222	C 3181-2	1N4148
D123	D223	C 5061-4	1N3070
D124	D224	C 3181-2	1N4148
D125	D225	C 3181-2	1N4148
D126	D226	C 5061-4	1N3070
D127	D227	C 5061-4	1N3070
D128	D228	C 5061-4	1N3070
D129	D229	C 3181-2	1N4148
D130	D230	C 3181-2	1N4148
D131	D231	C 3181-2	1N4148
D132	D232	C 3181-2	1N4148
D133	D233	C 3181-2	1N4148
D134	D234	C 3181-2	1N4148

LED's

E100	E200	C 9857-1	RED
E101	E201	C 9857-1	RED

Q43399-7 Main Module Parts List Cont. (D8827-4 Board)

RESISTOR NETWORKS

N101	N201	D 7944-8	Res. Net.
N102	N202	D 6082-8	Res. Net.

TRANSISTORS

Q100	Q200	D 2961-7	2N3859A
Q101	Q201	C 3578-9	MPSA93
Q102	Q202	C 3810-6	MPSA43
Q103	Q203	C 3786-8	PN4250
Q105	Q205	C 3578-9	MPSA93
Q106	Q206	C 3625-8	2N4125
Q107	Q207	C 3786-8	PN4250
Q108	Q208	C 5891-4	MTS105
Q109	Q209	D 2961-7	2N3859A
Q110	Q210	C 3810-6	MPSA43
Q112	Q212	C 3625-8	2N4125
Q113	Q213	C 3625-8	2N4125
Q115	Q215	D 2962-5	MPS8097
Q116	Q216	C 3786-8	PN4250
Q117	Q217	D 2961-7	2N3859A
Q118	Q218	D 2961-7	2N3859A
Q119	Q219	C 3625-8	2N4125
Q120	Q220	C 3625-8	2N4125
Q123	Q223	C 7458-0	2N4123
Q124	Q224	C 3625-8	2N4125
Q125	Q225	C 3786-8	PN4250
Q126	Q226	C 5891-4	MTS105
Q127	Q227	C 3625-8	2N4125
Q128	Q228	C 7458-0	2N4123
Q129	Q229	C 3625-8	2N4125
Q130	Q230	C 7458-0	2N4123
Q131	Q231	C 3625-8	2N4125
Q132	Q232	C 3625-8	2N4125
Q133	Q233	C 3625-8	2N4125
Q134	Q234	C 3625-8	2N4125
Q135	Q235	C 7458-0	2N4123
Q136	Q236	C 7458-0	2N4123
Q137	Q237	C 3625-8	2N4125
Q138	Q238	C 3810-6	MPSA42
Q139	Q239	C 3578-9	MPSA93

RESISTORS

R1	A10265-53621	53.6K 1%
R2	C 7340-0	24 5W
R3	C 7340-0	24 5W
R4	A10265-46421	46.4K 1%
R5	OPEN	
R7	A10266-4331	43K
R8	A10265-75021	75K 1%
R10	OPEN	
R11	OPEN	

R12	OPEN		
R17	A10265-75021	75K 1%	
R18	A10266-4331	43K	
R100	R200	C 7409-3	5K Lin. Pot.
R101	R201	A10265-49911	4.99K 1%
R102	R202	A10266-5111	510
R103	R203	A10265-10031	100K 1%
R104	R204	A10266-2721	2.7K
R105	R205	A10266-2721	2.7K
R106	R206	A10266-1231	12K
R107	R207	A10266-6831	68K
R108	R208	A10265-80601	806
R109	R209	A10266-5601	56
R110	R210	A10266-6831	68K
R111	R211	A10266-1231	12K
R112	R212	A10266-5131	51K
R113	R213	A10266-4721	4.7K
R114	R214	A10266-4721	4.7K
R115	R215	A10266-3341	330K
R116	R216	A10266-2751	2.7M
R117	R217	A10265-46421	46.4K 1%
R118	R218	A10265-28701	287 1%
R119	R219	A10265-68101	681 1%
R120	R220	A10265-28701	287 1%
R121	R221	C 5062-2	100K Pot
R122	R222	A10266-2741	270K
R123	R223	A10266-2732	27K .5W
R124	R224	A10266-6821	6.8K
R125	R225	C 8836-6	100 .5W FP
R126	R226	C 8836-6	100 .5W FP
R127	R227	A10266-6821	6.8K
R128	R228	A10266-1331	13K
R129	R229	A10265-10031	100K 1%
R130	R230	A10265-10031	100K 1%
R131	R231	A10266-1331	13K
R132	R232	C 5062-2	100K Pot
R133	R233	A10266-2741	270K
R134	R234	A10266-2732	27K .5W
R135	R235	C 8836-6	100 .5W FP
R136	R236	A10266-6821	6.8K
R137	R237	C 8836-6	100 .5W FP
R138	R238	A10266-6821	6.8K
R139	R239	A10265-80601	806 1%
R140	R240	A10266-5601	56
R141	R241	A10266-1541	150K
R142	R242	A10266-1541	150K
R143	R243	A10266-4711	470
R144	R244	A10266-4711	470
R145	R245	A10266-4711	470
R146	R246	A10266-1231	12K
R147	R247	C 8836-6	100 .5W FP
R148	R248	A10266-2721	2.7K

Q43399-7 Main Module Parts List Cont. (D8827-4 Board)

R149	R249	C 8836-6	100 .5W FP
R150	R250	A10266-2721	2.7K
R151	R251	A10266-1231	12K
R152	R252	A10265-11521	11.5K 1%
R153	R253	A10124-24	JUMPER
R154	R254	A10266-5601	56
R155	R255	A10266-1321	1.3K
R156	R256	A10266-1321	1.3K
R157	R257	A10266-1321	1.3K
R158	R258	A10265-11321	11.3K
R159	R259	A10265-10011	1K 1%
R160	R260	A10266-5601	56
R161	R261	A10266-4701	47
R162	R262	A10266-4701	47
R163	R263	C10166-4	56 FP
R164	R264	A10266-4711	470
R165	R265	A10266-4711	470
R166	R266	A10266-4711	470
R167	R267	A10265-10011	1K 1%
R168	R268	A10265-10011	1K 1%
R169	R269	OPEN	
R170	R270	A10265-10011	1K 1%
R171	R271	A10265-10011	1K 1%
R172	R272	OPEN	
R173	R273	C10166-4	56
R174	R274	A10265-24921	24.9K 1%
R175	R275	A10265-78711	7.87K 1%
R176	R276	A10265-24921	24.9K 1%
R177	R277	A10265-19121	19.1K 1%
R179	R279	A10266-1321	1.3K
R180	R280	A10266-4711	470
R181	R281	A10266-4721	4.7K
R182	R282	A10266-2201	22
R184	R284	A10266-4741	470K
R186	R286	A10266-2751	2.7M
R187	R287	A10266-3321	3.3K
R188	R288	A10266-3321	3.3K
R189	R289	A10266-2731	27K
R190	R290	A10266-2051	2M
R193	R293	A10266-1031	10K
R194	R294	A10265-10031	100K 1%
R195	R295	A10266-3021	3K
R196	R296	A10266-4721	4.7K
R197	R297	A10265-10021	10K 1%
R198	R298	A10266-4721	4.7K
R199	R299	A10265-10021	10K 1%
R300	R400	A10265-10031	100K 1%
R301	R401	A10265-10031	100K 1%
R911	R1011	A10266-1521	1.5K
R912	R1012	A10266-4711	470
R913	R1013	A10266-1041	100K
R914	R1014	A10266-5141	510K

R915	R1015	A10266-2201	22
R916	R1016	A10266-2201	22
R917	R1017	A10266-10021	10K
R918	R1018	A10266-10021	10K
R919	R1019	A10266-10021	10K
R920	R1020	A10266-10021	10K
R921	R1021	C 9079-2	200 Pot
R922	R1022	A10265-68101	681 1%
R923	R1023	A10265-35711	3.57K 1%
R924	R1024	A10265-60401	604 1%
R925	R1025	A10266-1041	100K
R926	R1026	A10265-60401	604 1%
R927	R1027	A10266-1041	100K
R928	R1028	A10265-35711	3.57K 1%
R929	R1029	A10266-1241	120K
R930	R1030	A10266-1241	120K
R931	R1031	A10266-3921	3.9K
R932	R1032	A10266-1031	10K
R933	R1033	A10266-4731	47K
R934	R1034	A10266-1031	10K
R935	R1035	A10266-4731	47K
R936	R1036	A10266-1031	10K
R937	R1037	A10266-1031	10K
R938	R1038	A10266-1031	10K
R939	R1039	A10266-4731	47K
R940	R1040	A10266-4731	47K
R941	R1041	A10266-4731	47K
R942	R1042	A10266-4731	47K
R943	R1043	A10266-1031	10K
R944	R1044	A10266-1031	10K
R945	R1045	A10266-4701	47
R946	R1046	A10266-2031	20K
R947	R1074	A10266-2031	20K

SWITCHES

S2	C 7325-1	Gnd Lift
S3	C 7960-5	Sensitivity
S4	C 6781-6	Stereo/Mon

TEST POINTS

TP1	TP2	C 6564-6	HDR
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INTEGRATED CIRCUITS

U1	C 5095-2	UA7815	
U2	C 5096-0	UA7915	
U100	U200	C 6911-9	UPA75
U101	U201	C 6411-0	H11C2
U102	U202	C 4345-2	LM339
U103	U203	C 6910-1	UPA76
U104	U204	C 7558-7	MC33079P
U100A	U200A	OPEN	

Q43399-7 Main Module Parts List Cont. (D8827-4 Board)

U103A U203A OPEN

MISC.

Board	D 8827-4	
Socket	C 3450-1	14 Pin
HW9-10	C 9494-3	Heatsinks
HW11-15	C 9944-7	Nyl. Spacer
J1	C 7593-4	5 Pin HDR
J2	C 4508-5	16 Pin
J11	C 7526-4	3 Pin HDR
J12	Not Used	
J100 J200	C 6777-4	Ph. Jack
Cover	C 6778-2	Ph Jk CVR
J101 J201	Not Used	
J500 J800	D 8681-5	10 In. RBN
J600 J700	D 8680-7	6 In. RBN
HW5-8	C 8812-7	5.5" Tie, (4)
Z1-Z5	OPEN	