



# POWER AMPLIFIER SERVICE MANUAL

## *COM-TECH<sup>®</sup> 200*

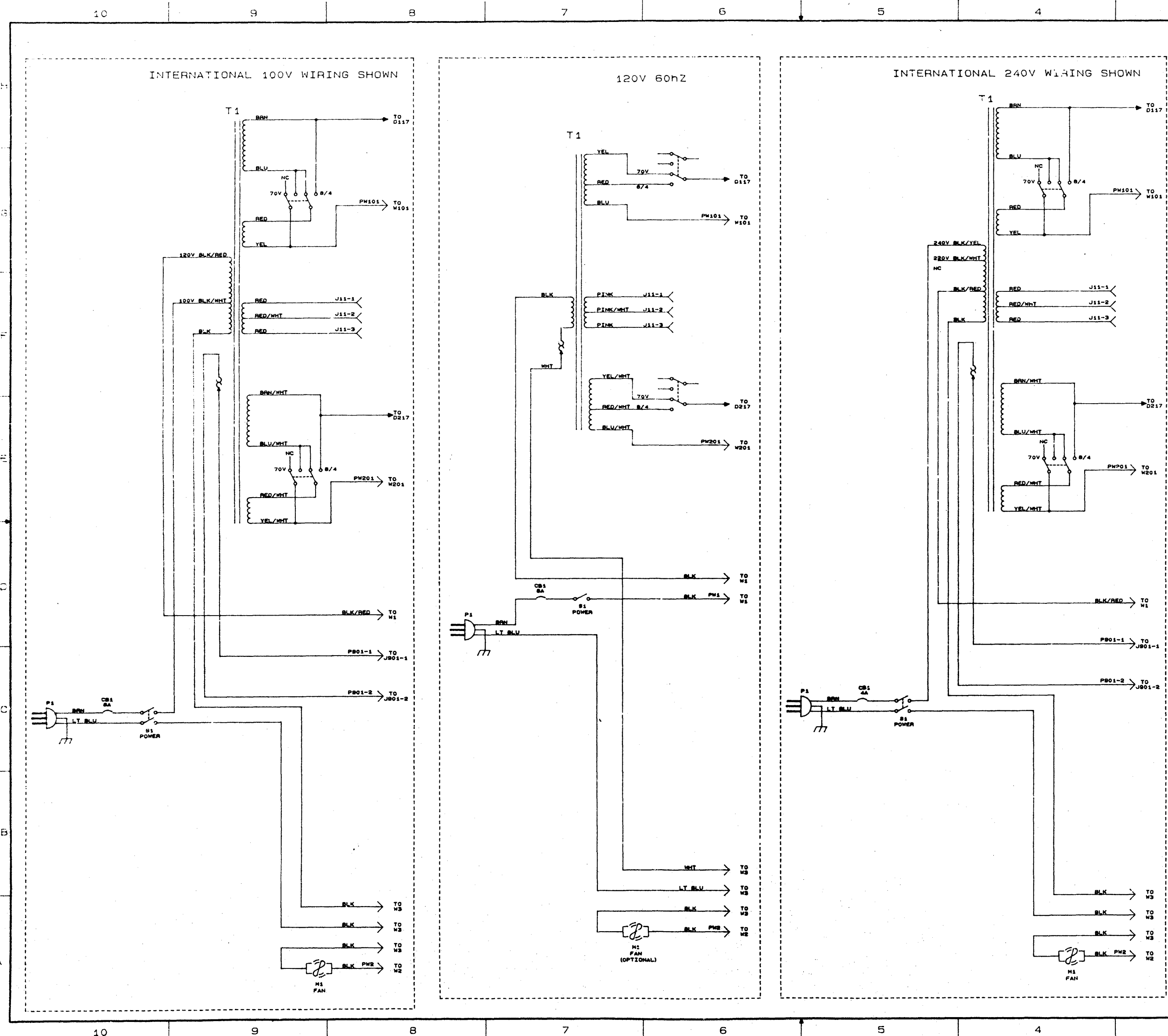
*Model CT200B*

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P.O. Box 1000  
Elkhart, IN U.S.A. 46515-  
1000

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E.C.N.	ZONE	REV	DESCRIPTION	DATE	BY	CHK	APP	TS
		①	REVISED CONTROL BD. "G" ODC. NUMBER.	05/02/84	TLM			TS
		②	C128, 158, 228, 258 WERE 0.001 INTERNATIONAL WAS EXPORT 120V 60HZ WAS NORTH AMERICA R145, 168, 245, 268 WERE 2.2M	12/08/84	LCD			EB
95-189		③	R191, R201 WERE 23K CORRECT NOTE 9	08/14/95	LCD			JH
95-183		④	C130, C230 WERE 27PF ARE NOW 47PF	04/01/96	LCD			JH

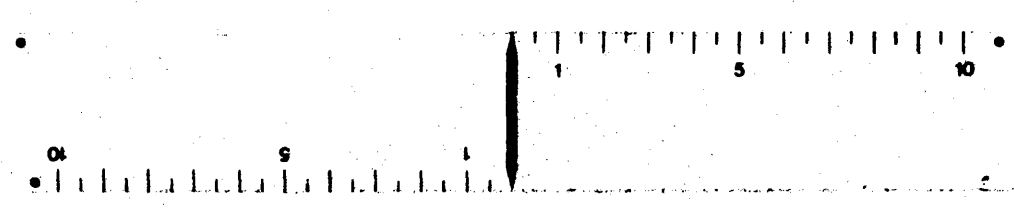
- NOTES:
1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% UNLESS OTHERWISE SPECIFIED.
  2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
  3. CHANNEL 1 SHOWN FOR CHANNEL 2 ADD 100 TO REFERENCE DESIGNATORS. (EXAMPLE: CHANNEL 1 R101 WOULD BE CHANNEL 2 R201.) CONNECTION AND IC PIN NUMBERS FOR CHANNEL 2 ARE SHOWN IN PARENTHESES WHEN THEY DIFFER FROM CHANNEL 1.
  4. ALL DIODES ARE 1N4148 UNLESS OTHERWISE SPECIFIED.
  5. ON J500 AND J700 THE STRIPED WIRE GOES TO PIN 10 OF THE BOARD AND THE PIN NUMBERS WOULD ON THE CABLE SOCKET ARE REVERSED FROM THE PIN NUMBERS OF THE BOARD AND THE SCHEMATIC.
  6. STANDARD UNIT HAS R10 OPEN. INSTALL JUMPER IN R10 TO DISABLE CHANNEL 2 SIGNAL INDICATOR LIGHT IN PARALLEL HORN MODE.
  7. POWER SUPPLY VOLTAGES SHOWN UNDER NO LOAD CONDITION.
  8. CHANNEL 2 PRE-DRIVER BASES LOOP THROUGH STEREO-MONO SWITCH S4, SECTIONS E AND F.
  9. THIS SCHEMATIC REVISION APPLIES TO:
    - 120V 60HZ
    - CONTROL BOARD P10405-2 / 043244-5 REV. A
    - MAIN BOARD 08368-7 / 043237-8 REV. E
    - DISPLAY BOARD 07083-5 / 042700-4
    - OUTPUT BOARD P10398-3 / 043180-4
  10. C128 AND C230 ARE:
    - 120V 60HZ INTERNATIONAL
    - 8300NF 205VDC 8300NF 135VDC

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**CROWN INTERNATIONAL, INC.**  
1718 WEST HIGHWAY ROAD ELKHART, IN. 46517 PHONE (317) 284-8000

**SCHEMATIC: CT-200**

PRINTS TO	DRAWN	LCD	01/18/84	APPROVED BY:	DO NOT SCALE PRINT
G	CHECKED	EE		EE	SUPERSEDES J0630-4 REV. B
	SCALE	NONE		EE	E.C.N.
	PROJ #	D323	PE TS	05/31/84	C.P.N. SH #3 OF 3 REV
	NEXT ASSEMBLY				J0630-4



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.

*Mail:* P.O. Box 1000 Elkhart IN 46515-1000

*Shipping:* 57620 C.R. 105 Elkhart IN 46517

*Phone:* (800) 342-6939/(219) 294-8200

*FAX:* (219) 294-8301

## **CAUTION**

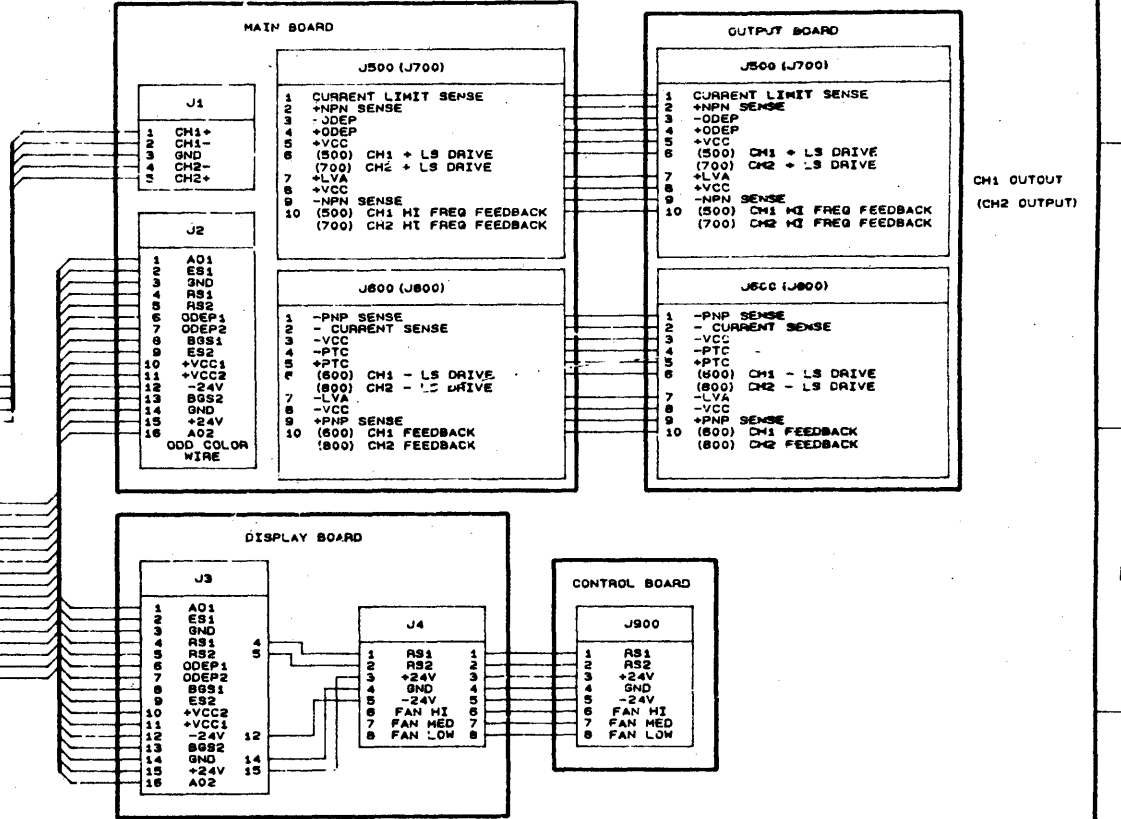
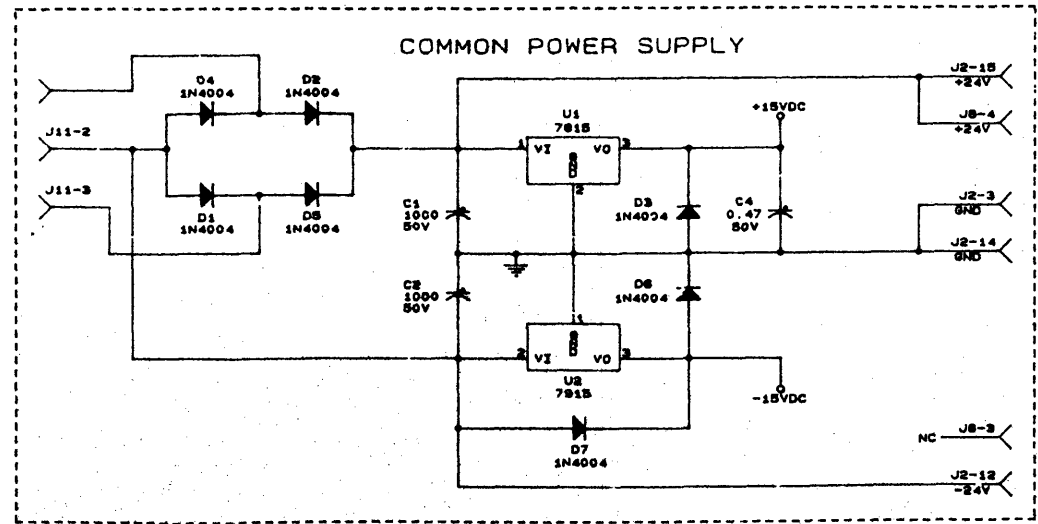
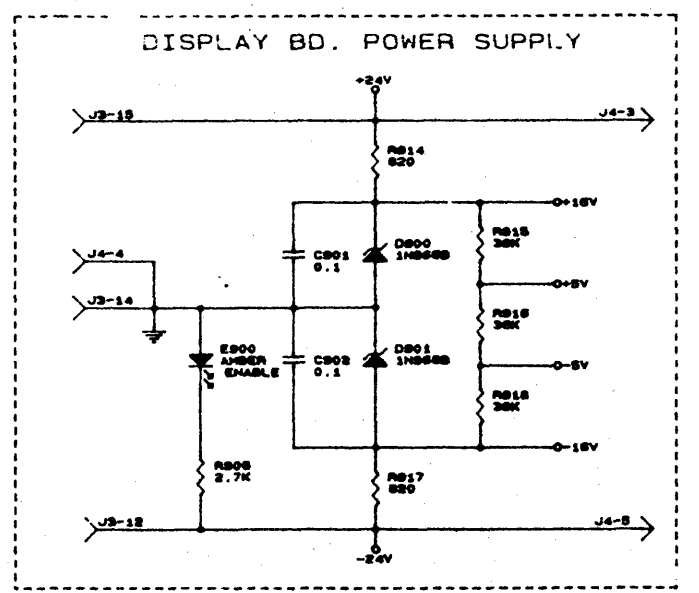
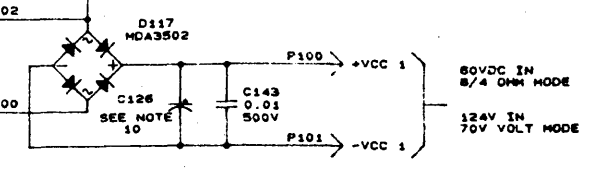
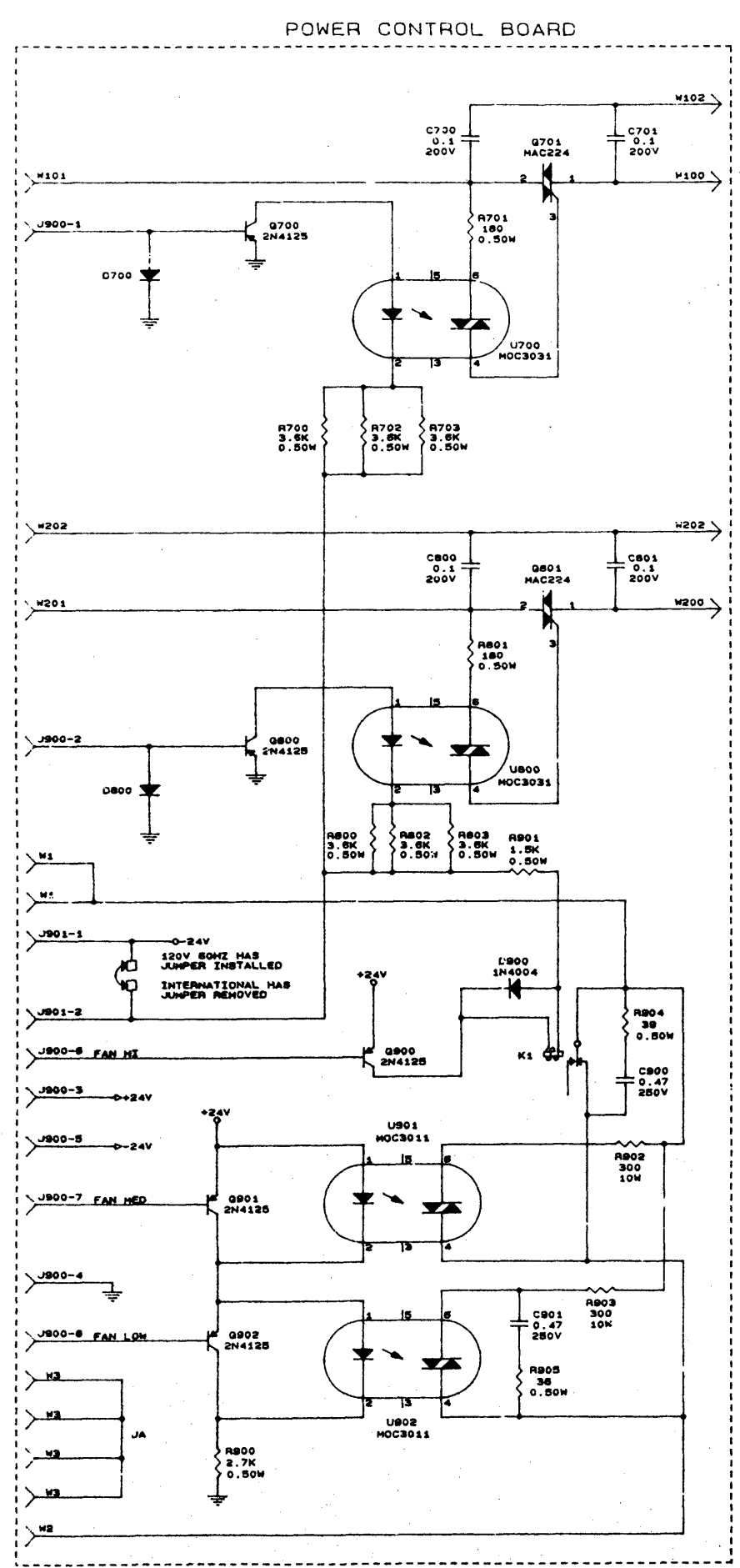
**TO PREVENT ELECTRIC SHOCK DO NOT REMOVE TOP OR BOTTOM COVERS. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL. DISCONNECT POWER CORD BEFORE REMOVING REAR INPUT MODULE TO ACCESS GAIN SWITCH.**

## **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!**



**CHANNEL 1**

LANT USED	OBSOLETE
C157	C102, 121, 125, 127, 128, 131, 132, 142
C343	C300, 310-342
D132	D100-107, 115, 118, 119
D312	D300
L302	
N102	N100
PTC301	
Q124	Q04, 111, 114
Q318	Q500, 302, 304, 306, 308, 311, 313, 315
R188	R158, 172, 178
R340	R303, 305, 308, 309, 310, 317, 318, 320
R321	R331-334
U100	
U104	

**COMMON**

LANT USED	OBSOLETE
CB1	
C7	C1-6
C701	
C801	
C901	
D700	
D800	
D900	
K1	
N1	
Q701	
Q801	
Q802	
R18	R2, 3, 5, 6, 11-15
R701	
R801	
R805	
S4	S2
U700	
U800	
U802	U800

SEE PAGE THREE FOR APPROPRIATE INPUT WIRING

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**SCHEMATIC; CT-200**

PRINTS TO	
G	
DRAWN	LCD 01/16/84
CHECKED	HE
SCALE	NONE
PROJ #	D323
NEXT ASSEMBLY	

**APPROVED BY:** \_\_\_\_\_

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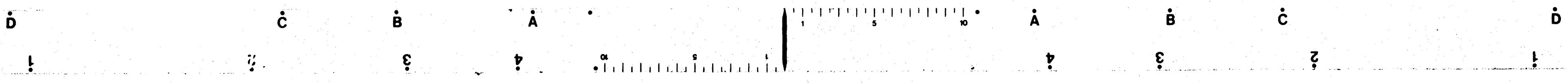
**SUPERSEDES J0630-4 REV. 8**

**E.C.H.**

**C.P.N.**

**SH 92 OF 3**

**J0630-4**

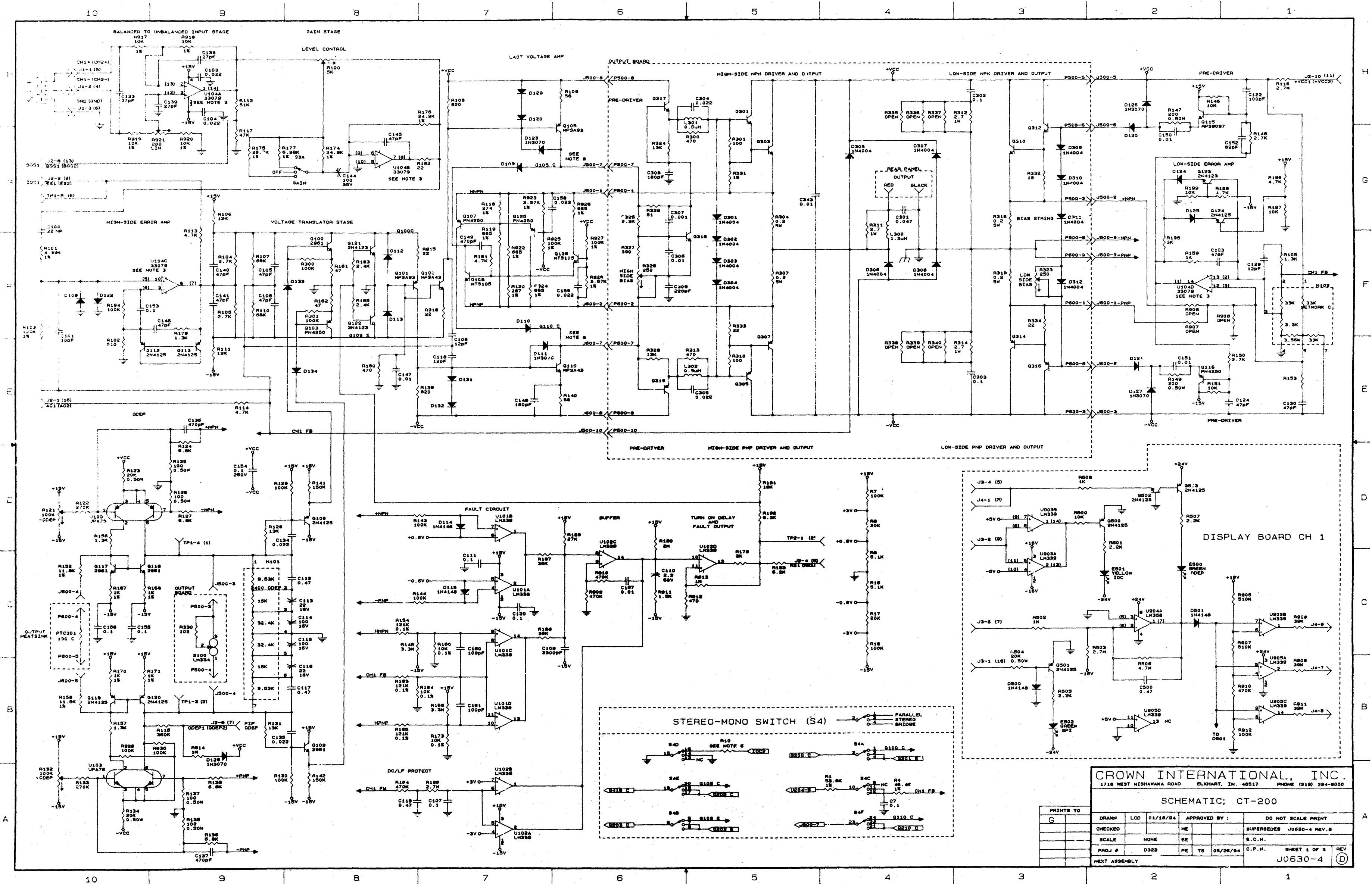


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SCHEMATIC: CT-200

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	NEXT ASSEMBLY				

SHEET 1 OF 3 REV J0630-4

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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 is intended to apply to all versions of the CT-200B amplifier including the Amcron version. The Parts Listings include parts specific for the US version and the European version (CT-200BE13). For parts specific only to other versions contact the Crown Technical Support Group for help in finding part numbers.

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  
Technical Support Group  
Factory Service  
Parts Department**

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PO Box 1000  
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FAX: (219) 294-8301

## 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 System

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 ship-

ment 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

Mailing Address:  
PO Box 1000  
Elkhart, IN USA 46515-1000

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

Phone: (219) 294-8210  
or: (219) 294-8211

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



## 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—110W/Ch  
 4 Ohm Stereo—150W/Ch  
 70-V Line Stereo—105W/Ch  
 8 Ohm Bridge Mono—295W  
 4 Ohm Parallel Mono—225W  
 2 Ohm Parallel Mono—300W  
 Bridge Mono, 140-V Line—210W  
 Parallel Mono, 70-V Line—210W

**Load Impedances:** Rated for 16, 8, 4, 2, Ohm, and 70-V use. 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 units are available when ordered country specific. Com-Tech amplifiers are not voltage convertible.

### Performance

**Frequency Response:**  $\pm 0.1$  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.

### Mechanical

**Input Connectors:** Balanced three-terminal barrier block for each channel on standard P.I.P.-BB module (included)

**Output Connectors:** Four-terminal barrier block.

**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 two position recessed switch for each channel selects between 8/4 ohm and 70-V modes. A push button circuit breaker used to protect the power supply.

**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. A green indicator for each channel shows the reserve energy status. If no reserve energy is available the indicator will dim in proportion to ODEP limiting. A yellow indicator for each channel flashes in the event of distortion. And green SPI (signal presence indicator) indicators show the presence of output signal.

**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:** 29 lbs, 6.5 oz.

## 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

Com-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 Com-Tech Series' include 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), signal presence, distortion, 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 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.

# Theory

## 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.

## Grounded 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.

## 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  $+V_{CC}$  is across the load. At this time the HS PNP is

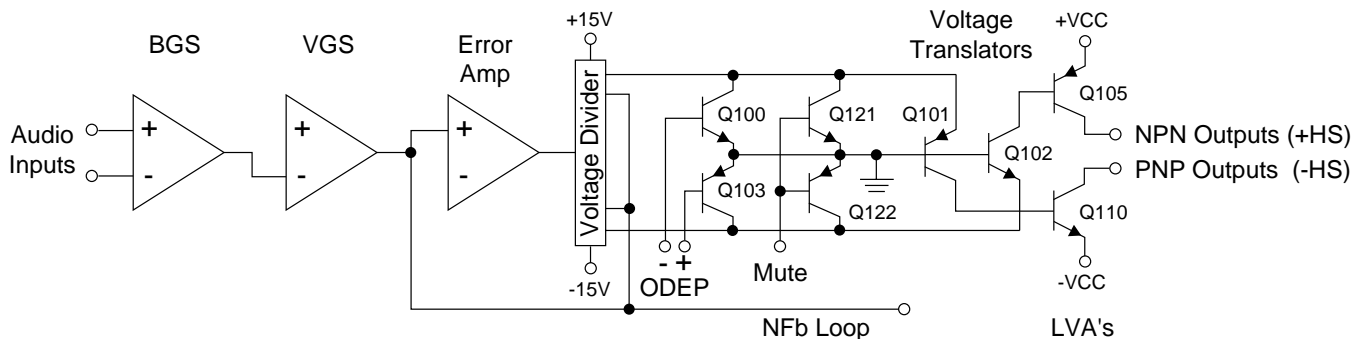


Figure 1. Typical Amplifier Front End and Voltage Amplification Stages.

## Theory

biased off. When the drive signal is negative going, the HS PNP conducts to deliver  $-V_{cc}$  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  $V_{be}$  multiplier which maintains approximately 3.3V  $V_{ce}$  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  $\pm V_{cc}$  remain constant with respect to each other. This allows the power supply to deliver  $+V_{cc}$  and  $-V_{cc}$  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.

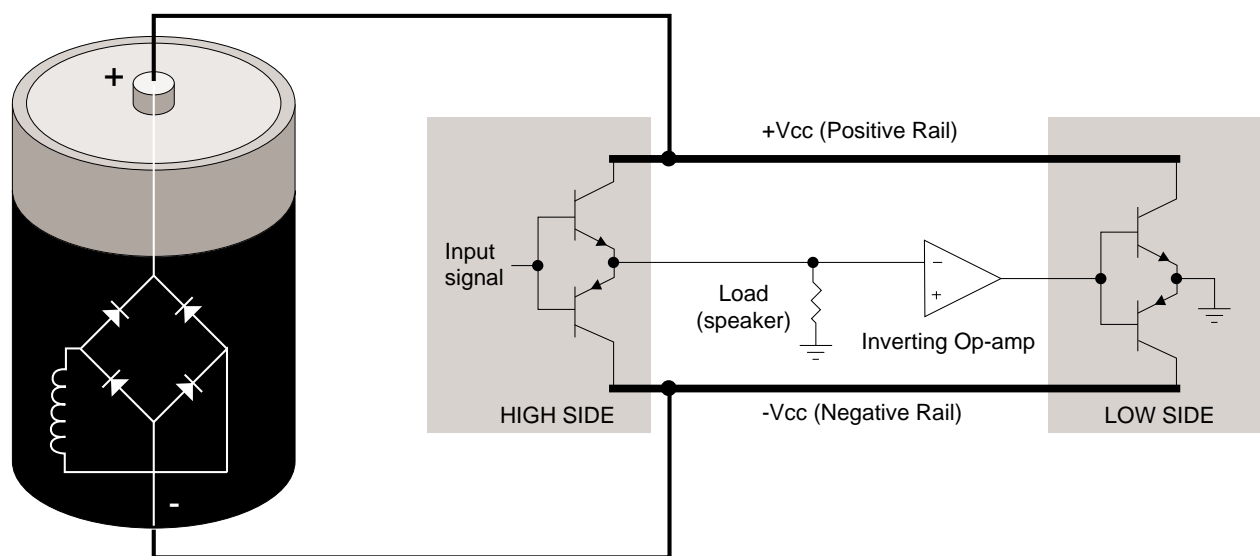


Figure 2. Crown Patented Grounded Bridge Topology

## Theory

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,  $V_{ce}$  of the PNP Darlington drops. With LS device emitters tied to ground,  $-V_{cc}$  is pulled toward ground reference. Since the power supply is not ground referenced (and the total voltage from  $+V_{cc}$  to  $-V_{cc}$  is constant)  $+V_{cc}$  is forced higher above ground potential. This continues until, at the positive amplifier output peak,  $-V_{cc} = 0V$  and  $+V_{cc}$  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  $+V_{cc}$  swinging toward ground potential and  $-V_{cc}$  further from ground potential. At the negative amplifier output peak,  $+V_{cc} = 0V$  and  $-V_{cc}$  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  $+V_{cc}$  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

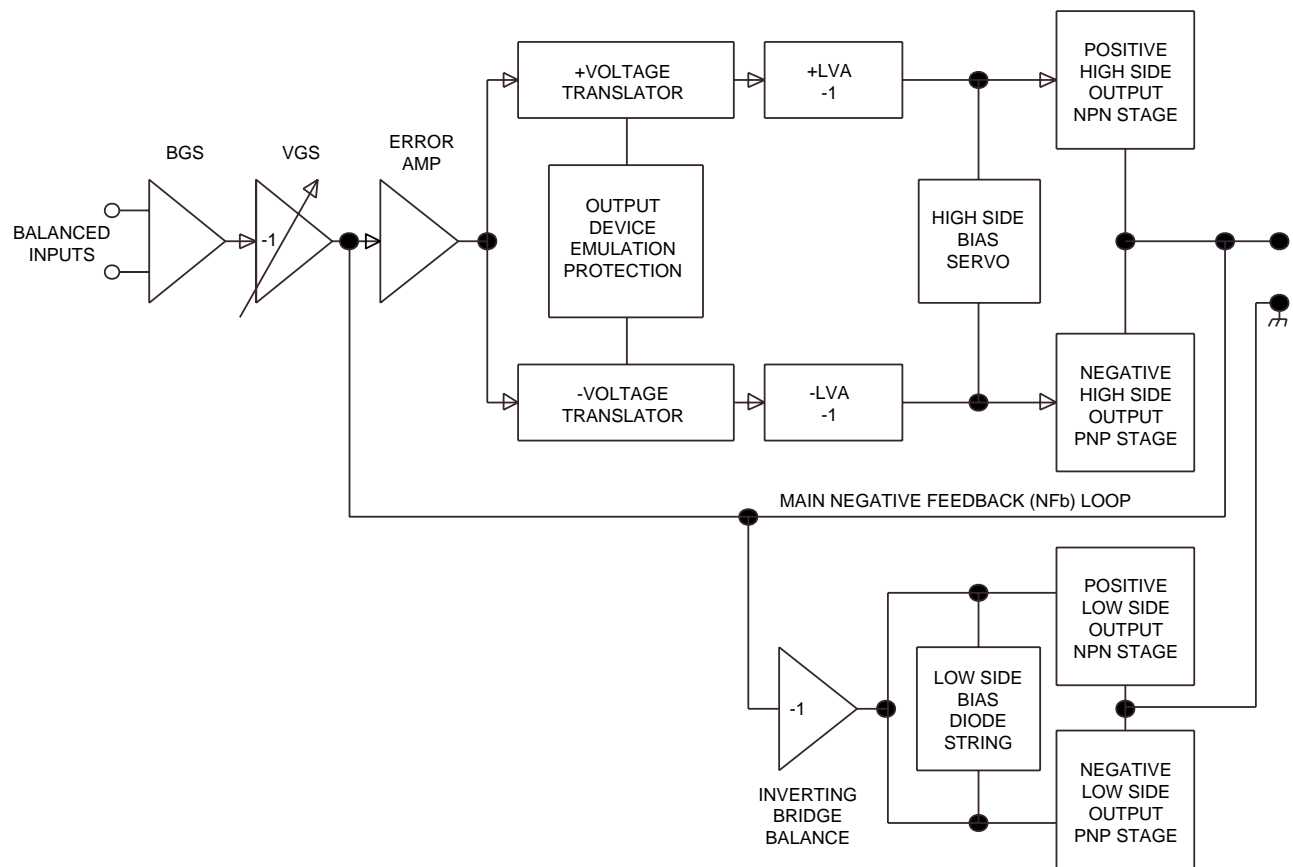


Figure 3. Typical Crown Amplifier Basic Block Diagram (One Channel Shown)

## 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.  
70-V mode switches in the 8/4 ohm 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,  $\pm 10$  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 R31 (15 ohm), adjust R26 if necessary. Measure DC voltages on the output module across R32 (15 ohm), adjust R23 if necessary. Repeat for second channel.

### Test 3: ODEP Voltage Adjustment

**Spec:** Bias Per Chart,  $\pm 0.1$ 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.

The following list of ODEP bias voltages VS. temperature is based on the use of Main Modules built on any circuit board up to and including the D 7911-7 board.

°F	°C	V <sub>-ODEP</sub>	V <sub>+ODEP</sub>
66	18.9	-10.31	11.41
68	20.0	-10.26	11.36
70	21.1	-10.20	11.30
72	22.2	-10.14	11.24
74	23.3	-10.09	11.19
76	24.4	-10.03	11.13
77	25.0	-10.00	11.10
78	25.6	-9.97	11.07
80	26.7	-9.91	11.01
82	27.8	-9.86	10.96
84	28.9	-9.80	10.90
86	30.0	-9.74	10.84
88	31.1	-9.69	10.79
90	32.2	-9.63	10.73
92	33.3	-9.57	10.67
94	34.4	-9.51	10.61

The following list of ODEP bias voltages VS. temperature is based on the use of Main Modules built on the D 7993-5 board.

°F	°C	V <sub>-ODEP</sub>	V <sub>+ODEP</sub>
66	18.9	-9.31	10.31
68	20.0	-9.26	10.26
70	21.1	-9.20	10.20
72	22.2	-9.14	10.14
74	23.3	-9.09	10.09
76	24.4	-9.03	10.03
77	25.0	-9.00	10.00
78	25.6	-8.97	9.97
80	26.7	-8.91	9.91
82	27.8	-8.86	9.86
84	28.9	-8.80	9.80
86	30.0	-8.74	9.74
88	31.1	-8.69	9.69
90	32.2	-8.63	9.63
92	33.3	-8.57	9.57
94	34.4	-8.51	9.51

The following list of ODEP bias voltages VS. temperature is based on the use of Main Modules built on any circuit board after the D 7993-5 board.

°F	°C	V <sub>-ODEP</sub>	V <sub>+ODEP</sub>
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

## Electrical Checkout Procedures

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 3 of J500 and, if necessary, adjust R121 to obtain  $V_{-ODEP}$  as specified above. Measure pin 3 of J500 and, if necessary, adjust R221 to obtain  $V_{-ODEP}$  as specified above.

**+ODEP Procedure:** Measure pin 4 of J500 and, if necessary, adjust R132 to obtain  $V_{+ODEP}$  as specified above. Measure pin 4 of J500 and, if necessary, adjust R232 to obtain  $V_{+ODEP}$  as specified above.

### Test 4: AC Power Draw

**Spec:** 60 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 (.775VRMS) 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 (4.9mVRMS). 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 (49mVRMS). For Main Modules with board numbers lower than D 7993-5 adjust N100 and N200 to calibrate CMR. For Main Modules with board number D 7993-5 or greater adjust R921 and R1021.

### Test 6: Voltage Gain

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

**Spec 0.775V 8/4 ohm Sensitivity:**  $\pm$ 6%.

**Spec 0.775V 70-V Sensitivity:**  $\pm$ 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  $\pm$ 0.5 VAC at the amplifier

output. Inject a 0.775 VAC 1 kHz sine wave with the Sensitivity Switch in the 0.775V 8/4 ohm position. Measure 28.9 VAC  $\pm$ 1.7 VAC at the amplifier output. Inject a 0.775 VAC 1 kHz sine wave with the Sensitivity Switch in the 0.775 VAC 70-V position and the Output Mode Switch in the 70-V position. Measure 70.7 VAC  $\pm$ 4.2 VAC at the amplifier output. Return the Sensitivity Switch to the 26 dB position. Return the Output Mode Switches to the 8/4 ohm position.

### Test 7: Phase Response

**Spec:**  $\pm$ 10° 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 13 Amps,  $\pm$ 2 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 13  $\pm$ 2 Amps (13 Vpk). Observe clean (no oscillations) current clipping.

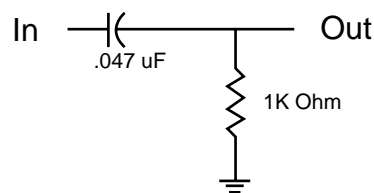


Figure 4. Differentiator Circuit



## Electrical Checkout Procedures

### Test 10: Slew Rate & 10 KHz Square Wave

**Spec:** 17 - 25 V/ $\mu$ S, 8 ohm load.

**Initial Conditions:** Controls per standard.

**Procedure:** Load each channel to 8 ohms. Inject a 10 kHz square wave to obtain 35 Volts zero-to-peak at each output. Observe the slope of the square wave. It should typically measure 17-25 V/ $\mu$ S. Also, the square wave must not include overshoot, ringing, or any type of oscillation.

### Test 11: Crosstalk

**Spec:** -60 dB 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 29 VAC. Measure less than 29 mVAC at the output of channel 2. Inject a 20 kHz sine wave into the channel 2 input and increase output level to 29 VAC. Measure less than 29 mVAC at the output of Ch 1.

### Test 12: Output Power

**Spec at 8 Ohm Stereo:**  $\geq$  105 Watts/Ch at 0.1% THD

**Spec at 4 Ohm Stereo:**  $\geq$  140 Watts/Ch at 0.1% THD

**Spec at 70-V Mode, Stereo:**  $\geq$  100 Watts/Ch at 0.1% THD, 50 Ohm load.

**Initial Conditions:** Controls per standard

**Procedure:** Load each channel to 8 ohms. Inject a 1 kHz sine wave and measure at least 28.98 VAC at the output of each channel. Load each channel to 4 ohms. Inject a 1 kHz sine wave and measure at least 23.66 VAC at the output of each channel. Switch each channel to the 70-V mode. Load each channel to 50 ohms. Inject a 1 kHz sine wave and measure at least 70.7 VAC at the output of each channel. 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 $\mu$ F. Inject a 20 kHz sine wave with 22 VAC output for 10 seconds.

**Procedure Inductive:** Load each channel to 8 ohms in parallel with 159 $\mu$ H. Inject a 1 kHz sine wave with 15 VAC output for 10 seconds.

**Procedure Torture:** Load each channel with the primary (red and black leads) of a PS-U transformer (CPN D 7040-5). Each channel in the 70-V mode. Inject a 10 Hz sine wave with an output level sufficient enough to cause 3 to 5 flyback pulses for 10 seconds.

**Procedure Short:** Inject a 60 Hz sine wave into the input and adjust for 5 VAC at the output. Short each channel, one at a time, 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 blade so it does not turn (if FAN is installed).

**Procedure:** Load the amplifier to 2 ohms per channel. Inject a 60 Hz sine wave into each channel and adjust the output to 10 VAC. Allow the amplifier to heat up until you observe a wave form similar to figure 5. Allow the amplifier to cool for a few minutes. Switch the amplifier to Parallel Mono mode and remove the load from channel 2. Inject a 60 Hz sine wave into each channel and adjust the output to 10 VAC. Allow the amplifier to heat up and observe limiting on both channels.

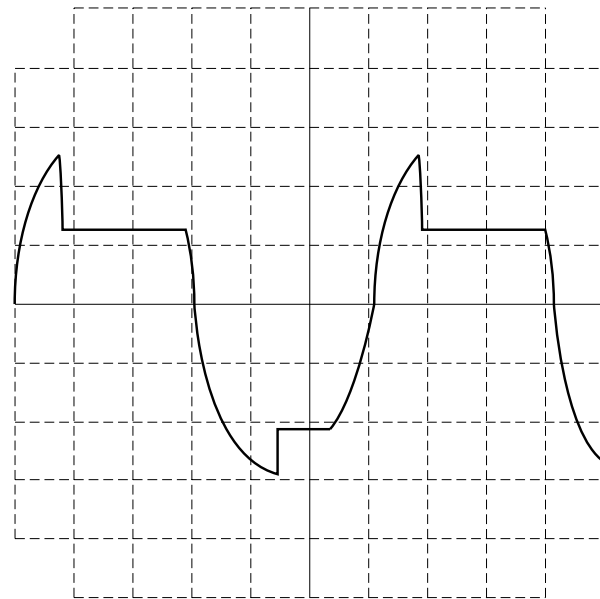


Figure 5. ODEP Limiting Wave Form

### Test 15: LF Protection

**Spec:** Amplifier mutes for dangerous subsonic frequencies.

**Initial Conditions:** Controls per standard.

**Procedure:** No load. Inject a .5 Hz 6 Vp-p, or a 2 Hz 6 VAC sine wave into each channel and verify that each channel cycles into mute.

## Electrical Checkout Procedures

### Test 16: Signal to Noise Ratio

**Spec:**  $\geq 100$  dB below 8 ohm rated continuous average 20-20kHz power.

**Initial Conditions:** Controls per standard. Short inputs.

**Procedure:** Load each channel to 8 ohms. Measure less than  $290\mu\text{V}$  at the output of each channel (20 Hz-20 kHz bandpass filter).

### Test 17: Turn off Transients

**Spec:**  $< 80\text{mV}$  across an 8 ohm speaker load

**Initial Conditions:** Controls per standard.

**Procedure:** Load the output with an 8 ohm speaker. 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 18: Intermodulation Distortion

**Spec at 0 dB output:**  $\leq 0.01\%$ .

**Spec at -35 dB output:**  $\leq 0.05\%$ .

**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 23 volts RMS. Set the 7 kHz portion to 25%. With an IM analyzer measure less than 0.01% IMD. Repeat test at -35 dB (reference 23 volts RMS, 60 Hz portion) and measure less than 0.05% IMD.

### Test 19: 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 into each input and drive the 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 8/4 Ohm.

**Stereo/Mono Switch:** Stereo.

**70-V Mode Switches:** 8/4 Ohm position.

**Power:** Off

## *Parts List (Non-Module)*

### *Supplimental Items*

<i>CPN</i>	<i>Item</i>	<i>Quantity</i>
A10087-71012	Rack Screw, 10-32 x .75	8
C 3342-0	Feet, Selfstick Black	4
D 4137-2	Nylon Washer	4
A10086-70808	Screw, 8-32 x .5 (For volume cover)	2
A10101-12	Spacer, #8 x 5/16OD x 1/4L (For volume cover)	2
F11489-6	Plexiglass Plate (Volume cover)	1
K80636-2	CT Series Reference Manual	1

### *Power Supply*

<i>CPN</i>	<i>Item</i>	<i>Quantity</i>
A10087-11028	Screw, 10-32 x 1.75 (For transformer)	4
C 10171-4	Breaker, 8 Amp VDE	1
C10168-0	Breaker, 4 Amp VDE (200V-240V Models)	1
D 7212-0	Power Transformer (120V 60 Hz)	1
D 7224-5	Power Transformer (220V/240V)	1
D 8022-2	Power Transformer (100V/120V)	1
A10099-7	Nylon Shoulder Washer, #10	4
A10095-4	Lockwasher, #10 External Star	4
A10098-5	Washer, 1/4" Belleville Spring	4
C 8752-5	Bridge Rectifier, 35A 400V	2
C 9852-2	Capacitor, 6300µF 200V Electrolytic	2
C 9870-4	Screw, 10-32 x .38	4
D 2934-4	Solder Lug, .218 Hole	4
D 6764-1	Washer, Shoulder	4
D 8438-0	Bracket, Capacitor	2

### *Output Assembly (One Per Channel)*

<i>CPN</i>	<i>Item</i>	<i>Quantity (Per Channel)</i>
A10315-1	Screw, 6-32 x .56 Hex Washer Head	12
C 8188-2	Output Power Transistor, PNP	2
D 6729-4	Output Power Transistor, NPN	2
C 7065-3	Output Power Transistor, PNP (early units)	2
C 8573-5	Driver Transistor, 2SA1186 PNP	2
C 8574-3	Driver Transistor, 2SC2837 NPN	2
M20591-0	Old Style Driver Transistor Assm. NPN, 2SC2527	2
M20590-2	Old Style Driver Transistor Assm. PNP, 2SA1077	2
D 7665-9	Mounting Clip, TO3P (For Drivers)	2
D 7666-7	Mounting Bracket, TO3P (For Drivers)	2
D 7796-2	Sil Pad, 2.87 x 14.57 (Between Heatsink & Chassis)	1
D 6280-8	Sil Pad for use with Output Board P10315-3	1
D 6104-0	Sil Pad for use with Output Board P10233-8	1
D 7797-0	Output Pad (Between Module and Chassis)	1
C 7597-4	Output Pad for use with Output Board P10315-3	1
D 7026-4	Output Pad for use with Output Board P10233-8	1
D 8774-8	PTC, 95DegC Cast Alum.	1
F12019-0	Heatsink (Under Diode String)	1
C 8813-5	Bias Transistor MPS8097/MPSA18 NPN (Q18)	1
B 5842-8	Tubing, #24 Thin Wall Red (For Q18)	Order in Inches
C 5826-0	LM234Z-6 Thermal Sense (S100/200)	1
B 5464-1	Tubing, #24 Teflon Thin Wall	Order in Inches
M21324-5	Aluminum Heat Sink, 3/4" With Fins	2

## *Parts List (Non-Module)*

### *Back Panel Assembly*

<i>CPN</i>	<i>Item</i>	<i>Quantity</i>
D 8367-1	Knob, .5 Dia. Level Control	2
A10086-10410	Screw, 4-40 x .62	2
A10086-70808	Screw, 8-32 x .5	4
A10094-2	Lockwasher, #4 Internal Star	2
A10100-7	Aluminum Spacer, .250OD x .140ID x .312L	2
A10109-70808	Screw, 8-18 x .5	4
A10214-4	Strain Relief	1
C10187-0	Strain Relief (For European Power Cord)	1
A11793-0105D	Power Cord, 16-3 SJT Neon UL/CSA	1
A10793-0503D	Power Cord, European Plug (E-13 Amplifiers)	1
C 4508-5	IC Socket, 16 Pin	1
C 5990-4	Barrier Block, 4 Term.	1
C 6821-0	Edge Card Connector, 22 Contact	1
C 7957-1	Slide Switch, DPDT 15A (70-V Mode)	2
C 8812-7	Cable Tie, 5.5"	2
C10060-9	Header, 5 Pin R Angle Locking	1
D 6899-5	Ribbon Connector, PIP Daisy	1
D 7623-8	Cable, 10" 22AWG With Terminals	1
F12690-8	Back Panel	1
P10286-6	PIP Interconnect Board	1

### *Chassis Front Assembly*

<i>CPN</i>	<i>Item</i>	<i>Quantity</i>
A10031-1	Captive Nut, 8-32 x .060 Flush (For rack ears)	4
A10090-70808	Screw, 8-32 x .5 Oval Head (For Grille)	3
A10101-5	Nylon Washer, .5 x .136 x .02 (For Grille)	3
A10173-1	Clip, Filter Grille	3
C 5297-4	Screw, 8-32 x .37 (For rack ears)	4
C 6487-0	Power Switch, 2 Pole 22 Amp Rocker	1
D 6944-9	Air Filter, 1.45 x 16.23	1
F11439J0	Front Panel Overlay	1
F12706-2	End Cap (For Rack ears)	2
F12710-4	Grille, Filter	1

### *Main Chassis Assembly*

<i>CPN</i>	<i>Item</i>	<i>Quantity</i>
A10094-3	Washer, #6 Internal Star, Black	8
A10110-70605	Screw, 6-32 x .312 Taptite (For covers)	7
D 7249-2	Label, 3 Position Voltage Gain	1
D 8501-5	Top Cover	1
D 8548-6	Bottom Cover	1
A10086-10606	Screw, 6-32 x .375	4
A10086-70806	Screw, 8-32 x .37	1
A10094-3	Washer, #6 Internal Star, Black	3
A10094-6	Washer, #8 Internal Star	2
A10109-10822	Screw, 8-18 x 1.375	2
A10110-70812	8-32 x .750 Taptite	2
A10192-1	Snap Bushing, OCB .500	3
C 1811-6	4" Cable Tie	8
C 3163-0	Solder Lug, #6	2

## *Parts List (Non-Module)*

### *Main Chassis Assembly Cont.*

<i>CPN</i>	<i>Item</i>	<i>Quantity</i>
C 6457-3	Screw, #8 x 3/8	2
C 6912-7	Tension Retaining Board Supports	2
C 6913-5	1" Spacer Toggle Nut, Plastic	2
C 6914-3	.75" Spacer Toggle Nut, Plastic	2
C 7705-4	Flat Cable Clamp	2
C 9491-9	Screw, 6-32 x .312	3
C 9953-8	Screw, 6-20 x .312	6
C10111-0	Button, Mtg.	2
D 7060-3	Sil Pad, 7 Mil 2.05 x .775	1
F11632-1	Bracket, Transformer Mtg.	1
F12642-9	Chassis, 3.5"	1

### *PIP-BB*

<i>CPN</i>	<i>Item</i>	<i>Quantity</i>
M46011-9	PIP-BB Assembly	1
A10086-70806	Screw, 8-32 x .37	2
A10094-5	Lockwasher, #8 Internal Star Black	2
A10110-10608	Screw, 6-32 x .5	4
A10266-2202	Resistor, 22 Ohm .5W	2
C 3842-9	Barrier Block, 3 Position	2
C 6806-1	Capacitor, .01μF 100V	2
C 7161-0	Screw, #8 x 1/4 #6 PNHD	2
F12553J7	Panel	1
P10343-5	PC Board	1

### *CT-200 Fan Assembly (Optional on Domestic Units)*

<i>CPN</i>	<i>Item</i>	<i>Quantity</i>
M44084-8	CT Fan Assembly	1
A10110-70605	Screw, 6-32 x .312 Taptite	2
C 7062-0	Screw, 6-32 x 5/16	2
C 9939-7	Fan Blade	1
D 8439-8	Fan Bracket	1
H43495-3	Fan Motor with Faston Connectors	1

## Module and Schematic Information

### Module History

The Com Tech 200B amplifier was introduced in 1990. 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, December 1995.

### Output Modules: (left and right are identical)

Q42716-3

Original Output Module on P10233-8 or P10263-5 board.

Q42888-0

Output Module on P10315-3 board.

Q42969-8

Output Module on P10337-7 board. No longer available. Use Q43188-4 as service replacement.

Q43188-4

Output Module on P10396-3 board.

### Main Modules:

Q42774-2

Original B Version Main Module. This Module's parts list is not documented. No longer available. Use Q43128-0 as a service replacement.

Q42922-7

Main Module on D 7605-5 board. This Module's parts list is not documented. No longer available. Use Q23128-0 as a service replacement.

Q43013-4

Main Module on D 7911-7 board. This module is still available at this time. If not, then use Q43128-0 as a service replacement.

Q43044-9

Main Module on D 7993-5 board. No longer available. Use Q43128-0 as service replacement.

Q43128-0

Main Module on D 8283-0 board.

Q43237-9

Main Module on D 8369-7 board. Detent Pots. Not reverse compatible.

### Control Module:

Q42762-7

CT-200/400 fan control on P10317-9 board.

Q43215-5

CT-200 fan control on P10404-5 board.

Q43244-5

CT control module for 120V, 60 Hz only. On P10405-2 board.

Q43242-9

CT control module for Export models. On P10405-2 board.

### Display Module:

Q42706-4

CT display on D 7083-5 board.

### Schematic Information:

The schematics provided are representative only. There may be slight variations between amplifier to amplifier. These schematics are intended to be used for troubleshooting purposes only.

For amplifiers with main boards D 7605-5, D 7911-7, D 7993-5, and D 8283-0 or earlier, refer to schematic number J0552-3.

For amplifiers with main board D 8369-7 refer to schematic number J0630-4.

## Q42762-7 Control Module (P10317-9 board) Parts Lists

**Capacitors**

C700	C800	C 8426-6	.1μF 250V
C701	C801	C 8426-6	.1μF 250V
C900		C 8963-8	.47μF 250V
C901		C 8963-8	.47μF 250V

**Diodes**

D700	D800	C 3181-2	1N4148
D900		C 2851-1	1N4004

**Relays**

K1		C 7860-7	SPST
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**Transistors**

Q700	Q800	C 3625-8	PNP 2N4125
Q701	Q801	C 7663-5	Triac MAC224A4
Q900		C 3625-8	PNP 2N4125
Q901		C 3625-8	PNP 2N4125
Q902		C 3625-8	PNP 2N4125

**Resistors**

R700	R800	A10266-1222	1.2K .5W
R701	R801	A10266-1812	180 .5W
R900		A10266-2722	2.7K .5W
R901		A10266-1021	1.5K .5W
R902		C 7669-2	300 10W
R903		C 7669-2	300 10W
R904		A10266-3902	39 .5W
R905		A10266-3602	36 .5W

**ICs**

U700	U800	C 7664-3	MOC3031 Optotriac
U901		C 7665-0	MOC3011 Optotriac
U902		C 7665-0	MOC3011 Optotriac

**Misc.**

Board		P10317-9	
J900		C 7672-6	8 Pin MTA Header
Tab Terminal		C 7817-7	W1-W3, W100-W102 W200-W202
0 Ohm Jmp		C 5868-2	

## Q43215-5 Control Module (P10404-5 board) Parts List

### Capacitors

C700	C800	C 8426-6	.1 $\mu$ F 250V
C701	C801	C 8426-6	.1 $\mu$ F 250V
C900		C 8963-8	.47 $\mu$ F 250V
C901		C 8963-8	.47 $\mu$ F 250V

### Diodes

D700	D800	C 3181-2	1N4148
D900		C 2851-1	1N4004

### Relays

K1		C 7860-7	SPST
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### Transistors

Q700	Q800	C 3625-8	PNP 2N4125
Q701	Q801	C 7663-5	Triac MAC224A4
Q900		C 3625-8	PNP 2N4125
Q901		C 3625-8	PNP 2N4125
Q902		C 3625-8	PNP 2N4125

### Resistors

R700	R800	A10266-1222	1.2K .5W
R701	R801	A10266-1812	180 .5W
R900		A10266-2722	2.7K .5W
R901		A10266-1021	1.5K .5W
R902		C 7669-2	300 10W
R903		C 7669-2	300 10W
R904		A10266-3902	39 .5W
R905		A10266-3602	36 .5W

### ICs

U700	U800	C 7664-3	MOC3031 Optotriac
U901		C 7665-0	MOC3011 Optotriac
U902		C 7665-0	MOC3111 Optotriac

### Misc.

Board		P10404-5	
J900		C 7672-6	8 Pin MTA Header
Tab Terminal		C 7817-7	W1-W3, W100-W102 W200-W202



## Q43244-5 Control Module (P10405-2 board) Parts List

**Capacitors**

C700	C800	C 8426-6	.1μF 250V
C701	C801	C 8426-6	.1μF 250V
C900		C 8963-8	.47μF 250V
C901		C 8963-8	.47μF 250V

**Diodes**

D700	D800	C 3181-2	1N4148
D900		C 2851-1	1N4004

**Relays**

K1		C 7860-7	SPST
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**Transistors**

Q700	Q800	C 3625-8	PNP 2N4125
Q701	Q801	C 7663-5	Triac MAC224A4
Q900		C 3625-8	PNP 2N4125
Q901		C 3625-8	PNP 2N4125
Q902		C 3625-8	PNP 2N4125

**Resistors**

R700	R800	A10266-3622	3.6K .5W
R701	R801	A10266-1812	180 .5W
R702	R802	A10266-3622	3.6K .5W
R703	R803	A10266-3622	3.6K .5W
R900		A10266-2722	2.7K .5W
R901		A10266-1021	1.5K .5W
R902		C 7669-2	300 10W
R903		C 7669-2	300 10W
R904		A10266-3902	39 .5W
R905		A10266-3602	36 .5W

**ICs**

U700	U800	C 7664-3	MOC3031 Optotriac
U901		C 7665-0	MOC3011 Optotriac
U902		C 7665-0	MOC3011 Optotriac

**Misc.**

Board		P10405-2	
J900		C 7672-6	8 Pin MTA Header
Tab Terminal		C 7817-7	W1-W3, W100-W102 W200-W202
0 Ohm Jmp		C 5868-2	

## Q43242-9 Control Module (P10405-2 board) Parts List

### Capacitors

C700	C800	C 8426-6	.1 $\mu$ F 250V
C701	C801	C 8426-6	.1 $\mu$ F 250V
C900		C 8963-8	.47 $\mu$ F 250V
C901		C 8963-8	.47 $\mu$ F 250V

### Diodes

D700	D800	C 3181-2	1N4148
D900		C 2851-1	1N4004

### Relays

K1		C 7860-7	SPST
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### Transistors

Q700	Q800	C 3625-8	PNP 2N4125
Q701	Q801	C 7663-5	Triac MAC224A4
Q900		C 3625-8	PNP 2N4125
Q901		C 3625-8	PNP 2N4125
Q902		C 3625-8	PNP 2N4125

### Resistors

R700	R800	A10266-3622	3.6K .5W
R701	R801	A10266-1812	180 .5W
R702	R802	A10266-3622	3.6K .5W
R703	R803	A10266-3622	3.6K .5W
R900		A10266-2722	2.7K .5W
R901		A10266-1021	1.5K .5W
R902		C 7669-2	300 10W
R903		C 7669-2	300 10W
R904		A10266-3902	39 .5W
R905		A10266-3602	36 .5W

### ICs

U700	U800	C 7664-3	MOC3031 Optotriac
U901		C 7665-0	MOC3011 Optotriac
U902		C 7665-0	MOC3011 Optotriac

### Misc.

Board		P10405-2	
J900		C 7672-6	8 Pin MTA Header
J901		C 7873-0	2 Pin MTA Header
Tab Terminal		C 7817-7	W1-W3, W100-W102 W200-W202
0 Ohm Jmp		C 5868-2	

## Q42706-4 Display Module (D 7083-5 board) Parts List

**Capacitors**

C500	C600	C 6802-0	.47µF 50V
C901		C 6804-6	.1µF 50V

**Diodes**

D500	D600	C 3181-2	1N4148
D501	D601	C 3181-2	1N4148
D900		C 3533-4	1N966B 16V Zener
D901		C 3533-4	1N966B 16V Zener

**LED's**

E500	E600	C 7863-1	Green
E501	E601	C 4431-0	Yellow
E502	E602	C 7863-1	Green
E900		C 4342-9	Amber

**Transistors**

Q500	Q600	C 3625-8	2N4125
Q501	Q601	C 3625-8	2N4125
Q502	Q602	C 7458-0	2N4123
Q503	Q603	C 3625-8	2N4125

**Resistors**

R500	R600	A10266-1031	10K
R501	R601	A10266-2221	2.2K
R502	R602	A10266-1051	1M
R503	R603	A102662751	2.7M
R504	R604	A10266-2032	20K .5W
R505	R605	A10266-2221	2.2K
R506	R606	A10266-4751	4.7M
R507	R607	A10266-2221	2.2K
R508	R608	A10266-1021	1K
R905		A10266-5141	510K
R906		A10266-2721	2.7K
R907		A10266-5141	510K
R908		A10266-3931	39K
R909		A10266-3931	39K
R910		A10266-4741	470K
R911		A10266-3931	39K
R912		A10266-1041	100K
R913		A10266-1031	10K
R914		A10266-8211	820
R915		A10266-3931	39K
R916		A10266-3631	36K
R917		A10266-8211	820
R918		A10266-3931	39K

**Integrated Circuits**

U903	C 4345-2	LMT339
U904	C 7661-9	LM358N
U905	C 4345-2	LMT339

**Misc.**

Board	D 7083-5	
IC Socket	C 4508-5	16 Pin
LED Spacer	C 7712-0	
Cable	H42913-6	8 Cond 24AWG Ribbon Cable with Connector

## Q42716-3 Output Module (P10233-8 or P10263-5 board) Parts List

### Capacitors

C01	C 3978-1	.047 $\mu$ F
C02	C 2938-6	.1 $\mu$ F
C03	C 2938-6	.1 $\mu$ F
C04	C 6806-1	.01 $\mu$ F
C05	C 6806-1	.01 $\mu$ F
C06	C 6806-1	.01 $\mu$ F
C07	C 6807-9	.001 $\mu$ F
C08	C 6809-5	220pF
C09	C 6850-7	180pF

### Diodes

D01	C 2851-1	1N4004
D02	C 2851-1	1N4004
D03	C 2851-1	1N4004
D04	C 2851-1	1N4004
D05	C 2851-1	1N4004
D06	C 2851-1	1N4004
D07	C 2851-1	1N4004
D08	C 2851-1	1N4004
D09	C 2851-1	1N4004
D10	C 2851-1	1N4004
D11	C 2851-1	1N4004
D12	C 2851-1	1N4004

### Inductors

L00	C 6592-6	1.3 $\mu$ H Output Coil
L01	C 3510-2	470 $\mu$ H
L02	C 3510-2	470 $\mu$ H

### Transistors

Q17	C 7271-7	NPN MPSU10
Q19	C 7318-6	PNP MPSU60

Note: Q18, S100, Driver Transistors, and Output Transistors are not included with Output Module. See Output Assembly parts list for these part numbers.

### Resistors

R00	C 2626-7	470
R01	C 2872-7	100
R02	C 3299-2	5.6 .5W
R04	C 6486-2	.2 5W
R07	C 6486-2	.2 5W
R09	C 4479-9	22
R10	C 2872-7	100
R11	C 7317-8	2.7 5W
R12	C 1001-4	2.7 1W
R13	C 2626-7	470
R16	C 6486-2	.2 5W
R19	C 6486-2	.2 5W
R21	C 3299-2	5.6 .5W
R22	C 4479-9	22
R23	C 6844-2	250 Pot LS Bias
R24	C 4300-7	13K
R25	C 2628-3	2.2K
R26	C 6844-2	250 Pot HS Bias
R27	C 6495-3	390
R28	C 4300-7	13K
R30*	C 6626-3*	102*

### Misc.

Board	P10233-8 or P10263-5
Jumpers	C 5868-2 0 Ohm .25W
J500 J600	C 7057-0 10 Pin Header

\*Note: R30 is 102 Ohms in most units, though in some cases a different value may be used to match the installed S100/S200 LM334 (C5826-0) device grade. This is the standard value and is used with the most common LM334 grade, green. If the LM334 is marked with a blue dot, R30 should be a 107 Ohm resistor (A10265-10701); if it is marked with a yellow dot then R30 should be a 100 Ohm resistor (A10265-10001).

## Q42888-0 Output Module (P10315-3 board) Parts List

### Capacitors

C01	C 8511-5	.047μF 250V Ax
C02	C 8426-6	.1μF
C03	C 8426-6	.1μF
C04	C 6805-3	.022μF
C05	C 6805-3	.022μF
C06	C 6806-1	.01μF 100V Ax
C07	C 6807-9	.001μF 100V Ax
C08	C 6809-5	220pF
C09	C 6810-3	180pF

### Diodes

D01	C 2851-1	1N4004
D02	C 2851-1	1N4004
D03	C 2851-1	1N4004
D04	C 2851-1	1N4004
D05	C 2851-1	1N4004
D06	C 2851-1	1N4004
D07	C 2851-1	1N4004
D08	C 2851-1	1N4004
D09	C 2851-1	1N4004
D10	C 2851-1	1N4004
D11	C 2851-1	1N4004
D12	C 2851-1	1N4004

### Inductors

L00	C 6592-6	1.3μH Output Coil
L01	C 3510-2	470μH
L02	C 3510-2	470μH

### Transistors

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

Note: Q18, S100, Driver Transistors, and Output Transistors are not included with Output Module. See Output Assembly parts list for part numbers.

### Resistors

R00	C 2626-7	470
R01	C 2872-7	100
R02	C 7778-1	5.6 .5W Flame Proof
R04	C 6486-2	.2 5W
R07	C 6486-2	.2 5W
R09	C 7779-9	22 Flame Proof
R10	C 2872-7	100
R11	C 7317-8	2.7 5W
R12	C 1001-4	2.7 1W
R13	C 2626-7	470
R16	C 6486-2	.2 5W
R19	C 6486-2	.2 5W
R21	C 7778-1	5.6 .5W Flame Proof
R22	C 7779-9	22 Flame Proof
R23	C 6844-2	250 Pot LS Bias
R24	C 4300-7	13K
R25	C 2628-3	2.2K
R26	C 6844-2	250 Pot HS Bias
R27	C 6495-3	390
R28	C 4300-7	13K
R30*	C 6626-3*	102*

### Misc.

Board	P10315-3	
Jumpers	C 5868-2	0 Ohm .25W
Clips	D 6414-3	Q17/Q19 Hold Down
J500 J600	C 7057-0	10 Pin Header

\*Note: R30 is 102 Ohms in most units, though in some cases a different value may be used to match the installed S100/S200 LM334 (C5826-0) device grade. This is the standard value and is used with the most common LM334 grade, green. If the LM334 is marked with a blue dot, R30 should be a 107 Ohm resistor (A10265-10701); if it is marked with a yellow dot then R30 should be a 100 Ohm resistor (A10265-10001).

## Q42969-8 Output Module (P10337-7 board) Parts List

### Capacitors

C01	C 8511-5	.047 $\mu$ F 250V Ax
C02	C 8426-6	.1 $\mu$ F
C03	C 8426-6	.1 $\mu$ F
C04	C 6805-3	.022 $\mu$ F
C05	C 6805-3	.022 $\mu$ F
C06	C 6806-1	.01 $\mu$ F 100V Ax
C07	C 6807-9	.001 $\mu$ F 100V Ax
C08	C 6810-3	180pF
C09	C 6809-5	220pF
C10	C 7697-3	.01 $\mu$ F
C11	C 7697-3	.01 $\mu$ F
C43	C 7697-3	.01 $\mu$ F

### Diodes

D01	C 2851-1	1N4004
D02	C 2851-1	1N4004
D03	C 2851-1	1N4004
D04	C 2851-1	1N4004
D05	C 2851-1	1N4004
D06	C 2851-1	1N4004
D07	C 2851-1	1N4004
D08	C 2851-1	1N4004
D09	C 2851-1	1N4004
D10	C 2851-1	1N4004
D11	C 2851-1	1N4004
D12	C 2851-1	1N4004

### Inductors

L00	C 6592-6	1.3 $\mu$ H Output Coil
L01	C 3510-2	470 $\mu$ H
L02	C 3510-2	470 $\mu$ H

### Transistors

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

Note: Q18, S100, Driver Transistors, and Output Transistors are not included with the Output Module. See Output Assembly parts list for part numbers.

### Resistors

R00	A10266-4711	470
R01	A10266-1011	100
R04	C 6486-2	.2 5W
R07	C 6486-2	.2 5W
R10	A10266-1011	100
R11	A10266-2R73	2.7 1W
R12	A10266-2R73	2.7 1W
R13	A10266-4711	470
R14	A10266-2R73	2.7 1W
R16	C 6486-2	.2 5W
R19	C 6486-2	.2 5W
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*
R31	C 3614-2	15 .5W Flame Proof
R32	C 3614-2	15 .5W Flame Proof
R33	C 7779-9	22 .5W Flame Proof
R34	C 7779-9	22 .5W Flame Proof

### Misc.

Board	P10337-7	
Jumpers	C 5868-2	0 Ohm .25W
Clips	D 6414-3	Q17/Q19 Hold Down
J500 J600	C 7057-0	10 Pin Header

\*Note: R30 is 102 Ohms in most units, though in some cases a different value may be used to match the installed S100/S200 LM334 (C5826-0) device grade. This is the standard value and is used with the most common LM334 grade, green. If the LM334 is marked with a blue dot, R30 should be a 107 Ohm resistor (A10265-10701); if it is marked with a yellow dot then R30 should be a 100 Ohm resistor (A10265-10001).

## Q43188-4 Output Module (P10396-3 board) Parts List Cont.

### Capacitors

C01	C 8511-5	.047μF 250V Ax
C02	C 8426-6	.1μF
C03	C 8426-6	.1μF
C04	C 6805-3	.022μF
C05	C 6805-3	.022μF
C06	C 6806-1	.01μF 100V Ax
C07	C 6807-9	.001μF 100V Ax
C08	C 6810-3	180pF
C09	C 6809-5	220pF
C43	C 7697-3	.01μF Disc

### Diodes

D01	C 2851-1	1N4004
D02	C 2851-1	1N4004
D03	C 2851-1	1N4004
D04	C 2851-1	1N4004
D05	C 2851-1	1N4004
D06	C 2851-1	1N4004
D07	C 2851-1	1N4004
D08	C 2851-1	1N4004
D09	C 2851-1	1N4004
D10	C 2851-1	1N4004
D11	C 2851-1	1N4004
D12	C 2851-1	1N4004

### Inductors

L00	C 6592-6	1.3μH Output Coil
L01	C 3510-2	470μH
L02	C 3510-2	470μH

### Transistors

Q17	C10155-7	NPN 2SC4793
Q19	C10156-5	PNP 2SA1837

Note: Q18, S100, Driver Transistors, and Output Transistors are not included with Output Module. See Output Assembly parts list for part numbers.

### Resistors

R00	A10266-4711	470
R01	A10266-1011	100
R04	C 6486-2	.2 5W
R07	C 6486-2	.2 5W
R10	A10266-1011	100
R11	A10266-2R73	2.7 1W
R12	A10266-2R73	2.7 1W
R13	A10266-4711	470
R14	A10266-2R73	2.7 1W
R16	C 6486-2	.2 5W
R19	C 6486-2	.2 5W
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* 1%
R31	C 3614-2	15 .5W
R32	C 3614-2	15 .5W
R33	C 7779-9	22 .5W Flame Proof
R34	C 7779-9	22 .5W Flame Proof

### Misc.

Board	P10396-3	
Z1-Z7, Z9	C 5868-2	0 Ohm Jumper
Z8	A10124-24	Solid Wire
Clips	D 6414-3	Q17/Q19 Hold Down
J500 J600	C 7057-0	10 Pin Header

\*Note: R30 is 102 Ohms in most units, though in some cases a different value may be used to match the installed S100/S200 LM334 (C5826-0) device grade. This is the standard value and is used with the most common LM334 grade, green. If the LM334 is marked with a blue dot, R30 should be a 107 Ohm resistor (A10265-10701); if it is marked with a yellow dot then R30 should be a 100 Ohm resistor (A10265-10001).

## Q43013-4 Main Module (D 7911-7 board) Parts List

### Capacitors

C1	C 4303-1	1000 $\mu$ F
C2	C 3913-8	470 $\mu$ F
C4	C 6802-0	.47 $\mu$ F
C5	A10124-24	Jumper Wire
C6	A10124-24	Jumper Wire
C7	C 8897-8	.1 $\mu$ F
C100	C200 C 5311-3	22 $\mu$ F
C101	C201 C 2821-4	10pF
C103	C203 C 6805-3	.022 $\mu$ F
C104	C204 C 6805-3	.022 $\mu$ F
C105	C205 C 6812-9	47pF
C106	C206 C 6812-9	47pF
C107	C207 C 6804-6	.1 $\mu$ F
C108	C208 C 6814-5	12pF
C109	C209 C 7417-6	.0033 $\mu$ F
C110	C210 C 5362-6	2.2 $\mu$ F
C111	C211 C 6804-6	.1 $\mu$ F
C112	C212 C 6803-8	.12 $\mu$ F
C113	C213 C 6802-0	.47 $\mu$ F
C114	C214 C 8854-9	100 $\mu$ F
C115	C215 C 8854-9	100 $\mu$ F
C116	C216 C 6802-0	.47 $\mu$ F
C117	C217 C 6803-8	.12 $\mu$ F
C118	C218 C 6814-5	12pF
C119	C219 C 6802-0	.47 $\mu$ F
C120	C220 C 6804-6	.1 $\mu$ F
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	.022 $\mu$ F
C135	C235 C 6805-3	.022 $\mu$ F
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	100 $\mu$ F
C145	C245 C 6812-9	47pF
C146	C246 C 6812-9	47pF
C147	C247 C 6806-1	.01 $\mu$ F
C148	C248 C 6810-3	180pF
C149	C249 C 6808-7	470pF
C150	C250 C 6806-1	.01 $\mu$ F
C151	C251 C 6806-1	.01 $\mu$ F
C152	C252 C 6950-7	82pF 5%
C153	C253 C 6804-6	.1 $\mu$ F
C154	C254 C 8426-6	.1 $\mu$ F 250V

C155	C255	C 6804-6	.1 $\mu$ F
C156	C256	C 6804-6	.1 $\mu$ F
C157	C257	C 6806-1	.01 $\mu$ F

### 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
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

### Transistors

Q100	Q200	D 2961-7	NPN 2N3859A
Q101	Q201	C 3578-9	PNP MPSA93
Q102	Q202	C 3810-6	NPN MPSA43
Q103	Q203	C 3786-8	PNP PN4250
Q105	Q205	C 3578-9	PNP MPSA93
Q106	Q206	C 3625-8	NPN 2N4125
Q107	Q207	C 3786-8	PNP PN4250
Q108	Q208	D 2961-7	NPN 2N3859A
Q109	Q209	D 2961-7	NPN 2N3859A
Q110	Q210	C 3810-6	NPN MPSA43
Q112	Q212	C 3625-8	NPN 2N4125
Q113	Q213	C 3625-8	NPN 2N4125
Q115	Q215	D 2962-5	NPN MPS8097
Q116	Q216	C 3786-8	PNP PN4250
Q117	Q217	D 2961-7	NPN 2N3859A
Q118	Q218	D 2961-7	NPN 2N3859A
Q119	Q219	C 3625-8	NPN 2N4125



## Q43013-4 Main Module (D 7911-7 board) Parts List

Q120	Q220	C 3625-8	NPN 2N4125	R130	R230	A10266-1041	100K
Q121	Q221	C 7458-0	NPN 2N4123	R131	R231	A10266-1031	10K
Q122	Q222	C 7458-0	NPN 2N4123	R132	R232	C 5062-2	100K Pot (+ODEP)
Q123	Q223	C 7458-0	NPN 2N4123	R133	R233	A10266-2741	270K
Q124	Q224	C 3625-8	NPN 2N4125	R134	R234	A10266-2032	20K .5W
<b>Resistors</b>				R135	R235	C 7782-3	100 Flame Proof
				R136	R236	A10266-6821	6.8K
				R137	R237	C 7782-3	100 Flame Proof
				R138	R238	A10266-6821	6.8K
N100	N200	D 4669-4	Resistor Network	R139	R239	A10266-8211	820
N101	N201	D 6081-0	Resistor Network	R140	R240	A10266-6801	68
N102	N202	D 6082-8	Resistor Network	R141	R241	A10266-1541	150K
R1		A10265-53621	53.6K 1%	R142	R242	A10266-1541	150K
R2		OPEN		R143	R243	A10266-1041	100K
R3		OPEN		R144	R244	A10266-1041	100K
R4		A10265-46421	46.4K 1%	R145	R245	A10266-1851	1.8M
R7		A10266-1041	100K	R146	R246	A10266-1031	10K
R8		A10266-2031	20K	R147	R247	C 7781-5	200 .5W Flame Proof
R9		A10266-5121	5.1K	R148	R248	A10266-2721	2.7K
R16		A10266-5121	5.1K	R149	R249	C 7781-5	200 .5W Flame Proof
R17		A10266-2031	20K	R150	R250	A10266-2721	2.7K
R18		A10266-1041	100K	R151	R251	A10266-1031	10K
R100	R200	C 7409-3	5K Linear Pot	R152	R252	A10266-1231	12K
R101	R201	A10265-49911	4.99K 1%	R153	R253	JUMPER	A10124-24
R102	R202	A10266-5111	510	R154	R254	A10265-12131	121K 1%
R103	R203	A10265-10031	100K 1%	R155	R255	A10266-1321	1.3K
R104	R204	A10266-2721	2.7K	R156	R256	A10266-1321	1.3K
R105	R205	A10266-2721	2.7K	R157	R257	A10266-1321	1.3K
R106	R206	A10266-1231	12K	R158	R258	A10266-9121	9.1K
R107	R207	A10266-6831	68K	R159	R259	A10266-1021	1K
R108	R208	A10266-8211	820	R160	R260	C 8260-9	10K 0.1%
R109	R209	A10266-6801	68	R161	R261	A10266-4701	47
R110	R210	A10266-6831	68K	R162	R262	A10266-4701	47
R111	R211	A10266-1231	12K	R163	R263	A10265-12131	121K 1%
R112	R212	A10266-5131	51K	R164	R264	A10265-10021	10K 1%
R113	R213	A10266-4721	4.7K	R165	R265	A10265-12131	121K 1%
R114	R214	A10266-4721	4.7K	R166	R266	A10266-1851	1.8M
R115	R215	A10266-5141	510K	R167	R267	A10265-10011	1K 1%
R116	R216	A10266-2751	2.7M	R168	R268	A10265-95301	953 1%
R117	R217	A10266-4731	47K	R170	R270	A10265-10011	1K 1%
R118	R218	A10266-2711	270	R171	R271	A10265-95301	953 1%
R119	R219	A10266-3911	390	R173	R273	A10265-10021	10K 1%
R120	R220	A10266-2711	270	R174	R274	A10265-24921	24.9K 1%
R121	R221	C 5062-2	100K Pot (-ODEP)	R175	R275	A10265-28721	28.7K 1%
R122	R222	A10266-2741	270K	R176	R276	A10265-24921	24.9K 1%
R123	R223	A10266-2032	20K .5W	R177	R277	A10265-69811	6.98K 1%
R124	R224	A10266-6821	6.8K	R179	R279	A10266-1321	1.3K
R125	R225	C 7782-3	100 Flame Proof	R180	R280	A10266-4711	470
R126	R226	C 7782-3	100 Flame Proof	R181	R281	A10266-4721	4.7K
R127	R227	A10266-6821	6.8K	R182	R282	A10266-2201	22
R128	R228	A10266-1031	10K	R183	R283	A10266-2421	2.4K
R129	R229	A10266-1041	100K	R184	R284	A10266-4741	470K

## Q43013-4 Main Module (D 7911-7 board) Parts List

R185	R285	A10266-2421	2.4K				
R186	R286	A10266-2751	2.7M				
R187	R287	A10266-3631	36K				
R188	R288	A10266-3631	36K				
R189	R289	A10266-2731	27K				
R190	R290	A10266-2051	2M				
R191	R291	A10266-3331	33K				
R192	R292	A10266-1031	10K				
R193	R293	A10266-1031	10K				
R194	R294	A10266-1041	100K				
R195	R295	A10266-3021	3K				
R196	R296	A10266-4721	4.7K				
R197	R297	A10266-1031	10K				
R198	R298	A10266-4721	4.7K				
R199	R299	A10266-1031	10K				
R906	R1006	OPEN					
R907	R1007	OPEN					
R908	R1008	OPEN					
R909	R1009	A10266-4741	470K				
R910	R1010	A10266-4741	470K				
R911	R1011	A10266-1521	1.5K				
R912	R1012	A10266-4711	470				
R913	R1013	A10266-1051	1M				
R914	R1014	A10266-1051	1M				
R915	R1015	A10266-2201	22				
R916	R1016	A10266-2201	22				
				<b>Switches</b>			
				S2		OPEN	
				S3		C 7960-5	Sensitivity
				S4		C 6781-6	Switch, Stereo/Mono
				<b>IC's</b>			
				U1		C 5095-2	UA7815
				U2		C 5096-0	UA7915
				U100	U200	C 6911-9	UPA75
				U101	U201	C 4345-2	LM339
				U102	U202	C 4345-2	LM339
				U103	U203	C 6910-1	UPA76
				U104	U204	C 7558-7	MC33079P
				<b>Misc.</b>			
				Board		D 7911-7	
				Socket		C 3450-1	14 Pin (Qty 6)
				Nut		A10102-5	Hex 6-32 (Qty 2)
				Heatsink		C 5341-0	TO-220 (Qty 2)
				Torq Spreader		C 6541-4	(Qty 2)
				Washer		A10096-5	#6, Split (Qty 2)
				Screw		A10240-0608	Stainless (Qty 2)
				J1		C 7593-4	5 Pin Header
				J2		C 4508-5	16 Pin Socket
				J3		C 7526-4	3 Pin Header
				J100	J200	OPEN	
				J500	J800	D 6619-7	10 Inch Ribbon
				J600	J700	D 6620-5	6 Inch Ribbon
				Cable Tie		C 1811-6	(Qty 4)

## ***Q43044-9 Main Module (D 7993-5 board) Parts List***

***Capacitors***

C1	C 4303-1	1000μF
C2	C 3913-8	470μF
C4	C 6802-0	.47μF
C5	A10124-24	Jumper Wire
C6	A10124-24	Jumper Wire
C7	C 8897-8	.1μF
C100 C200	C 5311-3	22μF
C101 C201	C 2821-4	10pF
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 7417-6	.0033μF
C110 C210	C 5362-6	2.2μF
C111 C211	C 8897-8	.1μF
C112 C212	C 8991-9	.47μF
C113 C213	C 8987-7	22μF
C114 C214	C 8854-9	100μF
C115 C215	C 8854-9	100μF
C116 C216	C 8987-7	22μF
C117 C217	C 8991-9	.47μF
C118 C218	C 6814-5	12pF
C119 C219	C 6802-0	.47μF
C120 C220	C 8897-8	.1μF
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	C 8426-6	.1μF 250V

C155	C255	C 8897-8	.1μF
C156	C256	C 8897-8	.1μF
C157	C257	C 6806-1	.01μF

***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
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
D114 D214		OPEN	
D115 D215		OPEN	
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

***Transistors***

Q100 Q200	D 2961-7	NPN 2N3859A
Q101 Q201	C 3578-9	PNP MPSA93
Q102 Q202	C 3810-6	NPN MPSA43
Q103 Q203	C 3786-8	PNP PN4250
Q105 Q205	C 3578-9	PNP MPSA93
Q106 Q206	C 3625-8	NPN 2N4125
Q107 Q207	C 3786-8	PNP PN4250
Q108 Q208	D 2961-7	NPN 2N3859A
Q109 Q209	D 2961-7	NPN 2N3859A
Q110 Q210	C 3810-6	NPN MPSA43
Q112 Q212	C 3625-8	NPN 2N4125
Q113 Q213	C 3625-8	NPN 2N4125
Q115 Q215	D 2962-5	NPN MPS8097
Q116 Q216	C 3786-8	PNP PN4250
Q117 Q217	D 2961-7	NPN 2N3859A

## Q43044-9 Main Module (D 7993-5 board) Parts List

Q118	Q218	D 2961-7	NPN 2N3859A	R128	R228	A10266-1031	10K
Q119	Q219	C 3625-8	NPN 2N4125	R129	R229	A10266-1041	100K
Q120	Q220	C 3625-8	NPN 2N4125	R130	R230	A10266-1041	100K
Q121	Q221	C 7458-0	NPN 2N4123	R131	R231	A10266-1031	10K
Q122	Q222	C 7458-0	NPN 2N4123	R132	R232	C 5062-2	100K Pot (+ODEP)
Q123	Q223	C 7458-0	NPN 2N4123	R133	R233	A10266-2741	270K
Q124	Q224	C 3625-8	NPN 2N4125	R134	R234	A10266-2032	20K .5W
				R135	R235	C 7782-3	100 Flame Proof
				R136	R236	A10266-6821	6.8K
				R137	R237	C 7782-3	100 Flame Proof
				R138	R238	A10266-6821	6.8K
				R139	R239	A10266-8211	820
				R140	R240	A10266-6801	68
				R141	R241	A10266-1541	150K
				R142	R242	A10266-1541	150K
				R143	R243	A10266-1041	100K
				R144	R244	A10266-1041	100K
				R145	R245	A10266-1851	1.8M
				R146	R246	A10266-1031	10K
				R147	R247	C 7781-5	200 .5W Flame Proof
				R148	R248	A10266-2721	2.7K
				R149	R249	C 7781-5	200 .5W Flame Proof
				R150	R250	A10266-2721	2.7K
				R151	R251	A10266-1031	10K
				R152	R252	A10265-11821	11.8K 1%
				R153	R253	JUMPER	A10124-24
				R154	R254	C 8261-7	121K 0.1%
				R155	R255	A10266-1321	1.3K
				R156	R256	A10266-1321	1.3K
				R157	R257	A10266-1321	1.3K
				R158	R258	A10265-11321	11.3K 1%
				R159	R259	A10266-1021	1K
				R160	R260	C 8260-9	10K 0.1%
				R161	R261	A10266-4701	47
				R162	R262	A10266-4701	47
				R163	R263	C 8261-7	121K 0.1%
				R164	R264	C 8260-9	10K 0.1%
				R165	R265	C 8261-7	121K 0.1%
				R166	R266	A10266-1851	1.8M
				R167	R267	A10265-10011	1K 1%
				R168	R268	A10265-97601	976 1%
				R170	R270	A10265-10011	1K 1%
				R171	R271	A10265-95301	953 1%
				R173	R273	C 8260-9	10K 0.1%
				R174	R274	A10265-24921	24.9K 1%
				R175	R275	A10265-28721	28.7K 1%
				R176	R276	A10265-24921	24.9K 1%
				R177	R277	A10265-69811	6.98K 1%
				R179	R279	A10266-1321	1.3K
				R180	R280	A10266-4711	470
				R181	R281	A10266-4721	4.7K
				R182	R282	A10266-2201	22

<b>Resistors</b>			
			(.25W 5% unless noted otherwise)
N101	N201	D 7945-5	Resistor Network
N102	N202	D 6082-8	Resistor Network
R1		A10265-53621	53.6K 1%
R2		OPEN	
R3		OPEN	
R4		A10265-46421	46.4K 1%
R7		A10266-1041	100K
R8		A10266-2031	20K
R9		A10266-5121	5.1K
R10		OPEN	
R16		A10266-5121	5.1K
R17		A10266-2031	20K
R18		A10266-1041	100K
R100	R200	C 7409-3	5K Linear 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	A10266-8211	820
R109	R209	A10266-6801	68
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	A10266-5141	510K
R116	R216	A10266-2751	2.7M
R117	R217	A10266-4731	47K
R118	R218	A10266-2711	270
R119	R219	A10266-3911	390
R120	R220	A10266-2711	270
R121	R221	C 5062-2	100K Pot (-ODEP)
R122	R222	A10266-2741	270K
R123	R223	A10266-2032	20K .5W
R124	R224	A10266-6821	6.8K
R125	R225	C 7782-3	100 Flame Proof
R126	R226	C 7782-3	100 Flame Proof
R127	R227	A10266-6821	6.8K

## Q43044-9 Main Module (D 7993-5 board) Parts List

R183	R283	A10266-2421	2.4K	<b>Switches</b>	S2	OPEN	
R184	R284	A10266-4741	470K		S3	C 7960-5	Sensitivity
R185	R285	A10266-2421	2.4K		S4	C 6781-6	Switch, Stereo/Mono
R186	R286	A10266-2751	2.7M				
R187	R287	A10266-3631	36K				
R188	R288	A10266-3631	36K				
R189	R289	A10266-2731	27K				
R190	R290	A10266-2051	2M				
R191	R291	A10266-3331	33K				
R192	R292	A10266-1031	10K				
R193	R293	A10266-1031	10K				
R194	R294	A10266-1041	100K				
R195	R295	A10266-3021	3K				
R196	R296	A10266-4721	4.7K				
R197	R297	A10266-1031	10K				
R198	R298	A10266-4721	4.7K				
R199	R299	A10266-1031	10K				
R906	R1006	OPEN					
R907	R1007	OPEN					
R908	R1008	OPEN					
R909	R1009	A10266-4741	470K				
R910	R1010	A10266-4741	470K				
R911	R1011	A10266-1521	1.5K				
R912	R1012	A10266-4711	470				
R913	R1013	A10266-1051	1M				
R914	R1014	A10266-1051	1M				
R915	R1015	A10266-2201	22				
R916	R1016	A10266-2201	22				
R917	R1017	A10265-10021	10K 1%				
R918	R1018	A10265-10021	10K 1%				
R919	R1019	A10265-10021	10K 1%				
R920	R1020	A10265-10021	10K 1%				
R921	R1021	C 9079-2	200 Pot (CMR Null)				
				<b>IC's</b>			
				U1	C 5095-2	UA7815	
				U2	C 5096-0	UA7915	
				U100	U200	C 6911-9	UPA75
				U101	U201	C 4345-2	LM339
				U102	U202	C 4345-2	LM339
				U103	U203	C 6910-1	UPA76
				U104	U204	C 7558-7	MC33079P
				<b>Misc.</b>			
				Board	D 7993-5		
				Socket	C 3450-1		14 Pin (Qty 6)
				Nut	A10102-5		Hex 6-32 (Qty 2)
				Heatsink	C 5341-0		TO-220 (Qty 2)
				Torq Spreader	C 6541-4		(Qty 2)
				Washer	A10096-5		#6, Split (Qty 2)
				Screw	A10240-0608		Stainless (Qty 2)
				J1	C 7593-4		5 Pin Header
				J2	C 4508-5		16 Pin Socket
				J11	C 7526-4		3 Pin Header
				J100	J200	OPEN	
				J500	J800	D 6619-7	10 Inch Ribbon
				J600	J700	D 6620-5	6 Inch Ribbon
				Cable Tie	C 1811-6		(Qty 4)

## Q43128-0 Main Module (D8283-0 board) Parts List

### Capacitors

C1	C 4303-1	1000 $\mu$ F
C2	C 3913-8	470 $\mu$ F
C4	C 6802-0	.47 $\mu$ F
C5	A10124-24	Jumper Wire
C6	A10124-24	Jumper Wire
C7	C 8897-8	.1 $\mu$ F
C100	C200 C 5311-3	22 $\mu$ F
C101	C201 C 9464-6	10pF
C103	C203 C 6805-3	.022 $\mu$ F
C104	C204 C 6805-3	.022 $\mu$ F
C105	C205 C 6812-9	47pF
C106	C206 C 6812-9	47pF
C107	C207 C 8897-8	.1 $\mu$ F
C108	C208 C 6814-5	12pF
C109	C209 C 7417-6	.0033 $\mu$ F
C110	C210 C 5362-6	2.2 $\mu$ F
C111	C211 C 8897-8	.1 $\mu$ F
C112	C212 C 8991-9	.47 $\mu$ F
C113	C213 C 8987-7	22 $\mu$ F
C114	C214 C 8854-9	100 $\mu$ F
C115	C215 C 8854-9	100 $\mu$ F
C116	C216 C 8987-7	22 $\mu$ F
C117	C217 C 8991-9	.47 $\mu$ F
C118	C218 C 6814-5	12pF
C119	C219 C 6802-0	.47 $\mu$ F
C120	C220 C 8897-8	.1 $\mu$ F
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	.022 $\mu$ F
C135	C235 C 6805-3	.022 $\mu$ F
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	100 $\mu$ F
C145	C245 C 6812-9	47pF
C146	C246 C 6812-9	47pF
C147	C247 C 6806-1	.01 $\mu$ F
C148	C248 C 6810-3	180pF
C149	C249 C 6808-7	470pF
C150	C250 C 6806-1	.01 $\mu$ F
C151	C251 C 6806-1	.01 $\mu$ F
C152	C252 C 6950-7	82pF 5%
C153	C253 C 8897-8	.1 $\mu$ F
C154	C254 C 8426-6	.1 $\mu$ F 250V

C155	C255	C 8897-8	.1 $\mu$ F
C156	C256	C 8897-8	.1 $\mu$ F
C157	C257	C 6806-1	.01 $\mu$ F
C158	C258	C 6807-9	.001 $\mu$ F
C159	C259	C 6807-9	.001 $\mu$ F
C160	C260	C 6811-1	100pF
C161	C261	C 6811-1	100pF

### 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
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
D114	D214	C 3181-2	1N4148
D115	D215	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

### Transistors

Q100	Q200	D 2961-7	NPN 2N3859A
Q101	Q201	C 3578-9	PNP MPSA93
Q102	Q202	C 3810-6	NPN MPSA43
Q103	Q203	C 3786-8	PNP PN4250
Q105	Q205	C 3578-9	PNP MPSA93
Q106	Q206	C 3625-8	NPN 2N4125
Q107	Q207	C 3786-8	PNP PN4250
Q108	Q208	C 5891-4	NPN MTS105
Q109	Q209	D 2961-7	NPN 2N3859A
Q110	Q210	C 3810-6	NPN MPSA43
Q112	Q212	C 3625-8	NPN 2N4125

## ***Q43128-0 Main Module (D8283-0 board) Parts List***

Q113	Q213	C 3625-8	NPN 2N4125	R126	R226	C 7782-3	100 Flame Proof
Q115	Q215	D 2962-5	NPN MPS8097	R127	R227	A10266-6821	6.8K
Q116	Q216	C 3786-8	PNP PN4250	R128	R228	A10266-1331	13K
Q117	Q217	D 2961-7	NPN 2N3859A	R129	R229	A10266-1041	100K
Q118	Q218	D 2961-7	NPN 2N3859A	R130	R230	A10266-1041	100K
Q119	Q219	C 3625-8	NPN 2N4125	R131	R231	A10266-1331	13K
Q120	Q220	C 3625-8	NPN 2N4125	R132	R232	C 5062-2	100K Pot (+ODEP)
Q121	Q221	C 7458-0	NPN 2N4123	R133	R233	A10266-2741	270K
Q122	Q222	C 7458-0	NPN 2N4123	R134	R234	A10266-2032	20K .5W
Q123	Q223	C 7458-0	NPN 2N4123	R135	R235	C 7782-3	100 Flame Proof
Q124	Q224	C 3625-8	NPN 2N4125	R136	R236	A10266-6821	6.8K
Q125	Q225	C 3786-8	PNP PN4250A	R137	R237	C 7782-3	100 Flame Proof
Q126	Q226	C 5891-4	NPN MTS105	R138	R238	A10266-6821	6.8K
				R139	R239	A10266-8211	820
				R140	R240	A10266-5601	56
				R141	R241	A10266-1541	150K
				R142	R242	A10266-1541	150K
				R143	R243	A10266-1041	100K
				R144	R244	A10266-1041	100K
				R145	R245	A10266-2251	2.2M
				R146	R246	A10266-1031	10K
				R147	R247	C 7781-5	200 .5W Flame Proof
				R148	R248	A10266-2721	2.7K
				R149	R249	C 7781-5	200 .5W Flame Proof
				R150	R250	A10266-2721	2.7K
				R151	R251	A10266-1031	10K
				R152	R252	A10265-11821	11.8K 1%
				R153	R253	JUMPER	A10124-24
				R154	R254	C 8261-7	121K 0.1%
				R155	R255	A10266-1321	1.3K
				R156	R256	A10266-1321	1.3K
				R157	R257	A10266-1321	1.3K
				R158	R258	A10265-11521	11.5K 1%
				R159	R259	A10266-1021	1K
				R160	R260	C 8260-9	10K 0.1%
				R161	R261	A10266-4701	47
				R162	R262	A10266-4701	47
				R163	R263	C 8261-7	121K 0.1%
				R164	R264	C 8260-9	10K 0.1%
				R165	R265	C 8261-7	121K 0.1%
				R166	R266	A10266-2251	2.2M
				R167	R267	A10265-10011	1K 1%
				R168	R268	A10265-10011	1K 1%
				R170	R270	A10265-10011	1K 1%
				R171	R271	A10265-10011	1K 1%
				R173	R273	C 8260-9	10K 0.1%
				R174	R274	A10265-24921	24.9K 1%
				R175	R275	A10265-28721	28.7K 1%
				R176	R276	A10265-24921	24.9K 1%
				R177	R277	A10265-69811	6.98K 1%
				R179	R279	A10266-1321	1.3K
				R180	R280	A10266-4711	470

### **Resistors**

R1		A10265-53621	53.6K 1%
R2		OPEN	
R3		OPEN	
R4		A10265-46421	46.4K 1%
R7		A10266-1041	100K
R8		A10266-2031	20K
R9		A10266-5121	5.1K
R10		OPEN	
R16		A10266-5121	5.1K
R17		A10266-2031	20K
R18		A10266-1041	100K
R100	R200	C 7409-3	5K Linear 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	A10266-8211	820
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	A10266-5141	510K
R116	R216	A10266-2751	2.7M
R117	R217	A10266-4731	47K
R118	R218	A10265-27401	274 1%
R119	R219	A10265-66501	665 1%
R120	R220	A10265-28701	287 1%
R121	R221	C 5062-2	100K Pot (-ODEP)
R122	R222	A10266-2741	270K
R123	R223	A10266-2032	20K .5W
R124	R224	A10266-6821	6.8K
R125	R225	C 7782-3	100 Flame Proof

## Q43128-0 Main Module (D8283-0 board) Parts List

R181	R281	A10266-4721	4.7K				
R182	R282	A10266-2201	22				
R183	R283	A10266-2421	2.4K				
R184	R284	A10266-4741	470K				
R185	R285	A10266-2421	2.4K				
R186	R286	A10266-2751	2.7M				
R187	R287	A10266-3631	36K				
R188	R288	A10266-3631	36K				
R189	R289	A10266-2731	27K				
R190	R290	A10266-2051	2M				
R191	R291	A10266-3331	33K				
R192	R292	A10266-1031	10K				
R193	R293	A10266-1031	10K				
R194	R294	A10266-1041	100K				
R195	R295	A10266-3021	3K				
R196	R296	A10266-4721	4.7K				
R197	R297	A10266-1031	10K				
R198	R298	A10266-4721	4.7K				
R199	R299	A10266-1031	10K				
R906	R1006	OPEN					
R907	R1007	OPEN					
R908	R1008	OPEN					
R909	R1009	A10266-4741	470K				
R910	R1010	A10266-4741	470K				
R911	R1011	A10266-1521	1.5K				
R912	R1012	A10266-4711	470				
R913	R1013	A10266-1051	1M				
R914	R1014	A10266-1051	1M				
R915	R1015	A10266-2201	22				
R916	R1016	A10266-2201	22				
R917	R1017	A10265-10021	10K 1%				
R918	R1018	A10265-10021	10K 1%				
R919	R1019	A10265-10021	10K 1%				
R920	R1020	A10265-10021	10K 1%				
R921	R1021	C 9079-2	200 Pot (CMR Null)				
R922	R1022	A10265-66501	665 1%				
R923	R1023	A10265-35711	3.57K 1%				
R924	R1024	A10265-66501	665 1%				
R925	R1025	A10265-10031	100K 1%				
R926	R1026	A10265-66501	665 1%				
R927	R1027	A10265-10031	100K 1%				
R928	R1028	A10265-35711	3.57K 1%				
R929	R1029	A10266-1041	100K				
R930	R1030	A10266-1041	100K				
<b>Resistor Networks</b>							
N101	N201	D 7945-5	Resistor Network				
N102	N202	D 6082-8	Resistor Network				
				<b>Switches</b>			
				S2	OPEN		
				S3	C 7960-5	Sensitivity	
				S4	C 6781-6	Switch, Stereo/Mono	
				<b>Integrated Circuits</b>			
				U1	C 5095-2	UA7815	
				U2	C 5096-0	UA7915	
				U100	U200	C 6911-9	UPA75
				U101	U201	C 4345-2	LM339
				U102	U202	C 4345-2	LM339
				U103	U203	C 6910-1	UPA76
				U104	U204	C 7558-7	MC33079P
				<b>Misc.</b>			
				Board	D 8283-0		
				Socket	C 3450-1	14 Pin (Qty 6)	
				Nut	A10102-5	Hex 6-32 (Qty 2)	
				Heatsink	C 5341-0	TO-220 (Qty 2)	
				Tq Spreader	C 6541-4	(Qty 2)	
				Washer	A10096-5	#6, Split (Qty 2)	
				Screw	A10240-0608	Stainless (Qty 2)	
				J1	C 7593-4	5 Pin Header	
				J2	C 4508-5	16 Pin Socket	
				J11	C 7526-4	3 Pin Header	
				J100	J200	OPEN	
				J500	J800	D 6619-7	10 Inch Ribbon
				J600	J700	D 6620-5	6 Inch Ribbon
				Cable Tie	C 1811-6	(Qty 4)	
				TP 1	C 9450-5	Header, 6 pin RT Ang	
				Spacer	C 9225-1	Plastic Spcr (Qty 5)	



## Q43237-9 Main Module (D 8369-7 board) Parts List

### Capacitors

C1	C 9859-7	1000μF
C2	C 9859-7	1000μF
C4	C 6802-0	.47μF
C5	A10124-24	Jumper Wire
C6	A10124-24	Jumper Wire
C7	C 8897-8	.1μF
C100	C200 C 5311-3	22μF
C101	C201 C 9464-6	10pF
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 7417-6	.0033μF
C110	C210 C 5362-6	2.2μF
C111	C211 C 8897-8	.1μF
C112	C212 C 8991-9	.47μF
C113	C213 C 8987-7	22μF
C114	C214 C 8854-9	100μF
C115	C215 C 8854-9	100μF
C116	C216 C 8987-7	22μF
C117	C217 C 8991-9	.47μF
C118	C218 C 6814-5	12pF
C119	C219 C 6802-0	.47μF
C120	C220 C 8897-8	.1μF
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
C157	C257	C 6806-1	.01μF
C158	C258	C 6805-3	.022μF
C159	C259	C 6805-3	.022μF
C160	C260	C 6811-1	100pF
C161	C261	C 6811-1	100pF

### 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
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
D114	D214	C 3181-2	1N4148
D115	D215	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

### Transistors

Q100	Q200	D 2961-7	NPN 2N3859A
Q101	Q201	C 3578-9	PNP MPSA93
Q102	Q202	C 3810-6	NPN MPSA43
Q103	Q203	C 3786-8	PNP PN4250
Q105	Q205	C 3578-9	PNP MPSA93
Q106	Q206	C 3625-8	NPN 2N4125
Q107	Q207	C 3786-8	PNP PN4250
Q108	Q208	C 5891-4	NPN MTS105
Q109	Q209	D 2961-7	NPN 2N3859A
Q110	Q210	C 3810-6	NPN MPSA43
Q112	Q212	C 3625-8	NPN 2N4125

## Q43237-9 Main Module (D 8369-7 board) Parts List

Q113	Q213	C 3625-8	NPN 2N4125	R126	R226	C 8836-6	100 .5W Flame Proof
Q115	Q215	D 2962-5	NPN MPS8097	R127	R227	A10266-6821	6.8K
Q116	Q216	C 3786-8	PNP PN4250	R128	R228	A10266-1331	13K
Q117	Q217	D 2961-7	NPN 2N3859A	R129	R229	A10266-1041	100K
Q118	Q218	D 2961-7	NPN 2N3859A	R130	R230	A10266-1041	100K
Q119	Q219	C 3625-8	NPN 2N4125	R131	R231	A10266-1331	13K
Q120	Q220	C 3625-8	NPN 2N4125	R132	R232	C 5062-2	100K Pot (+ODEP)
Q121	Q221	C 7458-0	NPN 2N4123	R133	R233	A10266-2741	270K
Q122	Q222	C 7458-0	NPN 2N4123	R134	R234	A10266-2032	20K .5W
Q123	Q223	C 7458-0	NPN 2N4123	R135	R235	C 8836-6	100 .5W Flame Proof
Q124	Q224	C 3625-8	NPN 2N4125	R136	R236	A10266-6821	6.8K
Q125	Q225	C 3786-8	PNP PN4250A	R137	R237	C 8836-6	100 .5W Flame Proof
Q126	Q226	C 5891-4	NPN MTS105	R138	R238	A10266-6821	6.8K
				R139	R239	A10266-8211	820
				R140	R240	A10266-5601	56
				R141	R241	A10266-1541	150K
				R142	R242	A10266-1541	150K
				R143	R243	A10266-1041	100K
				R144	R244	A10266-1041	100K
				R145	R245	A10266-3351	3.3M
				R146	R246	A10266-1031	10K
				R147	R247	C 7781-5	200 .5W Flame Proof
				R148	R248	A10266-2721	2.7K
				R149	R249	C 7781-5	200 .5W Flame Proof
				R150	R250	A10266-2721	2.7K
				R151	R251	A10266-1031	10K
				R152	R252	A10265-11821	11.8K 1%
				R153	R253	JUMPER	A10124-24
				R154	R254	C 8261-7	121K 0.1%
				R155	R255	A10266-1321	1.3K
				R156	R256	A10266-1321	1.3K
				R157	R257	A10266-1321	1.3K
				R158	R258	A10265-11521	11.5K 1%
				R159	R259	A10266-1021	1K
				R160	R260	C 8260-9	10K 0.1%
				R161	R261	A10266-4701	47
				R162	R262	A10266-4701	47
				R163	R263	C 8261-7	121K 0.1%
				R164	R264	C 8260-9	10K 0.1%
				R165	R265	C 8261-7	121K 0.1%
				R166	R266	A10266-3351	3.3M
				R167	R267	A10265-10011	1K 1%
				R168	R268	A10265-10011	1K 1%
				R170	R270	A10265-10011	1K 1%
				R171	R271	A10265-10011	1K 1%
				R173	R273	C 8260-9	10K 0.1%
				R174	R274	A10265-24921	24.9K 1%
				R175	R275	A10265-28721	28.7K 1%
				R176	R276	A10265-24921	24.9K 1%
				R177	R277	A10265-69811	6.98K 1%
				R178	R278	A10266-2021	2K
				R179	R279	A10266-1321	1.3K

### Resistors

R1		A10265-53621	53.6K 1%
R2		OPEN	
R3		OPEN	
R4		A10265-46421	46.4K 1%
R7		A10266-1041	100K
R8		A10266-2031	20K
R9		A10266-5121	5.1K
R10		OPEN	
R16		A10266-5121	5.1K
R17		A10266-2031	20K
R18		A10266-1041	100K
R100	R200	C 9785-4	5K Linear W/21 Det.
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	A10266-8211	820
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	A10266-3641	360K
R116	R216	A10266-2751	2.7M
R117	R217	A10266-4731	47K
R118	R218	A10265-27401	274 1%
R119	R219	A10265-66501	665 1%
R120	R220	A10265-28701	287 1%
R121	R221	C 5062-2	100K Pot (-ODEP)
R122	R222	A10266-2741	270K
R123	R223	A10266-2032	20K .5W
R124	R224	A10266-6821	6.8K
R125	R225	C 8836-6	100 .5W Flame Proof

## **Q43237-9 Main Module (D 8369-7 board) Parts List**

R180	R280	A10266-4711	470
R181	R281	A10266-4721	4.7K
R182	R282	A10266-2201	22
R183	R283	A10266-2421	2.4K
R184	R284	A10266-4741	470K
R185	R285	A10266-2421	2.4K
R186	R286	A10266-2751	2.7M
R187	R287	A10266-3631	36K
R188	R288	A10266-3631	36K
R189	R289	A10266-2731	27K
R190	R290	A10266-2051	2M
R191	R291	A10266-1831	18K
R192	R292	A10266-6821	6.8K
R193	R293	A10266-6821	6.8K
R194	R294	A10266-1041	100K
R195	R295	A10266-3021	3K
R196	R296	A10266-4721	4.7K
R197	R297	A10266-1031	10K
R198	R298	A10266-4721	4.7K
R199	R299	A10266-1031	10K
R300	R400	A10266-1041	100K
R301	R401	A10266-1041	100K
R906	R1006	OPEN	
R907	R1007	OPEN	
R908	R1008	OPEN	
R909	R1009	A10266-4741	470K
R910	R1010	A10266-4741	470K
R911	R1011	A10266-1521	1.5K
R912	R1012	A10266-4711	470
R913	R1013	A10266-1051	1M
R914	R1014	A10266-1051	1M
R915	R1015	A10266-2201	22
R916	R1016	A10266-2201	22
R917	R1017	A10265-10021	10K 1%
R918	R1018	A10265-10021	10K 1%
R919	R1019	A10265-10021	10K 1%
R920	R1020	A10265-10021	10K 1%
R921	R1021	C 9079-2	200 Pot (CMR Null)
R922	R1022	A10265-66501	665 1%
R923	R1023	A10265-35711	3.57K 1%
R924	R1024	A10265-66501	665 1%
R925	R1025	A10265-10031	100K 1%
R926	R1026	A10265-66501	665 1%
R927	R1027	A10265-10031	100K 1%
R928	R1028	A10265-35711	3.57K 1%
R929	R1029	A10266-1041	100K
R930	R1030	A10266-1041	100K

**Resistor Networks**

N101	N201	D 7945-5	Resistor Network
N102	N202	D 6082-8	Resistor Network

**Switches**

S3		C 7960-5	Sensitivity
S4		C 6781-6	Switch, Stereo/Mono

**Integrated Circuits**

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

**Misc.**

Board		D 8369-7	
Socket		C 3450-1	14 Pin (Qty 6)
Nut		A10102-5	Hex 6-32 (Qty 2)
Heatsink		C 5341-0	TO-220 (Qty 2)
Tq Spreader		C 6541-4	(Qty 2)
Washer		A10096-5	#6, Split (Qty 2)
Screw		A10240-0608	Stainless (Qty 2)
J1		C 7593-4	5 Pin Header
J2		C 4508-5	16 Pin Socket
J11		C 7526-4	3 Pin Header
J100	J200	OPEN	
J500	J800	D 6619-7	10 Inch Ribbon
J600	J700	D 6620-5	6 Inch Ribbon
Cable Tie		C 1811-6	(Qty 4)
TP 1		C 9450-5	Header, 6 pin RT Ang
Spacer		C 9225-1	Plastic Spcr (Qty 5)