# 9303 / 9505 Installation & Operation





## PROFESSIONAL POWER AMPLIFIER

### NOTICE - IMPORTANT SAFETY INFORMATION



The lightning flash with arrowhead symbol within an equilateral triangle is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure, that may be of sufficient magnitude to constitute a risk of electric shock to persons.

The exclamation point within an equilateral triangle is intended to alert the user of the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

#### 1. READ INSTRUCTIONS

All the safety and operating instructions of your Hafler equipment should be read before power is applied to the equipment.

#### 2. RETAIN OWNER'S MANUAL

These safety and operating instructions should be retained for future reference.

#### 3. HEED WARNINGS

All warnings on the equipment and in the operating instructions are important and should be followed.

#### 4. FOLLOW INSTRUCTIONS

All operating and use instructions are important and should be followed.

#### 5. **HEAT**

The equipment should be kept away from areas of high temperature, i.e., heater vents, radiators, stoves/ovens, fireplaces, etc.

#### 6. VENTILATION

The equipment should be used in an area suitable for proper ventilation. Care should be taken not to impede airflow in and around the cabinet. Do not mount on a carpeted shelf or in a sealed enclosure. Allow for proper clearance above the equipment.

#### 7. WATER AND MOISTURE

The equipment should not be used in or around water, such as a bathtub, sink, or swimming area. Also, the equipment should not be used in areas prone to flooding, such as a basement.

#### 8. POWER SOURCES

The equipment should be connected only to a power source of the same voltage and frequency as that listed on the rear panel above the power cord entry point.

#### 9. POWER CORD PROTECTION

Power cords should be arranged so they do not interfere with the movement of objects in the room: people, fan blades, utility carts, etc. Also, care should be taken that the cord is not pinched or cut, and placed so it is not in danger of being pinched or cut, as in under a rug, around a tight corner, etc.

#### 10. POWER CORD GROUNDING

The power supply cord is of a three wire grounded type, designed to reduce the risk of electric shock sustained from a live cabinet. It is assumed to be of suitable length for most uses of the equipment. The use of extension cords and power strips is discouraged unless they are of suitable rating to deliver the required total current for safe operation of all connected equipment. Furthermore, extension cords or power strips must provide the same three wire grounded connection. It is important that the blades of the equipment's plug be able to fully insert into the mating receptacle. Never remove the round grounding pin on the plug in an attempt to mate to a two wire ungrounded receptacle: use a grounding adaptor with the grounding tab or wire suitably connected to earth ground.

#### 11. NON-USE PERIODS

During periods of extended non-use, the power cord should be unplugged from the power source.

#### 12. CLEANING

The equipment should be cleaned only as detailed in the operating instructions.

#### 13. OBJECT AND LIQUID ENTRY

Care should be taken so that objects and/or liquids, such as cleaning fluids or beverages, are not spilled into the enclosure of the equipment.

#### 14. DAMAGE REQUIRING SERVICE

Hafler equipment should be serviced by qualified service personnel when:

- A. The power supply cord or plug has been damaged, or
- B. Objects have fallen, or liquid has been spilled into the equipment, or
- C. The equipment has been exposed to rain, or
- D. The equipment does not appear to operate normally or exhibits a marked change in performance, or
- E. The equipment has been dropped, or the enclosure has been damaged.

#### 15. SERVICING

The user should not attempt to service the equipment beyond that which is described in the operating instructions. All other service should be referred to qualified service personnel.

#### 16. CARTS AND STANDS

The equipment should be used with carts or stands only of sufficient strength and stability for the use intended.

An equipment and cart combination should be moved with care. Quick stops and starts, excessive force, and uneven surfaces may cause the equipment and cart combination to topple.

## PERFORMANCE SPECIFICATIONS

#### 9303/9505

Full Power Bandwidth:	0.15Hz to 300kHz
Signal-to-Noise:	>100dB "A" Weighted
Slew Rate:	150 V/μs
CMRR:	75dB at 1kHz
Gain:	+29dB max.

#### 9303

Power Rating:	150 wpc @8 $\Omega$ , 225 wpc @ 4 $\Omega$ , 450 Watts mono @ 8 $\Omega$
Distortion:	0.07% THD 20-20Hz, Typically 0.005% THD 1kHz, at rated power into $8\Omega$
Damping Factor:	800 (to 1kHz); 80 (to 20kHz); 20 (to 100kHz) into 8 $\Omega$
Input Sensitivity Range:	1.22 Vrms for 150W into 8 $\Omega$ , 1.06Vrms for 225W into 4 $\Omega$
Dimensions:	19"W x 12-1/2"D x 3-1/2"H (excluding feet)
Weight:	36 lbs. (16.4kg)
Power Consumption:	Quiescent, 84 VA; at rated power, 612 VA (150W into $8\Omega$ , both channels driven)

#### 9505

Power Rating:	250 wpc @8 $\Omega$ , 375 wpc @ 4 $\Omega$ , 750 Watts mono @ 8 $\Omega$
Distortion:	0.1% THD 20-20Hz, Typically 0.005% THD 1kHz, at rated power into 8 $\Omega$
Damping Factor:	1000 (to 1kHz); 100 (to 20kHz); 20 (to 100kHz) into $8\Omega$
Input Sensitivity Range:	1.58 Vrms for 250W into 8 $\Omega$ , 1.37Vrms for 375W into 4 $\Omega$
Dimensions:	19"W x 12-1/2"D x 5-1/4"H (excluding feet)
Weight:	50 lbs. (22.7kg)
Power Consumption:	Quiescent, 132 VA; at rated power, 1020 VA (250W into $8\Omega$ , both channels driven)

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### NTRODUCTION

The Hafler 9303 and 9505 are two channel professional power amplifiers. Passive cooling with large heatsinks is used for low mechanical noise. Our patented **trans**•*nova* circuit topology and MOSFET output stage ensures trouble free, long term operation and is backed by our seven year warranty.

This manual contains information on using the 9303 and 9505 amplifiers. It is organized into three main sections. **"Installation**" covers the location and connection of the amplifier in the system. Like many precision components careful attention to the initial setup can yield dividends in higher performance and trouble-free use. **"Operation**" covers the controls and features of the amplifiers and how to use them to get the best effect. The **"Technical Information**" section contains information on the circuit implementation and the schematic diagram and parts list. We strongly urge reading over the Installation and Operation portions of this manual before putting the amplifier into service.

The circuitry used in the 9303 and 9505 is the latest refinement of our **trans**•*nova* (<u>TRANS</u>conductance <u>NO</u>dal <u>Voltage Amplifier</u>, US Patent 4,467,288) circuit. The 9303 and 9505 utilize our proprietary DIABLO (patent application in progress) transconductance driver stage which combines the linearity of Class A operation with the current headroom of a Class B system. When used in combination with the robust output stage used with these models, DIABLO yields lower high frequency distortion without the sonic penalties associated with increasing the negative feedback.

The 9303 and 9505 have fully differential inputs for use in balanced line systems. The balanced input terminals work with either 1/4" TRS phone or XLR plugs. Gold-plated RCA phono jacks are available for use with unbalanced source components. The output terminals are gold-plated binding posts, spaced on 3/4" centers for use with dual banana plugs. For high power applications, the amplifier can run in bridged mono for double the output voltage. Using state-of-the-art surface mount assembly equipment in our manufacturing facility ensures consistency and reliability.

### NSTALLATION

#### LOCATION

The 9303 and 9505 can produce considerable heat in normal operation so the primary consideration when determining a location for the amplifiers is to allow for adequate ventilation. The large heatsinks provide unrestricted airflow, but care must be taken to keep the slots in the bottom panel and top cover clear, as well. If the amplifier is mounted in an equipment rack, make sure adjacent equipment does not impede cool air flow through the amplifier bottom and out the top. The attached feet provide sufficient clearance for the bottom when the amplifier is resting on a hard surface. Inadequate ventilation can shorten component life, especially when other equipment raises the ambient air temperature, so a circulating fan should be considered in tight quarters. The power transformer can generate a substantial magnetic field, so caution should be exercised in the placement of low level components such as a tape deck, mixer or mic preamp to avoid inducing noise in the low level circuitry.

#### AC LINE

The 9303 and 9505 operate from a 120 volt, 60Hz AC power line. Connection is made by an IEC Type 320, grounded line cord. For safety considerations only a properly grounded (earthed) receptacle should be used. If a grounded circuit is not available do not break off the ground pin; use the proper adapter plug for a two wire receptacle. Located inside the amplifier is the line fuse which interrupts the power to the amplifier. If this fuse blows replace it only with the same type and rating fuse. The correct replacement fuse value is included in the parts list in the "Technical Information" section of this manual. If the replacement fuse blows, this is an indication of a fault with the amplifier. Servicing should be performed only by a qualified technician.

#### INPUT

The 9303 and 9505 have input jacks for both balanced and unbalanced input signals. The unbalanced inputs use conventional RCA phono jacks. When using the RCA inputs, the rear panel BALANCED/UNBALANCED switch must be set to the UNBALANCED position. The balanced input jacks are dual function connectors which accept 1/4" TRS (Rip Ring Sleeve) phone or XLR plugs. Set the BALANCED/UNBALANCED switch to the BALANCED Position to use these jacks. The connector pin-out is printed on the rear panel of the amp.

#### Balanced Input: 1/4" Tip Ring Sleeve

The 1/4" balanced input jack is connected according to conventional usage with the Tip high (+), Ring return (-) and the Sleeve ground shield.

#### **Balanced Input: XLR**

The XLR balanced input jack is connected according to the IEC International Standard, with pin 2 high (+), pin 3 return (-) and pin 1 ground shield. When preparing to use the amplifier, check the output configuration of the source unit to maintain the proper signal polarity.

#### **Unbalanced Input**

Many popular mixers use unbalanced RCA phono jacks for the monitor outputs. For short cable runs RCA audio patch cable can be used without any system performance penalty. Check the mixer specs for the maximum cable length it will drive. Make sure the BALANCED/UNBALANCED switch is set for UNBALANCED operation.

#### **Unbalanced Source with Balanced Input**

Better noise rejection for long cable runs can be achieved by using a twisted pair balanced cable from the unbalanced source. At the source end of the cable, connect an RCA plug with the return (-) wire and shield connected to the ground shell of the plug. Wire the plug at the amplifier end of the cable the same as for the regular balanced input connection.

#### **OUTPUT CONNECTIONS**

The speaker output connectors are dual binding posts. These binding posts will directly accept 12 AWG wire or banana plugs and are spaced on 3/4" centers to accept dual banana plugs.

#### **MONOPHONIC USE**

For systems with high power requirements, the amplifiers can be configured for single channel bridged mono operation. To bridge the amplifier, set the rear panel STEREO/MONO switch to the Mono position; use only the left channel input, and connect the speaker to the red output binding posts. When the amplifier is bridged, the output is floating. Any speaker which requires a common ground from the amplifier output cannot be used in this application. Since a bridged amplifier shares the load between the two channels, the amplifier will effectively drive half of the load. Therefore, for bridged mono operation we recommend using an eight ohm load as the minimum impedance.

### **O** P E R A T I O N

#### **POWER SWITCH**

The POWER switch is located on the front panel of the amplifier. An internal lamp indicates when it is turned on. Standard practice is to turn the amplifier on last and off first when switching components individually to prevent sending damaging transients, generated in the source components, to the speakers. It is possible to leave the power switch in the on position and switch the amplifier remotely through a power distribution block or preamp switched outlet. When doing so make sure the switch is rated for the current required by the amplifier.

#### BALANCED/UNBALANCED INPUT SWITCH

The BALANCED/UNBALANCED switch configures the input grounding when using the RCA phono input jacks. In the UNBALANCED position the balanced differential input return (–) port is grounded inside the amplifier. This prevents noise pickup or unstable amplifier operation caused by the open input. In the BALANCED position the differential amplifier inputs are connected to the hot (+) and (–) incoming signal connectors.

#### **GROUND SWITCH**

Ground loops are characterized by a hum or buzz in the system and are caused by a voltage potential difference between two points in a ground circuit. Ground loops are aggravated when multiple paths exist for a given circuit. Mounting components in a rack with metal rails may introduce ground loops between associated equipment, because the rails can establish an additional ground path. The CHASSIS/FLOAT switch allows you to select the amplifier grounding scheme for best system compatibility. With the switch in the CHASSIS position all signal grounds are referred to the chassis and power line ground. In the FLOAT position the signal ground is decoupled from the chassis. The position of the switch is determined by the overall noise in the system; choose the position which gives the lowest hum.

#### **MONO SWITCH**

Conventional two-channel stereo operation is obtained with the STEREO/MONO switch in the STEREO position. For high powered single channel use, set the switch to MONO and use the left channel input and the RED binding posts only for the output. For thermal considerations we do not recommend using less than an eight ohm load on the amplifier when running it in mono. When the switch is set in the mono position the left channel (+) and (-) inputs are connected to the right channel in reversed polarity, which inverts the right channel output.

#### LOAD FAULT PROTECTION

Because of the self-protecting properties and fault tolerance of the lateral MOSFETs used in the 9303 and 9505, elaborate voltage and current limiting protection schemes are not necessary. To prevent damage to the amplifier from a fault in the loudspeaker load, the power supply B+ and B– rails are fused. Check these fuses if the sound is garbled or there is no output. The fuses should not blow under normal use and a blown fuse is usually an indication of a fault. The fault could be a bad connection, a problem with the speaker or a short in the speaker line. **Disconnect power to the amplifier before removing the cover**.

#### WARM UP

In order to achieve the best sonic performance from the amplifier, we recommend letting it warm up for 1 hour before beginning any critical listening. The amplifier will not deliver its full potential sound quality before this time has passed.

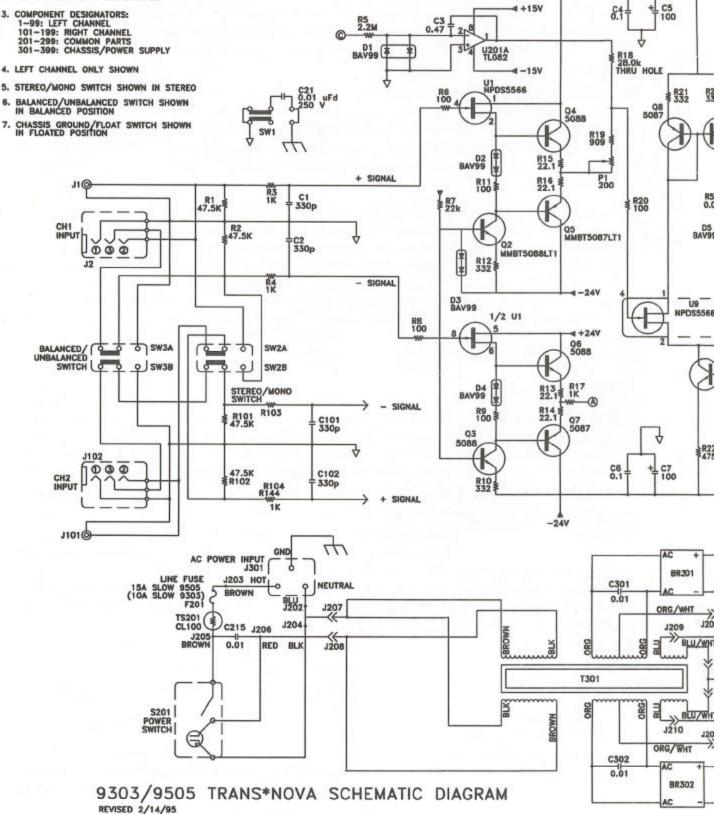
#### **CLEANING AND MAINTENANCE**

There is no requirement for regular maintenance on the electronic components of the amplifier. If the case becomes soiled it can be cleaned using a soft cloth and a mild detergent, such as spray window or glass cleaner. If the amplifier is located in a particularly dusty environment cleaning the inside with compressed air or vacuuming every 18 to 24 months is sufficient.

### SCHEMATIC DIAGRAM

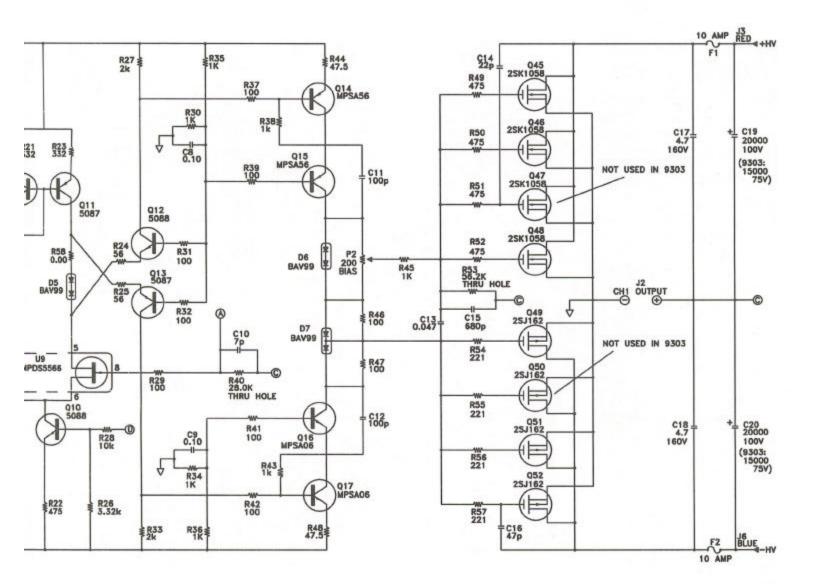
NOTES: UNLESS SPECIFIED OTHERWISE

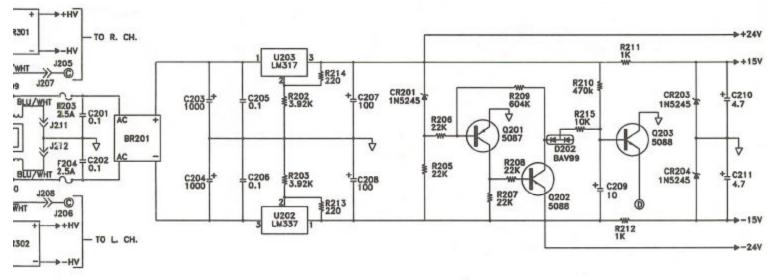
- 1. ALL RESISTORS IN OHMS
- 2. ALL CAPACITORS IN MICROFARADS
- 3. COMPONENT DESIGNATORS: 1-99: LEFT CHANNEL 101-199: RIGHT CHANNEL 201-299: COMMON PARTS 301-399: CHASSIS/POWER SUPPLY
- 4. LEFT CHANNEL ONLY SHOWN
- 5. STEREO/MONO SWITCH SHOWN IN STEREO
- 7. CHASSIS GROUND/FLOAT SWITCH SHOWN IN FLOATED POSITION



+24V #

4 +15V





- 5 -

## PC BOARD LAYOUT

## PARTS LIST

ALL HESTORS IN OMMS     P213     P201 HAW, 5%     PMM - 27C       R1, R101     7.9 K, 14W, 15%     RMA - 4752C     R214     202, 14W, 5%     RMA - 102C       R2, R103     K, 14W, 5%     RMA - 102C     P1, P101     D30, Time Part     RV1-201       R4, R104     K, 14W, 5%     RMA - 102C     P1, P101     BA/V94     S5. 2065M       R4, R104     K, 14W, 5%     RMA - 102C     P1, P101     BA/V94     S5. 2065M       R6, R104     100, 14W, 5%     RMA - 101C     D1, D101     BA/V94     S5. 2065M       R1, R101     100, 14W, 5%     RMA - 101C     D2, D103     BA/V91     S5. 2065M       R1, R111     100, 14W, 5%     RMA - 101C     D2, D105     BA/V91     S5. 2065M       R1, R111     100, 14W, 5%     RMA - 101C     D2, D105     BA/V91     S5. 2065M       R1, R111     100, 14W, 5%     RMA - 101C     D2, D106     BA/V91     S5. 2065M       R1, R111     100, 14W, 5%     RMA - 101C     D2,D 106     BA/V91     S5. 2065M       R11, R111     21,14W, 15%     RMA - 102C     <	DESIGNATOR		PART #	DESIGNATOR	VALUE	PART #
N, HOI     47 (Jb)     47 (Jb)     MM/4 4752C     R214     220, 1/4W, 3%     RM/4-103C       R3, R103     1X, 144W, 5%     RM/4-102C     P1, P101     200, 1/m Po1     RVH-201       R4, R104     1X, 144W, 5%     RM/4-102C     P1, P101     200, 1/m Po1     RVH-201       R6, R104     100, 1/4W, 5%     RM/4-101C     D2, D103     RAV94     S5, 2605M       R6, R106     100, 1/4W, 5%     RM/4-101C     D3, D103     RAV94     S5, 2605M       R8, R108     100, 1/4W, 5%     RM/4-101C     D4, D104     BAV99L     S5, 2605M       R10, R110     332, 1/4W, 1%     RM/4-320C     D5, D105     BAV99L     S5, 2605M       R11, R111     221, 1/4W, 1%     RM/4-021C     D6, D106     BAV99L     S5, 2605M       R13, R113     221, 1/4W, 1%     RM/4-021C     D20     1105/264 First     S5, 212       R14, R114     221, 1/4W, 1%     RM/4-021C     D203     1165/264 First     S5, 212       R14, R114     221, 1/4W, 1%     RM/4-021C     D203     1165/264 First     S5, 212       R14, R11	ALL RESISTORS	IN OHMS		R213	220, 1/4W, 5%	RM/4-221C
R3. R03     R1. 144W. 5%     RM44-102C     P1. P101     200. Tim Pot     RVH-201       R8. R106     2.2M. 144W. 5%     RM4-222C     P2. P00     200 Tim Pot     RVH-201       R8. R106     2.2M. 144W. 5%     RM4-223C     D1     D1     D1     BX-991     SS-2605M       R7. R107     220. 146W. 5%     RM4-122C     D2. 1102     BX-991     SS-2605M       R7. R107     220. 146W. 5%     RM4-123C     D3. D103     BX-991     SS-2605M       R10. R110     332. 144W. 1%     RM44 320C     D5. D105     BX-991     SS-2605M       R11. R111     332. 144W. 1%     RM44 320C     D7. D107     BX-991     SS-2605M       R12. R113     332. 144W. 1%     RM44 320C     D201     1MS245B 15V     SS-212       R14. R114     221. 144W. 1%     RM44 221C     D204     1MS245B 15V     SS-212       R16. R119     222. 144W. 1%     RM44 221C     D204     1MS245B 15V     SS-212       R16. R119     221. 144W. 1%     RM44 220C     U1     1MD245B 15V     SS-212       R16. R119	R1, R101	47.5k, 1/4W, 1%	RM/4-4752C			
R4, R104     R1, 144V, 556,     RM4/102C     P1, P101     200, Imm Pot     RV1-201       R5, R105     220, IMW, 556,     RV4-101C     D1, D101     BAV99L     SS-2605M       R7, R107     220, IMW, 556,     RV4-101C     D3, D103     BAV99L     SS-2605M       R8, R108     100, IAW, 556,     RV4-101C     D3, D103     BAV99L     SS-2605M       R11, R111     100, IAW, 556,     RV4-101C     D4, D104     BAV99L     SS-2605M       R11, R111     100, IAW, 556,     RV4-101C     D5, D105     BAV99L     SS-2605M       R11, R111     221, IAW, 156,     RV4-40221C     D201     INS/MB H5W     SS-212       R15, R115     221, IAW, 156,     RV4-4021C     D203     INS/A58 H5W     SS-212       R17, R117     R1, AW, 156,     RV4-4021C     D203     INS/A58 H5W     SS-212       R17, R117     R1, AW, 156,     RV4-4021C     D203     INS/A58 H5W     SS-212       R17, R117     R1, AW, 156,     RV4-4021C     D201     INS/A58 H5W     SS-212       R17, R117     R1, AW, 156,	R2, R102	47.5k, 1/4W, 1%	RM/4-4752C	R215	10k, 1/4W, 5%	RM/4-103C
Strictic     2.201, 1744, 758,     BMA4 225C     P2, P202     200, 11m, Pot     RVH-201       R7, P107     22k, 1744, 758,     RMA4-233C     D1, D1     BAV99L     S5-2605M       R7, P107     22k, 1744, 758,     RMA4-233C     D2, D102     BAV99L     S5-2605M       R9, P109     100, 1744, 758,     RMA4-101C     D3, D103     BAV99L     S5-2605M       R17, P117     100, 1744, 758,     RMA4-101C     D4, D104     BAV99L     S5-2605M       R17, P117     100, 1744, 758,     RMA4-101C     D6, D106     BAV99L     S5-2605M       R17, P117     P14, P104     R44-201     D201     116229H     S5-272       R14, R14     221, 17444, 158,     RMA4-202     D201     116229H     S5-212       R16, R16     221, 17444, 158,     RMA4-202     D204     116249H     S5-212       R16, R16     221, 17444, 158,     RMA4-202     D204     116249H     S5-212       R17, R171     R144, 174, 178,     RMA4-202     D204     116539H     S5-212       R17, R171     R144, 178, 1744, 178, 178, 17		1k, 1/4W, 5%	RM/4-102C	D1 D101	200 Trim Dat	
No.     Construction     Distance     Distance     Distance     Section       No.     Total     Total     Total     Total     Section     Section     Section       NS, H108     Total     Total     Total     Total     Section     Section     Section       NS, H108     Total     Total     Total     Section     Section     Section     Section       NS, H108     Total     Total     No.     No.     Section     Section       NS, H108     Total     No.     No.     No.     Section     Section       NS, H118     Total     No.     No.     No.     Section     Section       NS, H118     Total     No.     No.     No.     Section     Section       NS, H118     Total     No.     No.     No.     Section     Section       NS, H117     No.     No.     No.     No.     No.     Section       NS, H118     Total     No.     No.     No.     No.     Se						
R7, R107     22k, 144W, 5%     RM44 223C     D2     D102     RAV961     S5 2605M       R8, R109     100, 144W, 5%     RM44 101C     D4, D104     BAV991     S5 2605M       R11, R111     100, 144W, 5%     RM44 101C     D4, D104     BAV991     S5 2605M       R11, R111     100, 144W, 5%     RM44 101C     D6, D105     BAV991     S5 2605M       R11, R111     100, 144W, 5%     RM44 2021C     D2     D107     BAV91L     S5 2605M       R11, R112     221, 114W, 1%     RM44 0221C     D201     1N52456 15Y     S5 212       R16, R116     221, 114W, 1%     RM44 0221C     D203     1N32456 15Y     S5 212       R16, R116     221, 114W, 1%     RM44 0221C     D204     1N32456 15Y     S5 212       R16, R118     224, 114W, 1%     RM44 0221C     D204     1N32456 15Y     S5 212       R18, R118     284, 114W, 1%     RM44 2802 03     U1, U101     NPD55566     S5 0865       R20, R122     14W, 1%     RM44 320C     C101     330p+ 500V     CN-331-024       R21, R122 <td></td> <td></td> <td></td> <td>PZ, PZUZ</td> <td>200 11111 POL</td> <td>KVH-201</td>				PZ, PZUZ	200 11111 POL	KVH-201
R8, R109     100, 14W, 5%     RM4 101C     D3, D103     BAV901     SS-2605M       R10, R110     332, 14W, 1%     RM443320C     D14     BAV901     SS-2605M       R11, R111     332, 14W, 1%     RM443320C     D5, D105     BAV901     SS-2605M       R11, R111     332, 14W, 1%     RM44320C     D7, D107     BAV901     SS-2605M       R13, R113     221, 14W, 1%     RM440221C     D202     BAV901     SS-2605M       R14, R114     221, 14W, 1%     RM440221C     D202     BAV901     SS-2605M       R17, R117     21, 14W, 1%     RM440221C     D202     BAV901     SS-2605M       R17, R117     24, 14W, 1%     RM440221C     D204     1N5245B 15V     SS-212       R17, R117     24, 14W, 1%     RM440221C     U204     1N5245B 15V     SS-212       R17, R117     24, 14W, 1%     RM44021C     U201     1N5245B 15V     SS-212       R17, R117     32, 14W, 1%     RM44320C     U201     1N5245B 15V     SS-240.56       R14W, 1%     RM443320C     C1, C101     330				D1, D101	BAV99L	SS-260SM
PP, R109     100, 14W, 5%     RMM-101C     D4, D103     EAV991     S5-265M       R11, R111     100, 14W, 5%     RMM-101C     D4, D105     BAV991     S5-265M       R11, R111     100, 14W, 5%     RMM-402C     D5, D105     BAV991     S5-265M       R13, R13     221, 114W, 15%     RMM-40221C     D201     1N5/2481 15V     S5-212       R16, R115     221, 114W, 15%     RMM-40221C     D203     1N5/2481 15V     S5-212       R17, R117     15, 14W, 15%     RMM-40221C     D203     1N5/2481 15V     S5-212       R17, R117     15, 14W, 15%     RMM-40221C     D204     1N5/2481 15V     S5-212       R17, R117     15, 14W, 15%     RMM-4021C     D201     1N5/2481 15V     S5-212       R17, R117     15, 14W, 15%     RMM-4021C     D201     1N5/2586     S5.9665       R19, R119     901, 14W, 15%     RMM-4021C     D201     1N5/275     S5.40.056       R18, R118     23, 14W, 15%     RMM-402C     C1, C101     3007, 500V     CM-31.024       R28, R22     33, 21, 44W, 15%						
R10.     R10.     R10.     R10.     S2. 2693M       R11.     R111     R111     R112.     R12.     R14.						
R11.						
R12     R112     S32.14W, 1%     RM4-920C     D7     D107     BAV99L     S5.2405M       R14, R114     22.1, 14W, 1%     RM4-021C     D201     115245B 15V     S5.212       R14, R114     22.1, 14W, 1%     RM4-021C     D203     115245B 15V     S5.212       R16, R116     22.1, 14W, 1%     RM4-021C     D204     115245B 15V     S5.212       R18, R118     281, 14W, 1%     RM4-021C     D204     115245B 15V     S5.212       R18, R118     281, 14W, 1%     RM4-0900C     U.9     U.109     NPD55566     S5.0865       R20, R120     100, 14W, 1%     RM4-3300C     L201     TU72CD     S1.435M       R21, R121     352, 14W, 1%     RM4-4300C     L202     LM337     S2.40.056       R22, R122     475, 14W, 1%     RM4-4300C     C1, C101     330pF, 500V     CM-331.024       R23, R123     S2, 14W, 1%     RM4-4300C     C4, C104     0.14F, 50V     CY-474       R24, R124     56, 14W, 5%     RM4-430C     C4, C104     0.14F, 50V     CY-474       R24, R124 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>						
R13, R113   22.1, 14W, 1%   RM4-0221C   D201   THS 24B Flay   SS 212     R15, R115   22.1, 14W, 1%   RM4-0221C   D202   BAV99L   SS 2605M     R15, R115   22.1, 14W, 1%   RM4-0221C   D203   THS 24B Flay   SS 212     R17, R117   IL, 14W, 1%   RM4-022C   D204   THS 24B Flay   SS 212     R17, R117   IL, 14W, 1%   RM4-102C   D204   THS 24B Flay   SS 240-056     R18, R118   D00, 14W, 1%   RM4-400C   U011   U101   NPD55566   SS-0865     R18, R118   D33, TMW, 1%   RM4-400C   U201   IU072CD   SS-1435M     R21, R121   332, 14W, 1%   RM4-430C   U203   LM317   SS-240-056     R22, R122   A134W, 1%   RM4-430C   C 100   J30F, FSOV   C/W-313, O24     R24, R124   S6-14W, 5%   RM4-430C   C 300, FSOV   C/W-313, O24     R24, R124   S6-14W, 5%   RM4-430C   C 30, O13   O 47µF, SOV   C/W-140-024     R25, R125   S6-14W, 5%   RM4-402C   C 5, C 105   T00µF, SOV   C/W-140-024     R27, R127	,					
R14, R114     22.1, 144W, 1%     RMM-0221C     DD202     PAV90,     SS-205SM       R15, R115     22.1, 144W, 1%     RMM-0221C     DD204     1N5245B 15V     SS-212       R16, R116     22.1, 144W, 1%     RMM-0221C     D204     1N5245B 15V     SS-212       R16, R118     28.1, 144W, 1%     RMM-4020C     LJ     UI     UI     NPDSS566     SS-0866       R18, R118     28.1, 144W, 1%     RMM-4000C     LJ     UI     UI     NPDSS566     SS-08665       R20, R120     100, 144W, 1%     RMM-4000C     LJ     UI     UI     NPDSS566     SS-08665       R21, R121     332, 144W, 1%     RMM-4320C     CL     CI     UI     SS-240.056       R22, R122     475, 144W, 1%     RMM-4320C     CL     CI     CI     UI     SS-240.056       R24, R124     56, 174W, 1%     RMM-4520C     CL     CI     CI     CI     CI     MAIA     SS-240.056     CS-0800     CW-444     CI     CI     CI     CI     CI     CI     CI     CI						
R15. R115   22.1, 14W, 1%   RM4-0221C   D203   11N5245B 15V   SS.212     R17. R117   IK, 14W, 1%   RM4-022C   D204   11N5245B 15V   SS.212     R17. R118   R18. R118   Z2.1, 14W, 1%   RM4-022C   U1, U101   NPDS566   SS.0865     R19. R119   000, 14W, 1%   RM4-090C   U9, U109   NPDS566   SS.0465     R21. R121   332, 14W, 1%   RM4-320C   U203   LM317   SS.240-056     R23. R123   332, 14W, 1%   RM4-4320C   Cl.101   330pF, 500V   CM-331-024     R25. R125   56, 14W, 5%   RM4-450C   C.2, C102   330pF, 500V   CW-471     R24. R124   S32L, 14W, 1%   RM4-450C   C.2, C103   0.44, 50V   CYV-474     R26. R125   56, 14W, 5%   RM4-450C   C.2, C103   0.04, 50V   CVV-14-024     R28. R128   100, 14W, 5%   RM4-450C   C.2, C102   330pF, 50V   CVV-14-024     R27. R128   20, 14W, 5%   RM4-102C   C6, C106   0.14, 50V   CVV-14-024     R28. R129   100, 14W, 5%   RM4-102C   C10, C110   70P, 50V   CVV-14-024						
R16, R116 22,1,14W,1% RM/4-02C D204 1N52458 15V SS-212   R17, R117 R17, R117 N17, N174 RM/4-102C U1,U101 NPDSS566 SS-0865   R18, R118 28k,1/4W,1% RM/4-202C U201 TL072CD SS-1435M   R12, R121 332,1/4W,1% RM/4-320C U202 LM337 SS-240-056   R22, R122 332,1/4W,1% RM/4-4750C U203 LM317 SS-240-056   R23, R123 332,1/4W,1% RM/4-4750C C1023 LM317 SS-240-056   R24, R124 56,1/4W,5% RM/4-560C C3, C103 0.47µ; 500 CVV-474   R25, R125 50,1/4W,5% RM/4-322C C3, C103 0.47µ; 500 CVV-474   R26, R126 332k,1/4W,1% RM/4-302C C3, C103 0.47µ; 500 CVV-104-024   R28, R128 100,1/4W,5% RM/4-101C C7, C107 100µ; 500 CVV-104-024   R38, R130 1k, 14W, 5% RM/4-101C C7, C107 100µ; 500 CVV-104-024   R38, R131 100,1/4W, 5% RM/4-102C C3, C113 0.1µ; 500 CVV-104-024   R38, R131 1k, 14W, 5% RM/4-102C C11, C111 100p; 500V CM-070-024   R38, R133 1k, 14W,	R15, R115	22.1, 1/4W, 1%	RM/4-0221C			
R17, R117   1k, 14W, 5%   RM4-102C   U1, U101   NPD55566   SS-0865     R19, R119   909, 14W, 1%   RM4-9090C   U9, U109   NPD55566   SS-0865     R21, R121   332, 14W, 1%   RM4-3020C   U201   LM317   SS-240-056     R22, R122   732, 14W, 1%   RM4-4320C   U203   LM317   SS-240-056     R22, R122   A51, 14W, 1%   RM4-4320C   C1, C101   330p1; 500V   CM-331-024     R24, R124   S5, 14W, 5%   RM4-450C   C2, C102   330p1; 500V   CV-431     R25, R125   S6, 14W, 5%   RM4-450C   C3, C103   0.4 juf; 50V   CY-474     R28, R128   No, 14W, 5%   RM4-450C   C3, C103   0.4 juf; 50V   CY-474     R28, R128   No, 14W, 5%   RM4-102C   C3, C105   104juf; 50V   CY+140-024     R29, R129   No, 14W, 5%   RM4-101C   C6, C106   0.1 juf; 50V   CY+104-024     R31, R131   N0, 14W, 5%   RM4-102C   C10, C110   7pf; 500V   CM-107-024     R32, R132   N1, 14W, 5%   RM4-102C   C10, C110   7pf; 500V   CM-1024						
Pi0     Pi10     P00     Pi30     Pi10     Pi100     Pi100     Pi100     Pi100     Pi100     Pi100     Pi100     Pi100						
P20     P120     P120     P120     P120     S5:143SM       P21     P121	,					
P21, P121     332, P14W, P36     RN44-320C     U202     LM317     S5-240-056       P22, P122     475, 144W, 176     RN44-350C     U203     LM317     S5-240-056       P23, P123     332, 144W, 176     RN44-350C     C1, C101     330pf, 500V     CM-331-024       P24, P124     56, 144W, 5%     RN44-560C     C2, C102     330pf, 500V     CW-331-024       P23, P125     56, 144W, 5%     RN44-560C     C3, C103     0.47µF, 50V     CYV-144       P24, P124     3, 2k, 144W, 5%     RN44-322C     C5, C105     100µF, 50V     CYV-144-024       P29, P129     100, 144W, 5%     RN44-101C     C7, C107     100µF, 50V     CYV-144-024       R30, R130     1k, 144W, 5%     RN44-101C     C9, C109     0.1µF, 50V     CYV-144-024       R33, R131     100, 144W, 5%     RN44-102C     C11, C111     100pF, 50V     CM-010-024       R33, R132     100, 144W, 5%     RN44-102C     C12, C112     100pF, 50V     CM-101-024       R33, R133     1k, 144W, 5%     RN44-102C     C13, C113     0.49µF, 50V     CM-410-024						
122     123     1440     136     PM4-4790C     U203     LM317     SS 240.066       123     1141     56     114W     5%     PM4-350C     C1     C1     330.pF     S00V     CM-331.024       128     P126     56     114W     5%     PM4-560C     C2     C102     330.pF     S00V     CM-331.024       128     P126     3.32, 114W, 19%     PM4-50C     C3     C103     0.47.pF     CV     CV+144       128     P127     21     14W, 15%     PM4-202C     C4     C104     0.1µF, 50V     CV+104-024       128     P129     100, 14W, 5%     PM4-101C     C7, C107     100µF, 50V     CFR-107-024       128, R133     100, 14W, 5%     PM4-101C     C9, C109     0.1µF, 50V     CV+104-024       128, R133     120, 14W, 5%     PM4-102C     C12, C11     100pF, 500V     CM-101-024       133, R13     120, 14W, 5%     PM4-102C     C12, C11     100pF, 500V     CM-101-024       133, R133     114W, 5%     PM4-102C						
R23, R123     312, 144W, 1%     RM4-560C     C1, C101     330pF, 500V     CM-331-024       R24, R124     56, 144W, 5%     RM4-560C     C2, C102     330pF, 500V     CM-331-024       R26, R125     56, 114W, 5%     RM4-350C     C3, C103     0.47µF, 50V     CYV-474       R27, R127     2k, 114W, 5%     RM4-302C     C4, C104     0.1µF, 50V     CYV-104-024       R28, R128     106, 114W, 5%     RM4-103C     C5, C105     100µF, 50V     CYV-104-024       R30, R130     1k, 114W, 5%     RM4-101C     C7, C10     100µF, 50V     CYV-104-024       R31, R131     100, 114W, 5%     RM4-101C     C9, C109     0.1µF, 50V     CYV-104-024       R33, R132     100, 114W, 5%     RM4-101C     C10, C110     T00pF, 500V     CM-70-024       R34, R134     1k, 114W, 5%     RM4-102C     C112, C111     100pF, 500V     CM-101-024       R38, R133     1k, 114W, 5%     RM4-102C     C13, C113     0.47µF, 50V     CYV-473-024       R38, R138     1k, 114W, 5%     RM4-101C     C15, C116     640pF, 50V     CM+681-024  <						
P24, R124     56, 1/4W, 5%     RM4-560C     C1, C101     330P; 500V     CM-331-024       P26, R125     3320, 1/4W, 1%     RM4-560C     C2, C102     330P; 1,50V     CVV-31-024       P26, R126     3320, 1/4W, 1%     RM4-320C     C4, C104     0.1 µF, 50V     CVV-104-024       P26, R127     2k, 1/4W, 5%     RM4-202C     C4, C104     0.1 µF, 50V     CVV-104-024       R29, R129     100, 1/4W, 5%     RM4-103C     C6, C105     0.0 µF, 50V     CVV-104-024       R30, R130     1k, 1/4W, 5%     RM4-101C     C1, C107     7µF, 50V     CVV-104-024       R31, R131     100, 1/4W, 5%     RM4-101C     C10, C110     7µF, 50V     CVV-104-024       R33, R133     2k, 1/4W, 5%     RM4-102C     C12, C112     100pF, 50V     CM-070-024       R38, R133     1k, 1/4W, 5%     RM4-102C     C12, C112     100pF, 50V     CM-101-024       R38, R133     1k, 1/4W, 5%     RM4-102C     C15, C116     680PF, 50V     CM-470-024       R38, R133     1k, 1/4W, 5%     RM4-102C     C15, C116     680PF, 50V     CM+681-024						33 240 030
P25, R125     56, 114W, 5%     RM4-560C     C2, C102     330P, 500W     CH-31-024       R26, R126     3.32k, 144W, 5%     RM4-3321C     C3, C103     0.47µF, 50V     CYV-474       R27, R127     2k, 114W, 5%     RM4-3321C     C3, C103     0.47µF, 50V     CYV-474       R28, R128     10k, 114W, 5%     RM4-103C     C5, C105     100µF, 50V     CYV-104-024       R28, R128     10b, 114W, 5%     RM4-101C     C7, C107     100µF, 50V     CYV-104-024       R38, R131     100, 114W, 5%     RM4-101C     C9, C109     0.1µF, 50V     CYV-104-024       R38, R132     100, 114W, 5%     RM4-101C     C9, C109     0.1µF, 50V     CYV-104-024       R38, R133     1k, 114W, 5%     RM4-102C     C11, C111     100pF, 500V     CM-101-024       R38, R133     1k, 114W, 5%     RM4-102C     C13, C113     0.047µF, 50V     CVV-140-024       R38, R133     1k, 114W, 5%     RM4-101C     C14, C114     22pF, 50V     CVV-473-024       R38, R133     1k, 114W, 5%     RM4-101C     C15, C115     680pF, 500V     CM-470-024					• •	
P26, R126     3.32k, 14W, 1%     RMM-3321C     C3, C104     0.4 /µr, 50V     CTV-4/4       P27, R127     2k, 14W, 5%     RMM-202C     C4, C104     0.1µr, 50V     CR:107C-024       P28, R128     10k, 14W, 5%     RMM-101C     C6, C106     0.1µr, 50V     CFX-104-024       R28, R129     100, 14W, 5%     RMM-101C     C6, C106     0.1µr, 50V     CFX-104-024       R31, R131     100, 14W, 5%     RMM-101C     C9, C109     0.1µr, 50V     CVV-104-024       R32, R132     100, 14W, 5%     RMM-101C     C10, C110     7pr, 50V     CVV-104-024       R33, R133     100, 14W, 5%     RM4-102C     C11, C111     100pr, 500V     CM-101-024       R34, R134     1k, 14W, 5%     RM4-102C     C12, C112     100pr, 500V     CM-101-024       R38, R135     1k, 14W, 5%     RM4-102C     C13, C113     0.04 /µr, 50V     CM-470-024       R38, R133     10, 14W, 5%     RM4-102C     C14, C114     22pr, 500V     CM-470-024       R38, R133     10, 14W, 5%     RM4-102C     C16, C116     430pr, 500V     CM-470-024	,					
P27, P127   2k, 1/4W, 5%   RM/4-202C   C4, C104   0.1µF, 50V   CFV-104-024     P28, P129   100, 1/4W, 5%   RM/4-102C   C5, C105   100µF, 50V   CFV-104-024     P28, P129   100, 1/4W, 5%   RM/4-102C   C7, C107   100µF, 50V   CFV-104-024     P30, P130   1k, 1/4W, 5%   RM/4-101C   C9, C109   0.1µF, 50V   CFV-104-024     P33, P133   100, 1/4W, 5%   RM/4-101C   C9, C109   0.1µF, 50V   CFV-104-024     P33, P133   2k, 1/4W, 5%   RM/4-101C   C10, C110   P16, 500V   CM-070-024     P33, P133   1k, 1/4W, 5%   RM/4-102C   C11, C111   100pF, 500V   CM-101-024     P33, P133   1k, 1/4W, 5%   RM/4-102C   C13, C113   0.047µF, 50V   CM-470-024     P33, P133   100, 1/4W, 5%   RM/4-102C   C15, C116   470F, 500V   CM-470-024     P39, P139   100, 1/4W, 5%   RM/4-102C   C15, C116   470F, 500V   CM-470-024     P42, P142   100, 1/4W, 5%   RM/4-102C   C15, C116   470F, 500V   CM-470-024     P39, P139   100, 1/4W, 5%   RM/4-101C   C16, C116					•	
R129     R121     R13     R131     R13     R131     R13     R131     R13     R131     R13     R131     R14     R1444     R1444     R144     R126     R144     R126     R144     R126     R144     R1444     R144     R144     R1	R27, R127	2k, 1/4W, 5%	RM/4-202C		•	
R29, R129     IO0, IA4W, 5%     RM/4-101C     C7, C107     106µF, 50V     CER-107C-024       R31, R131     100, 1/4W, 5%     RM/4-101C     C9, C109     0, 1µF, 50V     CYV-104-024       R32, R132     100, 1/4W, 5%     RM/4-101C     C9, C109     0, 1µF, 50V     CVV-104-024       R33, R133     2k, 1/4W, 5%     RM/4-101C     C10, C110     7pF, 50V     CM-101-024       R34, R134     1k, 1/4W, 5%     RM/4-102C     C11, C111     100pF, 500V     CM-101-024       R35, R135     1k, 1/4W, 5%     RM/4-102C     C13, C113     0.047µF, 50V     CM-470-024       R37, R137     100, 1/4W, 5%     RM/4-102C     C16, C116     450F, 500V     CM-470-024       R38, R138     1k, 1/4W, 5%     RM/4-101C     C16, C116     47pF, 500V     CM-470-024       R39, R139     100, 1/4W, 5%     RM/4-101C     C16, C116     47pF, 500V     CM-470-024       R41, R41     100, 1/4W, 5%     RM/4-101C     C19, C119     20.000µF, 100V     CER-209F       R42, R142     100, 1/4W, 5%     RM/4-101C     C20, C120     20.00µF, 100V     CER-209F<	R28, R128	10k, 1/4W, 5%	RM/4-103C			
N30     N30     N14W, 5%     RM/4-102C     CB, C10B     0.1µF, 50V     CVV-104.024       R31, R131     100, 1/4W, 5%     RM/4-101C     C9, C109     0.1µF, 50V     CM-070-024       R33, R132     100, 1/4W, 5%     RM/4-101C     C9, C109     0.1µF, 50V     CM-070-024       R33, R133     1k, 1/4W, 5%     RM/4-102C     C11, C111     100pF, 500V     CM-101-024       R35, R135     1k, 1/4W, 5%     RM/4-102C     C13, C113     0.047µF, 50V     CV-473-024       R36, R136     1k, 1/4W, 5%     RM/4-102C     C16, C116     47pF, 500V     CM-681-024       R37, R137     100, 1/4W, 5%     RM/4-102C     C16, C116     47pF, 500V     CM-681-024       R38, R138     1k, 1/4W, 5%     RM/4-101C     C16, C116     47pF, 160V     CPP-475MC       R41, R141     100, 1/4W, 5%     RM/4-101C     C18, C118     4.7µF, 160V     CPP-475MC       R42, R142     100, 1/4W, 5%     RM/4-101C     C19, C119     20,00µF, 100V     CER-209F       R43, R143     1k, 1/4W, 5%     RM/4-101C     C20, C120     20,00µF, 100V     CER-	,				•	
N31, R131   100, 1/4W, 5%   RM/4-101C   C9, C109   0.1µF, 50V   CYV-104-024     R32, R133   2k, 1/4W, 5%   RM/4-202C   C10, C110   7pF, 50VV   CM-070-024     R34, R134   1k, 1/4W, 5%   RM/4-102C   C11, C111   100pF, 50VV   CM-101-024     R35, R135   1k, 1/4W, 5%   RM/4-102C   C12, C112   100pF, 50VV   CM-101-024     R37, R137   100, 1/4W, 5%   RM/4-102C   C13, C113   0.047µF, 50V   CM-470-024     R37, R137   100, 1/4W, 5%   RM/4-101C   C14, C114   22pF, 50VV   CM-470-024     R38, R138   1k, 1/4W, 5%   RM/4-101C   C16, C116   47pF, 50VV   CM-470-024     R40, R140   28k, 1/4W, 5%   RM/4-101C   C18, C118   47pF, 160V   CPP-475MC     R41, R141   100, 1/4W, 5%   RM/4-101C   C20, C120   20,000µF, 100V   CER-209E     R43, R143   1k, 1/4W, 1%   RM/4-101C   C20, C120   20,000µF, 100V   CER-209E     R44, R144   47, 5, 1/4W, 1%   RM/4-102C   C201   0.01µF, 50V   CFW-104-024     R45, R146   100, 1/4W, 5%   RM/4-101C   C20,202 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>						
N32, R132   100, 1/4W, 5%   RM/4-101C   C10, C110   7pF, 500V   CM-101-024     R33, R133   1k, 1/4W, 5%   RM/4-102C   C11, C111   100pF, 500V   CM-101-024     R35, R135   1k, 1/4W, 5%   RM/4-102C   C12, C112   100pF, 500V   CM-101-024     R36, R136   1k, 1/4W, 5%   RM/4-102C   C13, C113   0.047µF, 50V   CM-20-024     R37, R137   100, 1/4W, 5%   RM/4-102C   C16, C116   680pF, 500V   CM-470-024     R38, R138   1k, 1/4W, 5%   RM/4-101C   C16, C116   47pF, 50V   CM-470-024     R49, R140   28k, 1/4W, 5%   RM/4-101C   C16, C116   47pF, 50V   CM-470-024     R41, R141   100, 1/4W, 5%   RM/4-101C   C19, C119   20,000µF, 100V   CER-209E     R42, R142   100, 1/4W, 5%   RM/4-101C   C20, C120   20,000µF, 100V   CER-209E     R43, R143   1k, 1/4W, 5%   RM/4-101C   C204   1000UF, 50V   CER-108C-024     R44, R144   47, 5, 1/4W, 1%   RM/4-0475C   C21   0,1µF, 50V   CER-108C-024     R46, R146   100, 1/4W, 5%   RM/4-101C   C204					•	
R33, R133   24, R14W, 5%   RMW4-D2C   C11, C111   100pF, 500V   CM-101-024     R35, R135   1k, 1/4W, 5%   RMW4-102C   C12, C112   100pF, 500V   CM-220-024     R35, R136   1k, 1/4W, 5%   RMW4-102C   C13, C113   0.047µF, 50V   CW-470-024     R36, R136   1k, 1/4W, 5%   RMW4-102C   C14, C114   22pF, 500V   CM-220-024     R38, R138   1k, 1/4W, 5%   RM/4-102C   C16, C116   47pF, 500V   CM-470-024     R39, R139   100, 1/4W, 5%   RM/4-102C   C16, C116   47pF, 500V   CM-470-024     R40, R140   28k, 1/4W, 5%   RM/4-101C   C17, C117   47µF, 160V   CPP-475MC     R41, R141   100, 1/4W, 5%   RM/4-101C   C19, C119   20.000µF, 100V   CER-209E     R42, R142   100, 1/4W, 5%   RM/4-101C   C20, C120   0.01µF, 100V   CER-209E     R44, R144   47, 51 /4W, 1%   RM/4-102C   C201, 202   0.00µF, 100V   CER-108C-024     R45, R146   100, 1/4W, 5%   RM/4-102C   C201   0.01µF, 50V   CER-108C-024     R45, R145   1k, 1/4W, 5%   RM/4-102C   C201					•	
R35, R135   1k, 1/4W, 5%   RM/4-102C   C112   100pF, 500V   CW-101-024     R36, R136   1k, 1/4W, 5%   RM/4-102C   C13, C113   20.47 µF, 50V   CW-220-024     R37, R137   100, 1/4W, 5%   RM/4-101C   C15, C115   680pF, 500V   CM-220-024     R38, R138   1k, 1/4W, 5%   RM/4-101C   C16, C116   47pF, 500V   CM-681-024     R40, R140   28k, 1/4W, 5%   RM/4-101C   C16, C116   47pF, 500V   CM-681-024     R41, R141   100, 1/4W, 5%   RM/4-101C   C19, C119   20.000µF, 100V   CEP-475MC     R41, R141   100, 1/4W, 5%   RM/4-101C   C19, C119   20.000µF, 100V   CEP-209E     R43, R143   1k, 1/4W, 5%   RM/4-101C   C21   0.01µF, 100V   CEP-209E     R44, R144   47, 5, 1/4W, 1%   RM/4-0475C   C201   0.01µF, 50V   CEP-108C-024     R45, R145   1k, 1/4W, 5%   RM/4-101C   C204   1000µF, 50V   CER-108C-024     R46, R146   100, 1/4W, 5%   RM/4-0475C   C203   100µF, 50V   CEP-108C-024     R47, R147   100, 1/4W, 5%   RM/4-475C   C206				C11, C111	100pF, 500V	
R36     Its, 1/4W, 5%     RM/4-102C     C14, C114     22pF, 500V     CHV-473-024       R37, R137     100, 1/4W, 5%     RM/4-101C     C15, C115     680pF, 500V     CM-681-024       R38, R138     1k, 1/4W, 5%     RM/4-102C     C16, C116     47pF, 500V     CM-681-024       R39, R139     100, 1/4W, 5%     RM/4-101C     C16, C116     47pF, 500V     CM-647-024       R40, R140     28k, 1/4W, 5%     RM/4-101C     C17, C117     4, 7µF, 160V     CPP-475MC       R41, R141     100, 1/4W, 5%     RM/4-101C     C20, C120     20,000µF, 100V     CER-209E       R44, R144     47, 5, 1/4W, 1%     RM/4-102C     C20, C120     20,000µF, 100V     CER-209E       R44, R144     47, 5, 1/4W, 1%     RM/4-101C     C203     1000µF, 50V     CER-108C-024       R45, R145     1k, 1/4W, 5%     RM/4-101C     C204     1000µF, 50V     CER-108C-024       R44, R144     47, 5, 1/4W, 1%     RM/4-101C     C204     1000µF, 50V     CFR-108C-024       R46, R146     100, 1/4W, 5%     RM/4-101C     C205     0, 1µF, 50V     CV+104-024						
R37, R137     100, 1/4W, 5%     RM/4-101C     C C14, C 114     22pr, 500V     CM-220-224       R38, R138     1k, 1/4W, 5%     RM/4-101C     C 14, C 114     22pr, 500V     CM-461-024       R39, R139     100, 1/4W, 5%     RM/4-101C     C 16, C 116     47pr, 500V     CM-470-024       R40, R140     28k, 1/4W, 5%     RM/4-101C     C 19, C 119     20,000µF, 100V     C CP-475MC       R41, R141     100, 1/4W, 5%     RM/4-101C     C 19, C 119     20,000µF, 100V     C CR-209E       R43, R143     1k, 1/4W, 5%     RM/4-101C     C 20, C 120     20,000µF, 100V     C CP-103/20-024       R44, R144     47,5, 1/4W, 1%     RM/4-0475C     C 21     0.01µF, 50V     C CP-108C-024       R45, R145     1k, 1/4W, 5%     RM/4-101C     C 206     0.1µF, 50V     C CP-108C-024       R46, R146     100, 1/4W, 5%     RM/4-101C     C 204     1000µF, 50V     C CR-108C-024       R47, R147     100, 1/4W, 5%     RM/4-101C     C 204     1000µF, 50V     C CR-108C-024       R46, R146     100, 1/4W, 5%     RM/4-4750C     C 206     0.1µF, 50V					•	
R38     1k, 1/4W, 5%     RM/4-102C     C15, C115     OBOP, 500V     CM-81-024       R39, R139     100, 1/4W, 5%     RM/4-101C     C16, C116     47, 7F, 500V     CM-470-024       R40, R140     28k, 1/4W, 5%     RM/2802-03     C17, C117     4.7µF, 160V     CPP-475MC       R41, R141     100, 1/4W, 5%     RM/4-101C     C19, C119     20.000µF, 100V     CER-209E       R42, R142     100, 1/4W, 5%     RM/4-101C     C20, C120     20.000µF, 100V     CER-209E       R44, R144     47, 5, 1/4W, 1%     RM/4-0475C     C21     0.01µF, 50V     CD-103/20-024       R45, R145     1k, 1/4W, 5%     RM/4-102C     C203     1000µF, 50V     CER-108C-024       R46, R146     100, 1/4W, 5%     RM/4-101C     C204     1000µF, 50V     CFR-108C-024       R47, R147     100, 1/4W, 5%     RM/4-0475C     C205     0.1µF, 50V     CYV-104-024       R48, R148     475, 1/4W, 1%     RM/4-4750C     C206     0.1µF, 50V     CYV-104-024       R50, R150     475, 1/4W, 1%     RM/4-4750C     C208     1000µF, 50V     CER-107C-024						
R39, R139   100, 1/4W, 5%   RW4-101C   C17, C117   4.7µF, 160V   CPP-475MC     R40, R140   28k, 1/4W, 5%   RW4-101C   C18, C118   4.7µF, 160V   CPP-475MC     R41, R141   100, 1/4W, 5%   RM/4-101C   C19, C119   20,000µF, 100V   CER-209E     R42, R142   100, 1/4W, 5%   RM/4-101C   C20, C120   20,000µF, 100V   CER-209E     R43, R134   1k, 1/4W, 5%   RM/4-102C   C20   C21   0.01µF, 100V   CD-103/20-024     R44, R144   47.5, 1/4W, 1%   RM/4-102C   C203   1000µF, 50V   CER-108C-024     R45, R145   1k, 1/4W, 5%   RM/4-101C   C204   1000µF, 50V   CER-108C-024     R46, R146   100, 1/4W, 5%   RM/4-101C   C205   0.1µF, 50V   CYV-104-024     R47, R147   100, 1/4W, 5%   RM/4-4750C   C205   0.1µF, 50V   CFW-108-024     R49, R149   475, 1/4W, 1%   RM/4-4750C   C208   100µF, 50V   CER-107C-024     R51, R151   475, 1/4W, 1%   RM/4-4750C   C208   100µF, 50V   CER-107C-024     R51, R151   475, 1/4W, 1%   RM/4-4750C   C210 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>						
R40, R140     26k, I/4W, 5%     RW/2602-03     C18, C118     4.7µF, 160V     CP-475MC       R41, R141     100, I/4W, 5%     RW4-101C     C19, C119     20,000µF, 100V     CER-209E       R43, R143     1k, 1/4W, 5%     RW4-101C     C20, C120     20,000µF, 100V     CER-209E       R44, R144     47,5, 1/4W, 1%     RW4-102C     C21     0.1µF, 50V     CER-108C-024       R45, R145     1k, 1/4W, 5%     RW4-102C     C203     1000µF, 50V     CER-108C-024       R46, R146     100, 1/4W, 5%     RW4-101C     C204     1000µF, 50V     CER-108C-024       R47, R147     100, 1/4W, 5%     RW4-101C     C204     1000µF, 50V     CER-108C-024       R48, R148     47.5, 1/4W, 1%     RW4-0475C     C206     0.1µF, 50V     CYV-104-024       R49, R149     475, 1/4W, 1%     RW4-4750C     C207     100µF, 50V     CER-107C-024       R50, R150     475, 1/4W, 1%     RW/4-4750C     C209     100µF, 50V     CER-107C-024       R51, R151     475, 1/4W, 1%     RW/4-4750C     C209     100µF, 50V     CER-107C-024	R39, R139		RM/4-101C			
R42, R141   100, 1/4W, 5%   RM/4-101C   C19, C119   20,000µF, 100V   CER-209E     R42, R142   100, 1/4W, 5%   RM/4-101C   C20, C120   20,000µF, 100V   CER-209E     R43, R143   1k, 1/4W, 5%   RM/4-102C   C21   0.01µF, 100V   CER-209E     R44, R144   47.5, 1/4W, 1%   RM/4-0475C   C201, 202   0.1µF, 50V   CDS-104CCDB     R45, R146   100, 1/4W, 5%   RM/4-101C   C204   1000µF, 50V   CER-108C-024     R47, R147   100, 1/4W, 5%   RM/4-101C   C205   0.1µF, 50V   CYV-104-024     R48, R148   47.5, 1/4W, 1%   RM/4-475C   C206   0.1µF, 50V   CYV-104-024     R49, R149   475, 1/4W, 1%   RM/4-4750C   C208   100µF, 50V   CER-107C-024     R50, R150   475, 1/4W, 1%   RM/4-4750C   C209   10µF, 50V   CER-107C-024     R51, R151   475, 1/4W, 1%   RM/4-4750C   C209   10µF, 50V   CER-107C-024     R53, R153   56.2k, 1/4W, 1%   RM/4-4750C   C209   10µF, 50V   CER-107C-024     R55, R155   220, 1/4W, 5%   RM/4-21C   C210   4.7µF, 160		28k, 1/4W, 5%	RM/2802-03			
R42, R142   100, 1/4W, 5%   RMV4-101C   C20, C120   20,000µF, 100V   CER-209E     R43, R143   1k, 1/4W, 5%   RMV4-102C   C21   0.01µF, 100V   CD-103/20-024     R44, R144   47.5, 1/4W, 1%   RMV4-102C   C201, 202   0.1µF, 50V   CD-103/20-024     R45, R145   1k, 1/4W, 5%   RMV4-101C   C203   1000µF, 50V   CER-108C-024     R46, R146   100, 1/4W, 5%   RMV4-101C   C205   0.1µF, 50V   CYV-104-024     R47, R147   100, 1/4W, 5%   RMV4-101C   C206   0.1µF, 50V   CYV-104-024     R48, R148   47.5, 1/4W, 1%   RMV4-4750C   C206   0.1µF, 50V   CYV-104-024     R450, R150   475, 1/4W, 1%   RMV4-4750C   C209   100µF, 50V   CER-107C-024     R51, R151   475, 1/4W, 1%   RM/4-4750C   C209   10µF, 50V   CER-107C-024     R52, 152   475, 1/4W, 1%   RM/4-4750C   C209   10µF, 50V   CER-107C-024     R53, R153   56.2k, 1/4W, 1%   RM/4-4750C   C210   4.7µF, 160V   CTR-475A-024     R54, R154   220, 1/4W, 5%   RM/4-221C   C215   0.01µF,						
R43, R143   IK, 1/4W, 5%   RW4-102C   C21   0.01µF, 1000V   CD-103/20-024     R44, R144   47, 5, 1/4W, 1%   RW4-0475C   C201, 202   0.1µF, 50V   CDS-104CCDB     R45, R145   1k, 1/4W, 5%   RW/4-102C   C203   1000µF, 50V   CER-108C-024     R46, R146   100, 1/4W, 5%   RW/4-101C   C204   1000µF, 50V   CER-108C-024     R47, R147   100, 1/4W, 5%   RW/4-101C   C205   0.1µF, 50V   CYV-104-024     R48, R148   47.5, 1/4W, 1%   RW/4-0475C   C206   0.1µF, 50V   CYV-104-024     R49, R149   475, 1/4W, 1%   RW/4-4750C   C206   0.1µF, 50V   CER-107C-024     R50, R150   475, 1/4W, 1%   RW/4-4750C   C209   100µF, 50V   CER-106C-024     R51, R151   475, 1/4W, 1%   RW/4-4750C   C209   10µF, 160V   CTR-475A-024     R53, R153   56.2k, 1/4W, 1%   RW/4-4750C   C210   4.7µF, 160V   CTR-475A-024     R54, R154   220, 1/4W, 5%   RW/4-221C   C215   0.01µF, 160V   CD-103A-024     R56, R156   220, 1/4W, 5%   RW/4-221C   SW1   DPDT Swit					•	
R44, R144   47.5, R144, S7   RW, L20   C201, 202   0.1µF, 50V   CDS-104CCDB     R45, R145   1k, I14W, 5%   RW/4-102C   C203   1000µF, 50V   CER-108C-024     R46, R146   100, 1/4W, 5%   RW/4-101C   C204   1000µF, 50V   CER-108C-024     R47, R147   100, 1/4W, 5%   RW/4-101C   C204   1000µF, 50V   CTP-108C-024     R48, R148   47.5, 1/4W, 1%   RW/4-0475C   C206   0.1µF, 50V   CTV-104-024     R49, R149   475, 1/4W, 1%   RW/4-4750C   C207   100µF, 50V   CER-107C-024     R50, R150   475, 1/4W, 1%   RW/4-4750C   C209   10µF, 50V   CER-107C-024     R51, R151   475, 1/4W, 1%   RW/4-4750C   C209   10µF, 50V   CER-107C-024     R51, R151   475, 1/4W, 1%   RW/4-4750C   C210   4.7µF, 160V   CTR-475A-024     R53, R153   56.2k, 1/4W, 1%   RW/4-450C   C210   4.7µF, 160V   CTR-475A-024     R54, R154   220, 1/4W, 5%   RW/4-221C   C215   0.01µF, 160V   CD-103A-024     R56, R156   220, 1/4W, 5%   RW/4-221C   SW1   DPDT Switch<						CD-103/20-024
R46, R146     100, 1/4W, 5%     RM/4-101C     C203     1000µF, 50V     CER-108C-024       R47, R147     100, 1/4W, 5%     RM/4-101C     C204     1000µF, 50V     CER-108C-024       R48, R148     47.5, 1/4W, 1%     RM/4-01C     C205     0.1µF, 50V     CYV-104-024       R48, R148     47.5, 1/4W, 1%     RM/4-0475C     C206     0.1µF, 50V     CYV-104-024       R50, R150     475, 1/4W, 1%     RM/4-4750C     C208     100µF, 50V     CER-107C-024       R51, R151     475, 1/4W, 1%     RM/4-4750C     C209     10µF, 50V     CER-107C-024       R51, R153     56.2k, 1/4W, 1%     RM/4-4750C     C209     10µF, 50V     CER-107C-024       R53, R153     56.2k, 1/4W, 1%     RM/4-4750C     C209     10µF, 160V     CTR-475A-024       R54, R154     220, 1/4W, 5%     RM/4-221C     C215     0.01µF, 160V     CD-103A-024       R56, R156     220, 1/4W, 5%     RM/4-221C     SW1     DPDT Switch     SW-0280       R57, R157     220, 1/4W, 5%     RM/4-221C     SW2     DPDT Switch     SW-0280						
R47, R147   100, 1/4W, 5%   RM/4-101C   C204   1000µF, 50V   CER-108C-024     R48, R148   47.5, 1/4W, 1%   RM/4-0475C   C205   0.1µF, 50V   CYV-104-024     R49, R149   475, 1/4W, 1%   RM/4-4750C   C206   0.1µF, 50V   CYV-104-024     R50, R150   475, 1/4W, 1%   RM/4-4750C   C207   100µF, 50V   CER-107C-024     R51, R151   475, 1/4W, 1%   RM/4-4750C   C209   10µF, 50V   CER-107C-024     R52, 152   475, 1/4W, 1%   RM/4-4750C   C210   4.7µF, 160V   CTR-475A-024     R53, R153   56.2k, 1/4W, 1%   RM/4-4750C   C210   4.7µF, 160V   CTR-475A-024     R54, R154   220, 1/4W, 5%   RM/4-221C   C215   0.01µF, 160V   CD-103A-024     R56, R156   220, 1/4W, 5%   RM/4-221C   SW1   DPDT Switch   SW-0280     R57, R157   220, 1/4W, 5%   RM/4-221C   SW2   DPDT Switch   SW-0280     R56, R156   220, 1/4W, 5%   RM/4-221C   SW2   DPDT Switch   SW-0280     R202   3.92k, 1/4W, 1%   RM/4-221C   SW2   DPDT Switch   SW-0280	,					
R48, R148   47.5, 1/4W, 1%   RM/4-0475C   C205   0.1µF, 50V   CYV-104-024     R49, R149   475, 1/4W, 1%   RM/4-4750C   C206   0.1µF, 50V   CYV-104-024     R50, R150   475, 1/4W, 1%   RM/4-4750C   C207   100µF, 50V   CER-107C-024     R51, R151   475, 1/4W, 1%   RM/4-4750C   C209   10µF, 50V   CER-107C-024     R52, 152   475, 1/4W, 1%   RM/4-4750C   C210   4.7µF, 160V   CTR-475A-024     R53, R153   56.2k, 1/4W, 1%   RM/4-221C   C210   4.7µF, 160V   CTR-475A-024     R54, R154   220, 1/4W, 5%   RM/4-221C   C215   0.01µF, 160V   CD-103A-024     R55, R155   220, 1/4W, 5%   RM/4-221C   SW1   DPDT Switch   SW-0280     R57, R157   220, 1/4W, 5%   RM/4-221C   SW2   DPDT Switch   SW-0280     R202   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SW+0280     R203   3.92k, 1/4W, 1%   RM/4-223C   C2   DPDT Switch   SW+0280     R205   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   S-0114 <	,					
R49, R149475, 1/4W, 1%RM/4-4750CC207100μF, 50VCER-107C-024R50, R150475, 1/4W, 1%RM/4-4750CC208100μF, 50VCER-107C-024R51, R151475, 1/4W, 1%RM/4-4750CC20910µF, 50VCER-106C-024R52, 152475, 1/4W, 1%RM/4-4750CC20910µF, 50VCER-106C-024R53, R15356.2k, 1/4W, 1%RM/4-4750CC2104.7µF, 160VCTR-475A-024R54, R154220, 1/4W, 5%RM/4-221CC2150.01µF, 160VCD-103A-024R55, R155220, 1/4W, 5%RM/4-221CSW1DPDT SwitchSW-0280R56, R156220, 1/4W, 5%RM/4-221CSW1DPDT SwitchSW-0280R57, R157220, 1/4W, 5%RM/4-221CSW2DPDT SwitchSW-0280R58, R1580, 1/4W, 1%RM/4-3921CSW3DPDT SwitchSW-0280R2023.92k, 1/4W, 1%RM/4-3921CS201Power SwitchSW+152BR20522k, 1/4W, 1%RM/4-223CTS-201Inrush LimiterSH-618R20722k, 1/4W, 1%RM/4-223CQ2, 0102MMBT5088LSS-0114R20822k, 1/4W, 1%RM/4-223CQ3, 0103MMBT5088LSS-0114R209604k, 1/4W, 1%RM/4-6043CQ3, 0103MMBT5087LSS-0114R210470k, 1/4W, 4%RM/4-474CQ4, 0104MMBT5087LSS-0114R2111k, 1/4W, 5%RM/4-102CQ6, 0106MMBT5088LSS-0114			RM/4-0475C		• •	
R50475, 1/4W, 1%RM/4-4750CC208100µF, 50VCER-107C-024R51, R151475, 1/4W, 1%RM/4-4750CC20910µF, 50VCER-106C-024R52, 152475, 1/4W, 1%RM/4-4750CC2104.7µF, 160VCTR-475A-024R53, R15356.2k, 1/4W, 1%RMP/4-5622-03C2114.7µF, 160VCTR-475A-024R54, R154220, 1/4W, 5%RM/4-221CC2150.01µF, 160VCD-103A-024R55, R155220, 1/4W, 5%RM/4-221CSW1DPDT SwitchSW-0280R57, R157220, 1/4W, 5%RM/4-221CSW2DPDT SwitchSW-0280R57, R157220, 1/4W, 5%RM/4-221CSW2DPDT SwitchSW-0280R58, R1580, 1/4W, 1%RM/4-3921CSW3DPDT SwitchSW-0280R2023.92k, 1/4W, 1%RM/4-3921CS201Power SwitchSW+152BR20522k, 1/4W, 1%RM/4-223CTS-201Inrush LimiterSSH-618R20622k, 1/4W, 1%RM/4-223CQ2, Q102MMBT5088LSS-0114R20822k, 1/4W, 1%RM/4-223CQ4, Q104MMBT5088LSS-0114R209604k, 1/4W, 1%RM/4-474CQ4, Q104MMBT5088LSS-0114R210470k, 1/4W, 5%RM/4-474CQ5, Q105MMBT5088LSS-0114R2111k, 1/4W, 5%RM/4-102CQ6, Q106MMBT5088LSS-0114	R49, R149		RM/4-4750C		•	
R51, R151   475, 1/4W, 1%   RM/4-4750C   C209   10μF, 50V   CER-106C-024     R52, 152   475, 1/4W, 1%   RM/4-4750C   C210   4.7μF, 160V   CTR-475A-024     R53, R153   56.2k, 1/4W, 1%   RM/4-221C   C211   4.7μF, 160V   CTR-475A-024     R54, R154   220, 1/4W, 5%   RM/4-221C   C215   0.01μF, 160V   CD-103A-024     R55, R155   220, 1/4W, 5%   RM/4-221C   SW1   DPDT Switch   SW-0280     R57, R157   220, 1/4W, 5%   RM/4-221C   SW2   DPDT Switch   SW-0280     R58, R158   0, 1/4W, 1%   RM/4-20C   SW3   DPDT Switch   SW-0280     R202   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SW-152B     R205   22k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SW+152B     R205   22k, 1/4W, 1%   RM/4-233C   TS-201   Inrush Limiter   SSH-618     R207   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114	R50, R150	475, 1/4W, 1%	RM/4-4750C			
R52475, 174W, 1%RM/4-4730CC2104.7μF, 160VCTR-475A-024R53, R15356.2k, 1/4W, 1%RMP/4-5622-03C2114.7μF, 160VCTR-475A-024R54, R154220, 1/4W, 5%RM/4-221CC2150.01μF, 1600VCD-103A-024R55, R155220, 1/4W, 5%RM/4-221CSW1DPDT SwitchSW-0280R57, R157220, 1/4W, 1%RM/4-221CSW2DPDT SwitchSW-0280R58, R1580, 1/4W, 1%RM/4-3921CSW3DPDT SwitchSW-0280R2023.92k, 1/4W, 1%RM/4-3921CS201Power SwitchSW+152BR20522k, 1/4W, 1%RM/4-223CTS-201Inrush LimiterSSH-618R20722k, 1/4W, 1%RM/4-223CQ, Q102MMBT5088LSS-0114R20822k, 1/4W, 1%RM/4-223CQ, Q103MMBT5088LSS-0114R209604k, 1/4W, 1%RM/4-6043CQ4, Q104MMBT5088LSS-0114R210470k, 1/4W, 4%RM/4-02CQ5, Q105MMBT5088LSS-0114R2111k, 1/4W, 5%RM/4-102CQ6, Q106MMBT5088LSS-0114						
R35, R15336.2k, 1/4W, 1%RMI/4-3622-03C2114.7µF, 160VCTR-475A-024R54, R154220, 1/4W, 5%RM/4-221CC2150.01µF, 1600VCD-103A-024R55, R155220, 1/4W, 5%RM/4-221CSW1DPDT SwitchSW-0280R57, R157220, 1/4W, 5%RM/4-221CSW2DPDT SwitchSW-0280R58, R1580, 1/4W, 1%RM/4-000CSW2DPDT SwitchSW-0280R2023.92k, 1/4W, 1%RM/4-3921CSW3DPDT SwitchSW-0280R2033.92k, 1/4W, 1%RM/4-3921CS201Power SwitchSWH-152BR20622k, 1/4W, 1%RM/4-223CTS-201Inrush LimiterSSH-618R20722k, 1/4W, 1%RM/4-223CQ2, Q102MMBT5088LSS-0114R20822k, 1/4W, 1%RM/4-6043CQ3, Q103MMBT5088LSS-0114R209604k, 1/4W, 1%RM/4-6043CQ4, Q104MMBT5088LSS-0114R2111k, 1/4W, 5%RM/4-102CQ6, Q106MMBT5088LSS-0114					•	
R54, R154   220, 1/4W, 5%   RM/4-221C   C215   0.01µF, 1600V   CD-103A-024     R55, R155   220, 1/4W, 5%   RM/4-221C   SW1   DPDT Switch   SW-0280     R57, R157   220, 1/4W, 5%   RM/4-221C   SW2   DPDT Switch   SW-0280     R58, R158   0, 1/4W, 1%   RM/4-000C   SW3   DPDT Switch   SW-0280     R202   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SW-0280     R203   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SWH-152B     R205   22k, 1/4W, 1%   RM/4-223C   TS-201   Inrush Limiter   SSH-618     R206   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q4, Q104   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-102C   Q5, Q105   MMBT5088L   SS-0115     R211						
R55, R155   220, 1/4W, 5%   RIM/4-221C   SW1   DPDT Switch   SW-0280     R57, R157   220, 1/4W, 5%   RM/4-221C   SW2   DPDT Switch   SW-0280     R58, R158   0, 1/4W, 1%   RM/4-000C   SW3   DPDT Switch   SW-0280     R202   3.92k, 1/4W, 1%   RM/4-3921C   SW3   DPDT Switch   SW-0280     R203   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SWH-152B     R205   22k, 1/4W, 1%   RM/4-223C   TS-201   Inrush Limiter   SSH-618     R206   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q4, Q104   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-102C   Q5, Q105   MMBT5088L   SS-0115     R211					•	
R57, R157   220, 1/4W, 5%   RM/4-221C   SW1   DPDT Switch   SW-0280     R58, R158   0, 1/4W, 1%   RM/4-000C   SW3   DPDT Switch   SW-0280     R202   3.92k, 1/4W, 1%   RM/4-3921C   SW3   DPDT Switch   SW-0280     R203   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SWH-152B     R205   22k, 1/4W, 1%   RM/4-223C   TS-201   Inrush Limiter   SSH-618     R207   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-203C   Q4, Q104   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q4, Q104   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-102C   Q5, Q105   MMBT5087L   SS-0115     R211   1k, 1/4W, 5%   RM/4-102C   Q6, Q106   MMBT5088L   SS-0114	,					
R58, R158   0, 1/4W, 1%   RM/4-000C   SW2   D1D1 Switch   SW-0280     R202   3.92k, 1/4W, 1%   RM/4-3921C   SW3   DPDT Switch   SW-0280     R203   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SWH-152B     R205   22k, 1/4W, 1%   RM/4-223C   TS-201   Inrush Limiter   SSH-618     R207   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q4, Q104   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-474C   Q5, Q105   MMBT5087L   SS-0115     R211   1k, 1/4W, 5%   RM/4-102C   Q6, Q106   MMBT5088L   SS-0114	,					
R202   3.92k, 1/4W, 1%   RM/4-3921C   SW3   DFDT Switch   SW-0280     R203   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SWH-152B     R205   22k, 1/4W, 1%   RM/4-223C   TS-201   Inrush Limiter   SSH-618     R206   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q4, Q104   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-102C   Q5, Q105   MMBT5087L   SS-0115     R211   1k, 1/4W, 5%   RM/4-102C   Q6, Q106   MMBT5088L   SS-0114						
R203   3.92k, 1/4W, 1%   RM/4-3921C   S201   Power Switch   SWH-152B     R205   22k, 1/4W, 1%   RM/4-223C   TS-201   Inrush Limiter   SSH-618     R206   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q4, Q104   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-474C   Q5, Q105   MMBT5087L   SS-0115     R211   1k, 1/4W, 5%   RM/4-102C   Q6, Q106   MMBT5088L   SS-0114				SVV3	UPD1 Switch	SVV-0280
R205   22k, 1/4W, 1%   RM/4-223C   TS-201   Inrush Limiter   SSH-618     R206   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R207   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q3, Q103   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-474C   Q4, Q104   MMBT5088L   SS-0114     R211   1k, 1/4W, 5%   RM/4-102C   Q6, Q106   MMBT5088L   SS-0114     R212   1k 1/4W, 5%   RM/4-102C   Q6, Q106   MMBT5088L   SS-0114				S201	Power Switch	SWH-152B
R207   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMBT5088L   SS-0114     R208   22k, 1/4W, 1%   RM/4-223C   Q3, Q103   MMBT5088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q4, Q104   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-102C   Q5, Q105   MMBT5087L   SS-0115     R211   1k, 1/4W, 5%   RM/4-102C   Q6, Q106   MMBT5088L   SS-0114						
R208   22k, 1/4W, 1%   RM/4-223C   Q2, Q102   MMB15088L   SS-0114     R209   604k, 1/4W, 1%   RM/4-6043C   Q3, Q103   MMBT5088L   SS-0114     R210   470k, 1/4W, 4%   RM/4-474C   Q4, Q104   MMBT5088L   SS-0114     R211   1k, 1/4W, 5%   RM/4-102C   Q5, Q105   MMBT5088L   SS-0115     R212   1k   1/4W, 5%   RM/4-102C   Q6, Q106   MMBT5088L   SS-0114		22k, 1/4W, 1%		TS-201	Inrush Limiter	SSH-618
R208     22k, 1/4W, 1%     RM/4-223C     Q3, Q103     MMBT5088L     SS-0114       R209     604k, 1/4W, 1%     RM/4-6043C     Q4, Q104     MMBT5088L     SS-0114       R210     470k, 1/4W, 4%     RM/4-474C     Q5, Q105     MMBT5087L     SS-0115       R211     1k, 1/4W, 5%     RM/4-102C     Q6, Q106     MMBT5088L     SS-0114				02 0102	MMRT5088	SS-0114
R209     604k, 1/4W, 1%     RM/4-6043C     Q4, Q104     MMBT5088L     SS-0114       R210     470k, 1/4W, 4%     RM/4-474C     Q5, Q105     MMBT5087L     SS-0115       R211     1k, 1/4W, 5%     RM/4-102C     Q6, Q106     MMBT5088L     SS-0114       R212     1k, 1/4W, 5%     RM/4-102C     Q6, Q106     MMBT5088L     SS-0114						
R210 470K, 1/4W, 4% RM/4-474C Q5, Q105 MMBT5087L SS-0115   R211 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114   R212 1k 1/4W 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114						
R211 IK, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114						
Q7, Q107 MMBT5087L SS-0115				Q6, Q106	MMBT5088L	
	11212			Q7, Q107	MMBT5087L	SS-0115

DESIGNATOR	VALUE	PART #
Q8, Q108	MMBT5087L	SS-0115
Q10, Q110	MMBT5088L	SS-0114
Q11, Q111	MMBT5087L	SS-0115
Q12, Q112	MMBT5088L	SS-0114
Q13, Q113	MMBT5087L	SS-0115
Q14, Q114	MPS-A56	SS-101A
Q15, Q115	MPS-A56	SS-101A
Q46 Q146 Q47, Q147 Q48, Q148 Q49, Q149	MPS-A06 MPS-A06 2SK1058 2SK1058 2SK1058 2SK1058 2SJ162 2SJ162 2SJ162 2SJ162 2SJ162 MMBT5087L MMBT5088L MMBT5088L	SS-102A SS-102A SSH-741T SSH-741T SSH-741T SSH-740T SSH-740T SSH-740T SSH-740T SSH-740T SS-0115 SS-0114
F1, F101	AGC 10A Fuse	FS-010
F2, F102	AGC 10A Fuse	FS-010
F201	15A Slo/Blo	FS-015SB
F203, F204	2.5A Fast Mini	FS-0390

BI	<b>ESIGNATOR</b> R201 R301 R-302	VALUE Bridge Rectifier Bridge Rectifier Bridge Rectifier	<b>PART #</b> SS-222 SSH-609 SSH-609
		IEC Connector IEC Line Cord Dual Binding Post MOSFET Insulator	CC-0918 FA-0209 CC-0867 HWH-442
93	303 Differences		
		IEC Line Cord	FAH-146
	19, C119 20, C120	15000μf, 75V 15000μf, 75V	CER-159ES CER-159ES
F2	201	10A, Slo/Blo	FS-010SM
		Not Used	

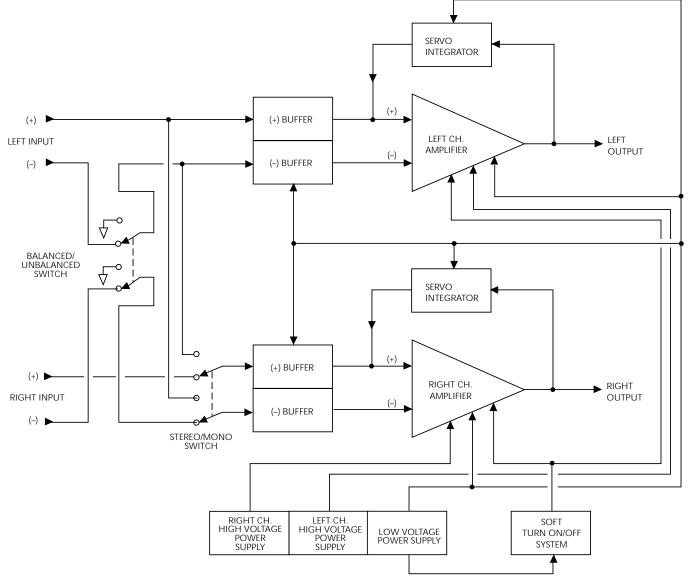
2SK/1058

2SJ/162

Q47, Q147

Q50, Q150

### 9303 / 9505 FUNCTIONAL BLOCK DIAGRAM



## TECHNICAL REFERENCE

#### THEORY AND OPERATION OF trans • nova

The (<u>TRANS</u>conductance <u>NO</u>dal <u>Voltage A</u>mplifier) principle is based on our 1984 U.S. Patent 4,467,288. This patent describes the advantages of audio power amplifiers in which a MOSFET output stage is connected in a grounded source configuration. In this connection the output stage has its full voltage gain of typically 20dB (ten times), instead of the usual 1dB loss of voltage follower designs.

It is an inevitable result of electrical physics that this output with gain inherently increases the power gain (for the same bandwidth) of the output stage by typically ten times over the conventional follower connection, using exactly the same MOSFET devices.

The output stage is thus now ten times less wasteful of its incoming drive power. The driver stage can now be of a low voltage (±24 volts) nature and be designed along the same principles always used in high quality preamplifiers: Class A operation, high linearity, and wide bandwidth. A topology utilizing an output stage with gain yields a much simpler, shorter total signal path than that of the usual high voltage driver designs. The number of serial stages is reduced from five or more, to only three.

But all of the above does not make an amplifier trans • *nova*. The output stage is further refined into a trans-impedance stage (current-to-voltage converter), to achieve extremely short loop (fast) negative feedback. The output stage is driven cooperatively by a transconductance stage (voltage-to-current converter).

The 9303and 9505are the most sophisticated amplifiers we have yet developed utilizing the basic trans • *nova* principle. And, although the measured specifications are very good, the numbers do not describe the realistic sound of the amplifiers.

#### CIRCUIT IMPLEMENTATION

Earlier models of amplifiers we have offered using the trans • *nova* topology have earned the reputation for clean, natural sounding reproduction. A conservative, purist design approach was used to avoid compromising the desirable characteristics of the trans • *nova* circuits. Circuit innovation was not prevented by this conservatism; as is evident in the discoveries which resulted in development of the DIABLO circuitry to be discussed shortly, and the novel balanced input system.

Many "balanced" amplifiers are merely conventional unbalanced designs with a Balanced-to-Unbalanced converter (usually IC op-amp based) preceding the power amplifier. The 9303 and 9505, however, are true differential input power amplifiers. Each (+) and (–) input port has been buffered to allow direct signal access to the differential amplifier, without conversion to unbalanced form. Deactivating the Balanced Mode is accomplished via a rear panel switch that grounds the (–) inputs, effectively converting the amplifier to unbalanced operation.

The input stage is a JFET differential amplifier. This circuit configuration results in excellent front end headroom and extremely low intermodulation effects. The ultra low noise characteristic of the JFETs virtually eliminates noise "mixing" (intermodulation) with the music signal, reducing discordant product frequencies known as "noise grain" or "noise fuzz." A servo integrator has been employed to establish minimal DC offset. This circuit monitors the DC offset at the output of the amplifier, and injects an equal but opposite DC voltage into the (+) port of the differential input, thereby cancelling the offset. This method eliminates the need for a sonically degrading electrolytic capacitor in the audio path, and provides superior subsonic frequency response.

The final output stage utilizes lateral MOSFETs; four pairs are used for each channel in the 9505 and three pairs in the 9303. These devices, unlike conventional bipolar transistors do not exhibit "thermal runaway." Thermal runaway is a phenomenon whereby a transistor heats up as it draws more current, which causes it to get hotter, and conduct more current, and so on until the device self destructs. Since the MOSFETs are inherently self protecting, no sonically degrading, complex circuitry is required to monitor and protect the devices. The lateral MOSFETs also have a linear input to output transfer function. Their connection in circuits and their operating characteristics are very similar to vacuum tubes, which is perhaps responsible for their widely recognized sonic trait of being "musical" and non-fatiguing.

Operation of the transconductance stage is a major factor in the reproduction quality of the amplifier. The number of MOSFETs used at the output stage of the 9303 and 9505 imposes sufficient capacitive load on the transconductance stage that if a conventional Class A stage were used (having intrinsically a 2:1 limit on peak-to-quiescent current) it would begin to show "stress" at the higher audio frequencies. The newly perfected DIABLO driver system (Dynamically Invariant <u>A-BL</u>inear Operation; patent application in progress) satisfies the current headroom requirement by smoothly and continuously varying the current transfer ratios of the two transconductance paths, under the control of the signal current itself. This implementation allows the current transfer ratio of one path to be smoothly and continuously reduced to zero while the other is smoothly and continuously increased by a factor of two. What is remarkably new here is that when this normally-limiting 2:1 value is reached there is now about 14dB of additional, perfectly linear current headroom left to drive the MOSFETs! The result is a dramatic decrease in high-frequency distortion combined with higher ultrasonic stability – the "Holy Grail" of amplifier design.

The power supply utilizes a UI style transformer with a separate primary for each channel. The transformer has a separate secondary for each channel high voltage power supply, each feeding a conventional split full wave bridge rectifier. High voltage power supply capacitance is  $20,000\mu$ F per rail for each channel for the 9505 and 5,000 for the 9303. The third transformer secondary feeds a regulated supply for the input stage and driver circuitry. Low voltage power supply capacitance is  $1,000\mu$ F per rail, with additional decoupling for each channel.

#### CALIBRATION

#### Common Mode Rejection:

The input common mode null is adjusted by the trim pot R1 (R101 for the left channel). The CMRR should be greater than 75dB below rated output. If the CMRR requires adjustment, feed the amplifier input with a common mode signal and adjust R1. **Disconnect the power to the amplifier before removing the cover**. Use a sinewave generator set to 1 volt output at 1kHz. Connect the generator signal output to the tip and ring of a 1/4" plug and ground to the sleeve. Plug this into the amplifier input. Connect an AC voltmeter to the amplifier output binding posts. Adjust R1 to give the lowest voltage output from the amplifier. For a temporary adjustment when a signal generator and voltmeter are not available, use an FM tuner and tune it to an unused station as your signal source, and connect the output to the amplifier as described above. Connect the amplifier output to a small full range speaker and adjust R1 for the lowest output from the speaker.

#### Bias:

The bias control establishes the quiescent Class AB output current of the amplifier. The bias should not need readjustment from the factory setting; however, if the amplifier is repaired and output devices have been changed, or if the two channels of the amplifier do not run at the same temperature, calibrating the bias is necessary. **Disconnect the power to the amplifier before removing the cover.** To adjust the bias, disconnect the input and speakers and remove the B+ fuse for that channel. Connect an amp meter across the now vacant fuse clips and adjust R45 (R145 for the left channel) to get a current reading of 300mA for the 9303, 400mA for the 9505.

## Service Policy and Limited Warranty

If you encounter any difficulty or have any question concerning your 9303 and 9505 Amplifier, please call our Technical Support Department weekdays, 8:00 a.m. to 3:30 p.m., Mountain Standard Time, at 800-795-2385.

Should you have any doubts as to whether the amplifier is malfunctioning and requires service, please call us before sending it in for repair. All units being returned (regardless of warranty status) must receive a Return Authorization (RA) number. In addition, we can offer troubleshooting assistance that may simplify or even eliminate the need for factory service.

The Hafler 9303 and 9505 Amplifiers are warranted to the original owner (non-transferrable) for seven years from the date of purchase, including parts, labor, and return shipping costs within the Continental United States, Alaska, and Hawaii. This warranty applies only to products sold in the United States Of America.

For warranties outside the U.S.A., please contact your local agent.

It is the owner's responsibility to pay shipping (preferably United Parcel Service, UPS) to the factory: collect shipments will not be accepted. Units under warranty should be accompanied by a copy of the dated Bill Of Sale. Use the original carton and all packing material, with the RA number clearly marked on the outside of the package. Be sure to include a return address, the RA number, a daytime telephone number, and a brief description of the difficulty, including whether it occurs continuously or intermittently.

This warranty gives you specific legal rights. You may also have other rights which may vary from state to state.



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