

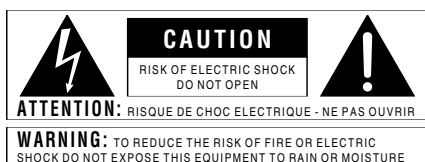


# MSR-600 II Series User's Manual

PROFESSIONAL AUDIO  
SIGNAL PROCESSING AND  
DISTRIBUTION EQUIPMENT



# IMPORTANT SAFETY INSTRUCTIONS



The symbols shown above are internationally accepted symbols that warn of potential hazards with electrical products. The lightning flash with arrowpoint in an equilateral triangle means that there are dangerous voltages present within the unit. The exclamation point in an equilateral triangle indicates that it is necessary for the user to refer to the owner's manual.

These symbols warn that there are no user serviceable parts inside the unit. Do not open the unit. Do not attempt to service the unit yourself. Refer all servicing to qualified personnel. Opening the chassis for any reason will void the manufacturer's warranty. Do not get the unit wet. If liquid is spilled on the unit, shut it off immediately and take it to a dealer for service. Disconnect the unit during storms to prevent damage.

## SAFETY INSTRUCTIONS

NOTICE FOR CUSTOMERS IF YOUR UNIT IS EQUIPPED WITH A POWER CORD.

**WARNING:** THIS APPLIANCE MUST BE EARTHED. CONNECT ONLY TO A MAINS SOCKET OUTLET WITH PROTECTIVE EARTHING CONNECTION.

The cores in the mains lead are coloured in accordance with the following code:

GREEN and YELLOW - Earth      BLUE - Neutral      BROWN - Live

As colours of the cores in the mains lead of this appliance may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

- The core which is coloured green and yellow must be connected to the terminal in the plug marked with the letter E, or with the earth symbol, or coloured green, or green and yellow.
- The core which is coloured blue must be connected to the terminal marked N or coloured black.
- The core which is coloured brown must be connected to the terminal marked L or coloured red.

This equipment may require the use of a different line cord, attachment plug, or both, depending on the available power source at installation. If the attachment plug needs to be changed, refer servicing to qualified service personnel who should refer to the table below. The green/yellow wire shall be connected directly to the units chassis.

| CONDUCTOR |           | WIRE COLOR |       |
|-----------|-----------|------------|-------|
|           |           | Normal     | Alt   |
| L         | LIVE      | BROWN      | BLACK |
| N         | NEUTRAL   | BLUE       | WHITE |
| E         | EARTH GND | GREEN/YEL  | GREEN |

**WARNING:** If the ground is defeated, certain fault conditions in the unit or in the system to which it is connected can result in full line voltage between chassis and earth ground. Severe injury or death can then result if the chassis and earth ground are touched simultaneously.

## WARNING FOR YOUR PROTECTION READ THESE INSTRUCTIONS:

**KEEP THESE INSTRUCTIONS**

**HEED ALL WARNINGS**

**FOLLOW ALL INSTRUCTIONS**

**DO NOT USE THIS APPARATUS NEAR WATER**

**THE APPARATUS SHALL NOT BE EXPOSED TO DRIPPING OR SPLASHING LIQUID AND NO OBJECT FILLED WITH LIQUID, SUCH AS VASES, SHALL BE PLACED ON THE APPARATUS.**

**CLEAN ONLY WITH A DRY CLOTH.**

**DO NOT BLOCK ANY OF THE VENTILATION OPENINGS. INSTALL IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.**

**DO NOT INSTALL NEAR ANY HEAT SOURCES SUCH AS RADIATORS, HEAT REGISTERS, STOVES, OR OTHER APPARATUS (INCLUDING AMPLIFIERS) THAT PRODUCE HEAT.**

**ONLY USE ATTACHMENTS/ACCESSORIES SPECIFIED BY THE MANUFACTURER.**

**UNPLUG THIS APPARATUS DURING LIGHTNING STORMS OR WHEN UNUSED FOR LONG PERIODS OF TIME.**

**Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or third prong are provided for your safety. If the provided plug does not fit your outlet, consult an electrician for replacement of the obsolete outlet.**

**Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.**

**Use only with the cart stand, tripod bracket, or table specified by the manufacture, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.**



**Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled on or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.**

**POWER ON/OFF SWITCH:** For products provided with a power switch, the power switch DOES NOT break the connection from the mains.

**MAINS DISCONNECT:** The plug shall remain readily operable. For rack-mount or installation where plug is not accessible, an all-pole mains switch with a contact separation of at least 3 mm in each pole shall be incorporated into the electrical installation of the rack or building.

**FOR UNITS EQUIPPED WITH EXTERNALLY ACCESSIBLE FUSE RECEPTACLE:** Replace fuse with same type and rating only.

**MULTIPLE-INPUT VOLTAGE:** This equipment may require the use of a different line cord, attachment plug, or both, depending on the available power source at installation. Connect this equipment only to the power source indicated on the equipment rear panel. To reduce the risk of fire or electric shock, refer servicing to qualified service personnel or equivalent.

**This Equipment is intended for rack mount use only.**

# IMPORTANT SAFETY INSTRUCTIONS

## **ELECTROMAGNETIC COMPATIBILITY**

This unit conforms to the Product Specifications noted on the **Declaration of Conformity**. Operation is subject to the following two conditions:

- this device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation.

Operation of this unit within significant electromagnetic fields should be avoided.

- use only shielded interconnecting cables.

This equipment has been tested and found to comply with the following European and international Standards for Electromagnetic Compatibility and Electrical Safety:

|                          |             |                                         |
|--------------------------|-------------|-----------------------------------------|
| Radiated Emissions (EU): | EN55013     | (1990) Associated Equipment             |
| RF Immunity (EU):        | EN50082/1   | (1992) RF Immunity, Fast Transients ESD |
| Mains Disturbance (EU):  | EN61000/3/2 | (1995)                                  |

### **IMPORTANT SAFETY INFORMATION**

**DO NOT REMOVE COVERS. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL. THIS EQUIPMENT MUST BE EARTHED. IT SHOULD NOT BE NECESSARY TO REMOVE ANY PROTECTIVE EARTH OR SIGNAL CABLE.**

**SHIELD CONNECTIONS TO PREVENT GROUND LOOPS. ANY SUCH DISCONNECTIONS ARE OUTSIDE THE RECOMMENDED PRACTICE OF BSS AUDIO AND WILL RENDER ANY EMC OR SAFETY CERTIFICATION VOID.**

For continued compliance with international EMC legislation ensure that all input and output cables are wired with the cable screen connected to Pin 1 of the XLR connectors and/or the jack plug sleeve. The input XLR Pin 1 and the side-chain input jack socket sleeve are connected to the chassis via a low value capacitor, providing high immunity from ground loops while ensuring good EMC performance.

The BSS MSR602 requires a standard 19 inch rack width and single rack-space for mounting.

In order to ensure proper ventilation and cooling it is to be mounted with one empty rack-space above and one empty rack-space below the unit.

## **U.K. MAINS PLUG WARNING**

**A molded mains plug that has been cut off from the cord is unsafe. Discard the mains plug at a suitable disposal facility. NEVER UNDER ANY CIRCUMSTANCES SHOULD YOU INSERT A DAMAGED OR CUT MAINS PLUG INTO A 13 AMP POWER SOCKET. Do not use the mains plug without the fuse cover in place. Replacement fuse covers can be obtained from your local retailer. Replacement fuses are 13 amps and MUST be ASTA approved to BS1362.**

## **BSS MSR 602II and 604II**

Manufacturer's Name: BSS Audio  
Manufacturer's Address: 8760 S. Sandy Parkway  
Sandy, Utah 84070, USA

declares that the product:

Product name: MSR602II and 604II  
Note: Product name may be suffixed by the letters-EU.

Product option: None

conforms to the following Product Specifications:

Safety: IEC 60065 (2001)

EMC: EN 61000-3-2:1995  
EN 55013:1990  
EN 50082-1:1992

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC as amended by Directive 93/68/EEC.

Director of Engineering, BSS Audio  
8760 S. Sandy Parkway  
Sandy, Utah 84070, USA  
Date: May 22, 2006  
Revised: October 27, 2006

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## Welcome to the MSR-602/604 II Users Manual

This manual is provided to assist sound engineers, installers and consultants to fully understand the MSR-604 II and to benefit from its full capability.

As opposed to most manuals, the contents can be read like a book.

At the same time, the information is structured under a series of broad headings for easy access. So where possible within each section:

- The most **immediate** information appears at the head of each section under the main title.
- As you read further into each subsequent section, more detailed, specific information is given.

Should you have any comments or questions about applying the MSR-604 II within your application, please write to us at the address in the warranty section.

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For continued compliance ensure that all input and output cables are wired with cable screen connected to pin 1 of the XLR. The input XLR pin 1 on BSS equipment is generally connected to chassis via a capacitor to prevent ground loops whilst ensuring good emc compatibility.

## Table Of Contents

|            |                                                                   |           |
|------------|-------------------------------------------------------------------|-----------|
| <b>1.0</b> | <b>Introduction</b>                                               | <b>4</b>  |
| 1.1        | MSR-604 II Mic/Line Signal Splitter                               | 5         |
| 1.2        | MSR-602 II Power Supply Unit                                      | 6         |
| <b>2.0</b> | <b>Unpacking</b>                                                  | <b>7</b>  |
| 2.1        | Warranty                                                          | 7         |
| 2.2        | Warning                                                           | 7         |
| <b>3.0</b> | <b>Connections and Control Descriptions</b>                       | <b>8</b>  |
| 3.1        | AC power connections and control settings                         | 9         |
| 3.2        | DC power connections                                              | 11        |
| 3.3        | Audio connections                                                 | 12        |
| 3.4        | MSR-602 II Controls                                               | 13        |
| 3.5        | MSR-604 II Controls                                               | 14        |
| <b>4.0</b> | <b>System Implementation and Use</b>                              | <b>16</b> |
| 4.1        | Racking                                                           | 16        |
| 4.2        | Grounding                                                         | 18        |
| 4.3        | Channel coding                                                    | 19        |
| 4.4        | Dual power supply operation                                       | 20        |
| 4.5        | Output drive level setting                                        | 20        |
| 4.6        | Multiple output Distribution Amplifier configuration              | 22        |
| 4.7        | Stereo Summing Configuration                                      | 24        |
| <b>5.0</b> | <b>Compatibility With Pre Mk II Systems</b>                       | <b>25</b> |
| 5.1        | Installing MSR-604 IIs in a Mk 1 system                           | 25        |
| 5.2        | Installing pre Mk II MSR-604s into a new system                   | 26        |
| 5.3        | Installing a Mk II power supply into a Mk I SYSTEM and vice versa | 26        |
| <b>6.0</b> | <b>Appendix A</b>                                                 | <b>27</b> |
| 6.1        | System block diagram and circuit description                      | 27        |
| 6.2        | Transient Suppressor replacement                                  | 28        |
| <b>7.0</b> | <b>Appendix B</b>                                                 | <b>29</b> |
| 7.1        | Input transformer balancing                                       | 29        |
| 7.2        | Output transformer balancing                                      | 29        |
| <b>8.0</b> | <b>Technical Specifications</b>                                   | <b>30</b> |
| <b>9.0</b> | <b>Warranty</b>                                                   | <b>33</b> |

## Introduction

### 1.0 Introduction

It is not uncommon within a sound system which uses microphones as a source of programme, for that microphone to be connected to the input of a number of different processing facilities.

An example of this would be in sound reinforcement work where a stage microphone is required to drive the main 'front of house' mixing console, the stage monitoring mixing console, a mobile recording studio and quite possibly an outside broadcast recording vehicle.

It is also common within such a system for the microphone to be connected to considerable lengths of shielded cable before being terminated at the processing facilities input connector.

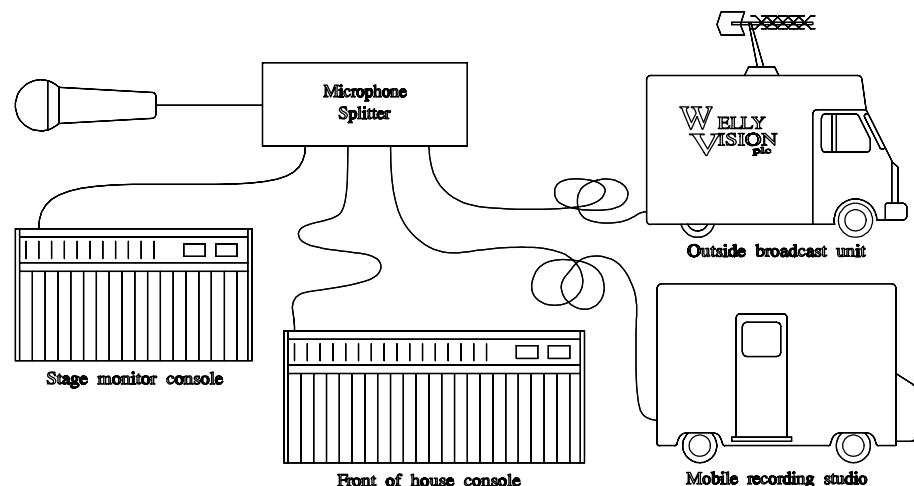
Such a load on the microphone is very much in excess of its design capability, and as a consequence the level and quality of the sound is impaired. (Fig. 1)

A further complication can arise within such a system from multiple earthing as each of the processing facilities would be providing its own ground.

To overcome these problems it is quite common for a multiple winding transformer to be used which provides separate secondary windings for each of the required outputs. This solution will solve the multiple grounding problems, however it does not tackle the sound level and quality problem as, being a passive device, it has no power amplification capability.

Cost effective active electronic solutions proved elusive until the introduction of the original BSS MSR-604 overcame the problems of noise and headroom. The current MSR-604 II further improves upon the performance of the original unit with yet greater dynamic range,

Fig. 1 Microphone Loading



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## MSR-604 II Microphone Signal Splitter

flexibility of gain and level control, internal bus routing, signal metering and a headphone monitoring facility.

The MSR-604 II is a four channel, four way signal splitting package and the MSR-602 II is the system power supply capable of supplying power for 20 channels, that is, 5 separate MSR-604 II units.

### 1.1 MSR-604 Mic/Line Signal Splitter

The MSR-604 II has four channels, each of which may be isolated and used totally independently from the next or, by internal re-configuration, be interconnected to form distribution amplifier sections with a single input driving up to 64 outputs.

The low noise floor requirement necessitates a remote power supply system, the MSR-602 II, which provides the required DC voltages.

A MIC/LINE switch introduces a 20dB input pad, which in combination with the 5 step GAIN switch allows any input signal below + 33dBu to be perfectly matched to the MSR-604 II's dynamic range. The setting up process is further assisted by the provision of a momentary LISTEN switch which routes the signal to a calibrated HEADROOM meter and a headphone monitor amplifier built into the MSR-602 II power supply unit. Each channel also has a CLIP LED to give constant warning against signal overdrive. As a further refinement a separate 10dB input pad may be activated from the front of house mixing console by switching the desks phantom supply. This remote attenuator allows the engineer to preserve the channel headroom directly from the console in the event that an input is overdriven.

Each channel also provides a separate phantom powering selector switch providing an independent 48V across the 'mic input' connector.

Each channel has two low impedance electronically balanced outputs on the rear panel to feed the MAIN (Front of House) and the MONITOR mixing consoles. These outputs may be independently configured by internal header blocks to drive at mic (+3dBu clip) or at line (+23dBu clip) levels. A third setting allows these outputs to be driven at +13dBu clip which gives a gain/headroom structure compatible with earlier versions of the MSR-604. The two FEED XLR connectors on the front panel offer microphone level transformer isolated and balanced outputs.

# MSR-600 II Series

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## MSR-602 II Power Supply

**1.2 MSR-602 II Power Supply** The MSR-602 II is the system power supply providing all the necessary DC voltages for the MSR-604 II. It utilises a custom designed low field toroidal transformer and separate mumetal screen to reduce the possibility of mains field coupling into the electronic circuitry of the MSR-604 II.

The HEADROOM LED meter and high quality headphone amplifier give the operator absolute confidence in signal integrity during setting up, and provide an indispensable aid to trouble shooting and fault detection. The signal wiring involved is contained with the power wiring in a multicore cable for simple interconnection between units.

In addition it also carries the main system ground switch which has important considerations within a large system for both safety and noise.

**PLEASE READ SECTION 4.2 CAREFULLY PRIOR TO OPERATING THE COMPLETE SYSTEM.**



## 2.0 Unpacking

As part of our system of quality control, this product is carefully inspected before packing to ensure flawless appearance. After unpacking the units, please inspect for any physical damage and retain the shipping carton and all relevant packing materials, should the unit require repacking.

In the event that damage has occurred, immediately notify your dealer, so that a written claim to cover damages can be initiated.

**2.1 Warranty** The MSR-604 II and MSR-602 II units are warranted by BSS to the original purchaser, against defects in workmanship and materials used in manufacture, for a period of one year from date of shipment. Faults due to purchaser misuse, unauthorised modifications or accidents are not covered by this warranty.

No other warranty is expressed or implied.

If the unit is faulty, it should be sent, shipping prepaid, to an authorised dealer of the manufacturer stating the faults found.

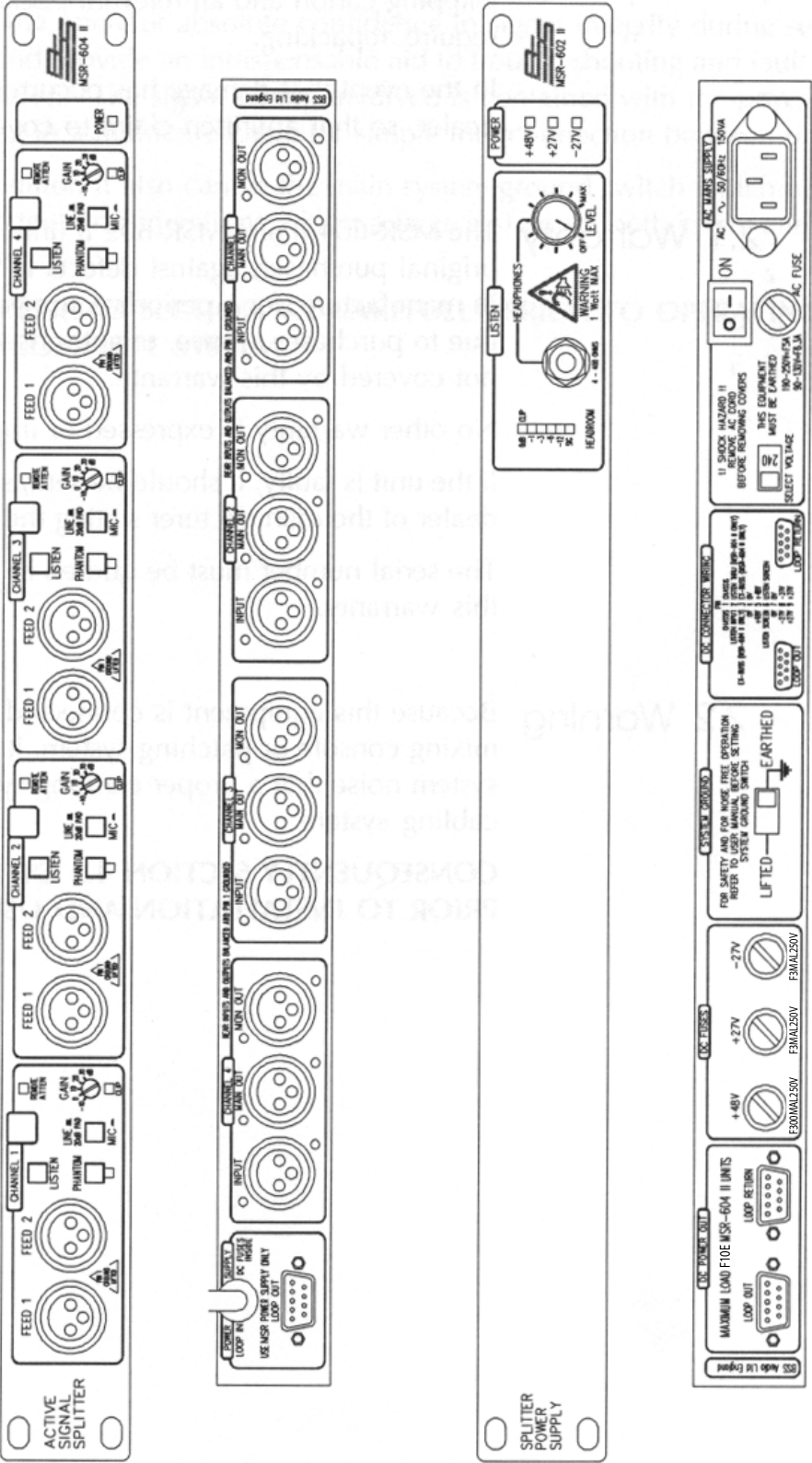
The serial number must be quoted in all correspondence relating to this warranty.

**2.2 Warning** Because this equipment is connected between the microphone and mixing console or patching system, it is important for safety and system noise that a proper earthing system is implemented within the cabling system.

**CONSEQUENTLY SECTION 4.2 OF THIS MANUAL MUST BE READ PRIOR TO INSTALLATION AND USE.**

3.0 Connections and Control Descriptions

Fig. 2 MSR-602 II and MSR-604 II



## AC Power Connections and Control Settings

### 3.1 AC Power Connections and Control Settings

Before connecting the MSR-602 II to the AC power source, check that the voltage selector switch located on the rear panel is correctly set. If a change is necessary, ensure that the mains fuse is also changed for one of the correct rating. Before connecting the DC power leads, check that the system ground switch on the rear panel is also correctly set to 'earthed'.

The power cord attached to this unit carries the following information label.

**WARNING: THIS APPLIANCE MUST BE EARTHED**

**IMPORTANT:** The wires in this mains lead are colour coded in accordance with the following code.

|                    |         |
|--------------------|---------|
| Green and yellow : | Earth   |
| Blue :             | Neutral |
| Brown :            | Live    |

As the colours of the wires in the mains lead of this appliance may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

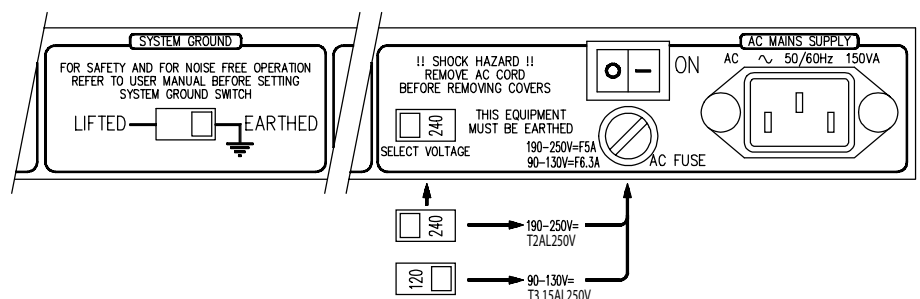
The wire which is coloured green-and-yellow must be connected to the terminal in the plug which is marked with the letter 'E' or by the earth symbol which is '⏏', or coloured green or green-and-yellow.

The wire which is coloured blue must be connected to the terminal which is marked with the letter 'N' or coloured black.

The wire which is coloured brown must be connected to the terminal which marked with the letter 'L' or coloured red.

Those units that are supplied to the North American market will have an integral moulded 3 pin connector which is provided to satisfy required safety standards.

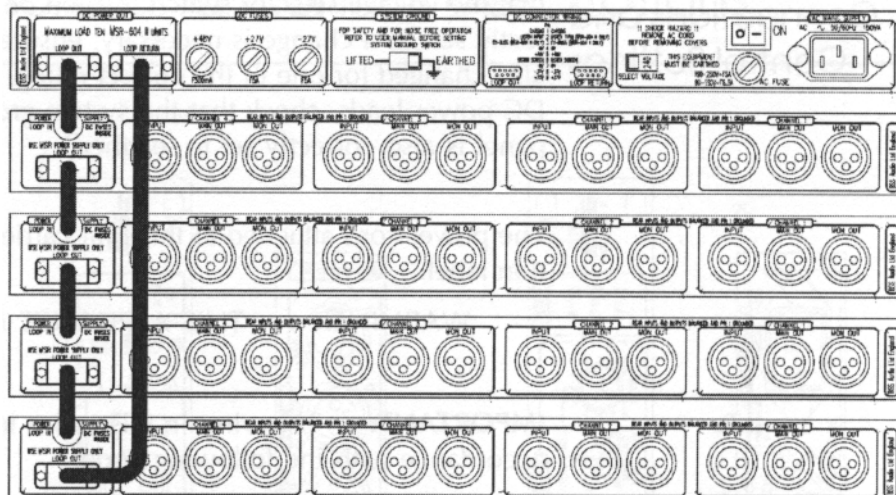
Fig. 3 MSR-602 II  
Voltage Switch and  
Mains Fuse



# MSR-600 II Series

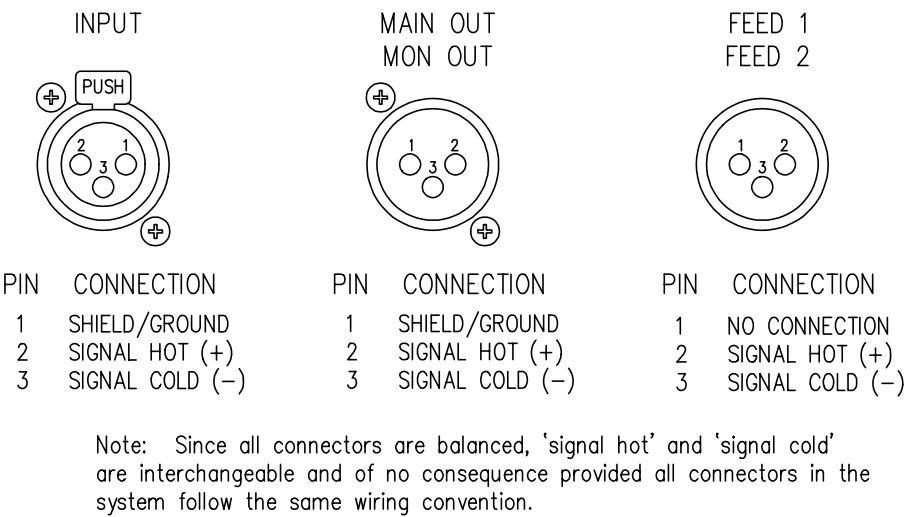
## Voltage Setting Safety EarthingAC Power Fusing

Fig. 4 DC Connection  
Cabling



# DC Power Connections

Fig. 5 Cable Wiring Details



ent connection of line to line rather than line to neutral phase voltages when using a three phase supply. In either case internal transient suppressors (VDRs) can become damaged and will consistently blow replacement fuses. You may be assured that they have protected your unit from damage, but they will need removal to allow further use of your unit, and should be replaced as soon as possible to ensure continued protection. If you feel this has happened, please refer to the appropriate section at the rear of this manual for the removal and replacement procedure.

## 3.2 DC Power Connections

DC connection between the MSR-604 II units and the MSR-602 II power supply is by the integral multicore cable with 9 pin D connectors. Note that the MSR-602 II power supply must always be located above the MSR-604 II units. (NB - this is opposite to the way early MSR-604s were racked.) Having the power supply at the top gives superior hum performance, and also places the HEADROOM meter and headphone amplifier in the most convenient position where they will not be obscured by cable looms from the FEED outputs. (Fig 4)

The topmost MSR-604 II's LOOP IN cable is plugged into the power supplies LOOP OUT connector. Each remaining MSR-604 II is connected to the unit above it in similar fashion. Finally the male to female multicore D cable packed with the MSR-602 II is used to loop the final MSR-604 II's LOOP OUT connector back to the LOOP RETURN socket on the power supply.

This 'ring' circuit allows a more reliable system set up, since an individual MSR-604 II may be isolated and removed from the rack without disturbing the power to the rest of the system. Ensure that the JACK SCREWS on the connectors are secured and tightened.

## Audio Connections

### 3.3 Audio Connections

The audio connections to the MSR-604 II are via XLR style connectors on the front and rear panels and their wiring configuration is as shown in figure 5.

Attention must be given to maintaining a consistent earthing system for safe and noise free operation. Please refer to section 4.2 for a fuller explanation and design guides.

**INPUT (REAR PANEL):** This is electronically balanced, non floating and is for direct connection to the microphone, DI box or other source of programme. The input is fully RFI suppressed and has excellent common mode rejection performance.

Care should be taken to ensure continuity of the pin 1 earth connection.

The 48v phantom powering appears across this input when the channel phantom switch is operated. (Refer to section 3.2)

**MAIN OUT (REAR PANEL):** This is electronically balanced, non floating and should be connected to the 'front of house' mixing console or main control area. The remote attenuator facility looks at this connector for detection of phantom power voltage. **This output should not be connected to an unbalanced input.**

For consistent remote attenuator switching and microphone screening, it is important that the pin 1 earth connection is maintained. (See section 4.5 for configuring the output drive level.)

**MON OUT (REAR PANEL):** This is electronically balanced, non floating, and should be connected to the stage monitor mixing console or ancillary console which is being operated within the same grounding system.

**This output should not be connected to an unbalanced input.**

It is probable that the pin 1 earth connection will need to be disconnected at this point to avoid earth loops. (See section 4.5 for configuring the output drive level.)

**FEED 1 AND FEED 2 (FRONT PANEL):** These two identical outputs are actively buffered, fully transformer balanced and floating with primary/secondary isolation of 2.5kV. They are for connection to any other facility requiring a signal and are totally isolated and independent.

There is no connection to the pin 1 earth and all cable screening should be derived from the receiving end.

It is also important to ensure there is no earth connection to the shell of the mating female connector as this would make connection to the MSR-602 II chassis ground and cause potential ground loops.

Since all the audio connections are balanced, the convention of pin 2 or pin 3 'hot' is of no consequence provided all connections are wired in a similar manner.

Please refer to appendix B for details of the transformer balancing options.

### 3.4 MSR-602 II Controls

**SYSTEM GROUND:** This switch, located on the rear panel, is the main grounding point for all the MSR-604 II units connected to the system.

The switch will connect the electronic/signal ground to chassis earth when in the 'EARTHED' position.

The switch will disconnect the electronic/signal ground from chassis earth when in the 'LIFTED' position.

For a more detailed explanation of the grounding arrangements and implications of this switch, please refer to section 4.2.

**POWER:** The LEDs are used to indicate that the power is turned on and present. The LEDs are wired after the main DC Fuses, so should a fuse blow the corresponding LED will go out. The DC fuses are on the rear panel and are clearly marked with value and function. Always replace blown fuses with the correct value.

**LISTEN: HEADROOM METER:** The HEADROOM meter is calibrated to show signal level relative to the clip point. In practice, the red 0db LED will illuminate when the signal is approximately 0.5dB below actual clip. The meter indication is not affected by HEADPHONE LEVEL control.

**LISTEN: HEADPHONE LEVEL:** Adjusts the level of the headphone amplifier from off to full level. Because the amplifier is designed to produce high monitoring levels into any impedance headphones extreme caution must be used when setting headphone levels.

**CAUTION! ALWAYS TURN LEVEL DOWN BEFORE LISTENING TO UNKNOWN SIGNALS. HIGH EFFICIENCY HEADPHONES AND A HOT SIGNAL CAN PRODUCE DANGEROUS SOUND PRESSURE LEVELS. OBSERVE THE WARNING SYMBOL NEXT TO THE HEADPHONE SOCKET.**

The gain of the monitor system is such that the amplifier will not clip or distort even if the level control is turned fully up. This ensures that if any distortion or clipping is heard it is not due to the monitoring system and needs to be corrected at the signal source or by adjusting the channel gain settings.

## MSR-604 II Controls

### 3.5 MSR-604 II Controls

**PHANTOM ON/OFF** The MSR-602 II power supply provides each MSR-604 II with 48v DC for phantom powering capacitor microphones. This is selected by operating the individual channel switch and it is connected across the 'input' connector in the standard phantom powering manner. Typical current availability is 10mA per channel for a 40 channel system.

Phantom power is indicated by a front panel LED.

It should be noted that phantom powering is interlocked to the LINE/MIC switch so that when LINE input is selected phantom power and the LED indicator are disabled.

**LINE/MIC** This switch introduces a 20dB pad into the input circuit of the unit, and raises the input impedance to suit line level signals. In the mic position the maximum signal level is +13dBu (with the GAIN set to -10dB). In the line position phantom powering is disabled and the maximum permitted signal level is +33dBu (with the GAIN set to -10dB).

**GAIN** The GAIN switch allows the input amplifier gain to be changed in 10dB steps from -10dB to +30dB to precisely match the input signal to the internal headroom of the MSR-604 II. Combined with the very low inherent noise of the input stage this ensures that none of the dynamic range of the source is lost.

The absolute system gain is dependent upon the internal system configurations chosen, but with factory default settings and in the MIC position the gain indicated on the GAIN switch setting is correct, i.e. with a mic input, 0dB gain selected and default jumper settings the output level is the same as the input signal.

**CLIP LED** The CLIP LED which is situated below the GAIN switch illuminates when the peak signal level approaches within 1dB of clip. It features a fast acting full wave rectifier and a hold circuit which ensure that all transient peaks are unambiguously indicated.



**REMOTE ATTENUATOR** A 10dB input pad is activated when the channel detects a +48v phantom signal is present on the MAIN OUTPUT. This allows the front of house mixing engineer to remotely reduce the input signal if he detects that the channel is being overdriven. This is a not uncommon occurrence in live rock and roll, when musicians get into the spirit of a performance and sing louder than during sound checks.

A front panel LED indicates when REMOTE ATTENUATOR is active.

Because the attenuator slightly degrades the noise and common mode performance of the unit it is recommended that the system is set up and calibrated without the remote attenuator activated, and that it is reserved for emergency use as described above.

The remote attenuator function cannot be disabled, so the engineer should observe the same caution with the desk phantom switch as he would if a phantom powered microphone were directly connected to the desk input.

**CAUTION! USE OF THE DESK PHANTOM SWITCH IS ALMOST CERTAIN TO PRODUCE AN AUDIBLE CLICK SO IT IS RECOMMENDED THAT THE CHANNEL BE CLOSED BRIEFLY DURING SWITCHING.**

**LISTEN** Pressing the LISTEN switch connects the channel signal to the HEADROOM meter and headphone amplifier on the MSR-602 II power supply. It is a momentary switch which needs to be held in during monitoring.

The listen bus is arranged in such a way that only one channel will register on the monitor section at any time. If two listen switches are pressed at the same time the one that is closest in the chain to the PSU will register. See the MSR-602 II controls section for further details.

**CAUTION! ALWAYS TURN LEVEL DOWN BEFORE LISTENING TO UNKNOWN SIGNALS. HIGH EFFICIENCY HEADPHONES AND A HOT SIGNAL CAN PRODUCE DANGEROUS SOUND PRESSURE LEVELS. OBSERVE THE WARNING SYMBOL NEXT TO THE HEADPHONE SOCKET.**

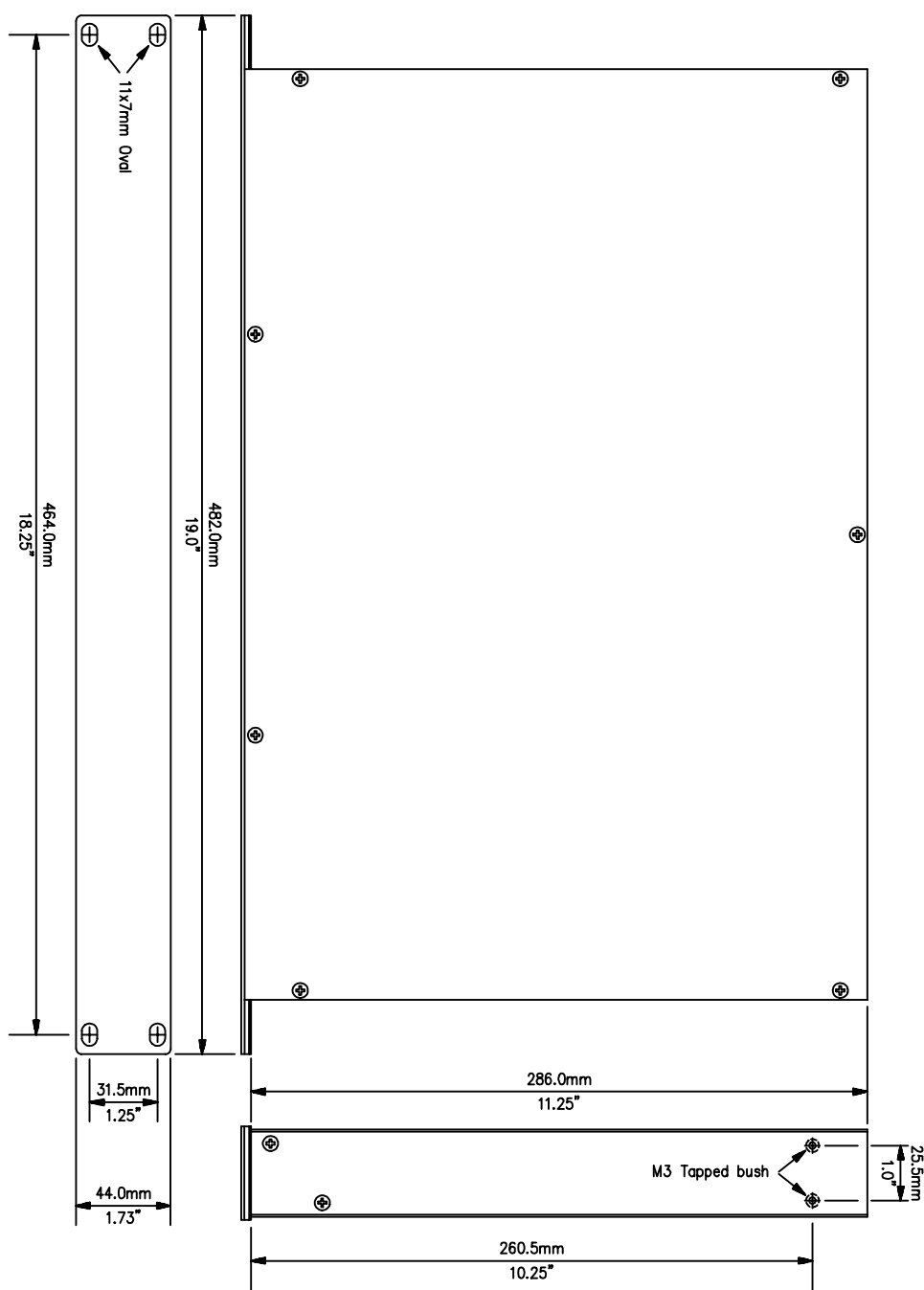
## System Implementation and Use Racking

### 4.0 System Implementation and Use

4.1 Racking It is envisaged that a number of the MSR-604 II units will be racked together with one MSR-602 II power supply.

The metal case of the MSR-604 II is not connected to the electronic 0V, and is taken to the mains safety ground via its DC lead connection into

Fig. 6 Physical Dimensions



the MSR-602 II. The MSR-602 II has a permanent safety ground connection via the power cord.

Please read section 4.2 for discussion of grounding of the electronic Ov.

The MSR-602 II power supply unit, unlike its predecessor has been designed for mounting at the TOP of a rack, above the MSR-604 II units it powers. In a properly installed MSR system mains induced hum from the PSU will be unmeasurable.

If a power supply unit needs to be mounted below a MSR-604 II, the system should be checked for mains induced hum. The following steps may be taken to reduce it.

- a) Leave a gap of at least 1U between the PSU and the closest MSR-604 II.
- b) Contact your BSS agent to obtain a mumetal shield which may be affixed to the top cover plate of the MSR-602 II.
- c) Reduce the number of units in the system. (The stray magnetic field is proportional to the current demanded from the PSU.)

In all cases, the MSR-602 II and the MSR-604 II's MUST be fully supported along their depth. For touring system, failure to observe this precaution will cause eventual metal failure of the MSR-II cases which will not be covered by the guarantee.

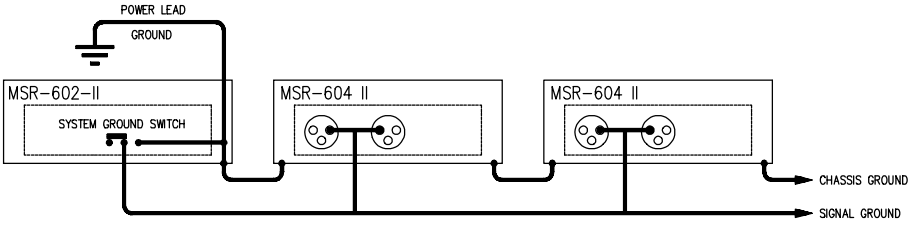
The physical dimensions and mounting points for the MSR-604 II and MSR-602 II are identical. They are shown in figure 6.

In large touring systems, it is envisaged that the rear panel input and output connectors will be wired into a multiway distribution panel forming part of the same rack. In this way, all cabling for the main system is kept tidy and away from the front of the unit. The isolated feeds appearing on the front of the unit are available for the external facilities, and their connection will not interfere with the in-house cabling system.

As with any microphone stage box system it is advisable to avoid the close proximity of heavy power cabling, power transformers and all forms of lighting control equipment.

Grounding

Fig. 7 MSR Grounding



4.2 Grounding In any multi-channel audio system where low level signals are being routed, it is important to ensure a consistent and positive earthing system to minimise any possible noise interference and hum loops.

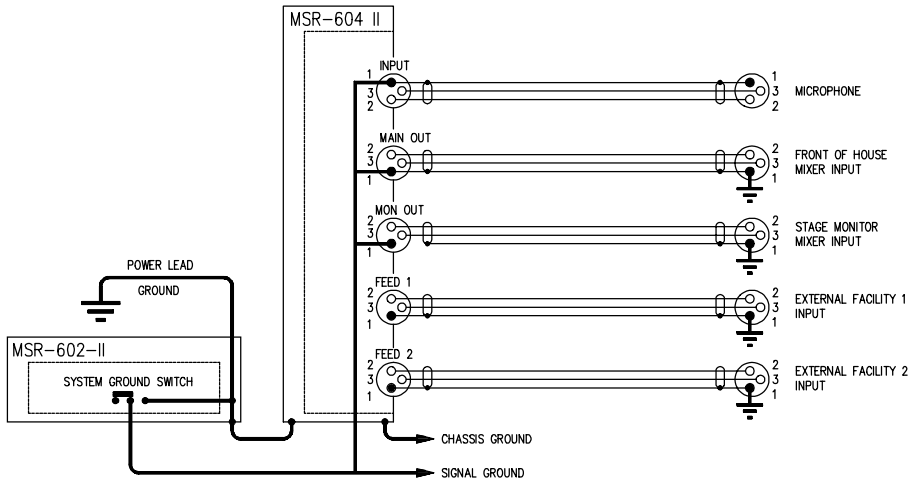
With the use of microphones it is especially important to ensure reliable earthing and screening not only for these noise considerations but also for safety of the performers.

Figure 7 shows the internal grounding arrangements for the MSR-602 II and MSR-604 II, and figure 8 shows one of the common earth and grounding arrangements for a complete MSR-600 system, where the microphone shielding is held directly to ground.

The star grounding point is the main ‘front of house’ mixing console, and this earth is the one used to shield all cables and the microphone body. There should be no connection between this earth and that of the MSR-604 II chassis, and the system ground switch on the MSR-602 II rear panel should be set to ‘lifted’.

All the metal casing associated with the MSR-600 II system will be grounded via the MSR-602 II power cord, and through a separate conductor within the DC power lead to the MSR-604 II units. The electronic 0v ground will be connected to the main front of house mixing console earth system via the interconnecting audio cables.

Fig. 8 System Grounding Arrangements



## Channel Coding

In general the stage monitor console will be connected to the stage mains power grounding system so the signal connecting cables to the 'MON OUTPUT' connector will require the earth connection to be disconnected. That is, the cable screening will be derived from the monitor console, but should not be connected to the electronic 0v earthing system of the MSR-604 II via pin 1 of the connector. This disconnection would be implemented either in the connector, or at the monitor console multiway connector wiring point.

Other systems of earthing can be implemented, such as using the stage earth as the main star point, in which case the system ground switch would be set to 'grounded', or to use the stage monitor console as the main star point.

In any system it is important to remember:

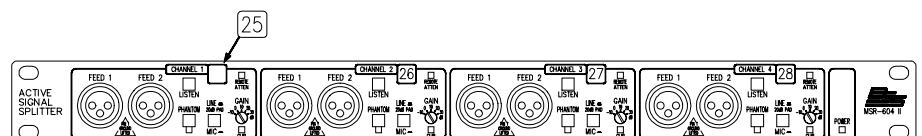
- Choose one star point for all grounding.
- Ensure all microphone screening is permanently held to this ground.
- Ensure that the two main earthing systems, namely stage and front of house, do not accidentally short together.
- Avoid sending signal currents along cable screens.

If these simple guide lines are followed, then implementation of the MSR-600 system will be completed without any troublesome earthing faults, and full safety will be implicit within the design.

### 4.3 Channel Coding

In a system with more than one MSR-604 II unit, identifying which channel of which MSR is the actual system channel will become necessary, and the small pre-numbered self-adhesive labels supplied with the MSR-604 II can be used for this purpose. Figure 9 shows the fitting of these labels to the MSR-604 II front panel.

Fig. 9 Channel Coding



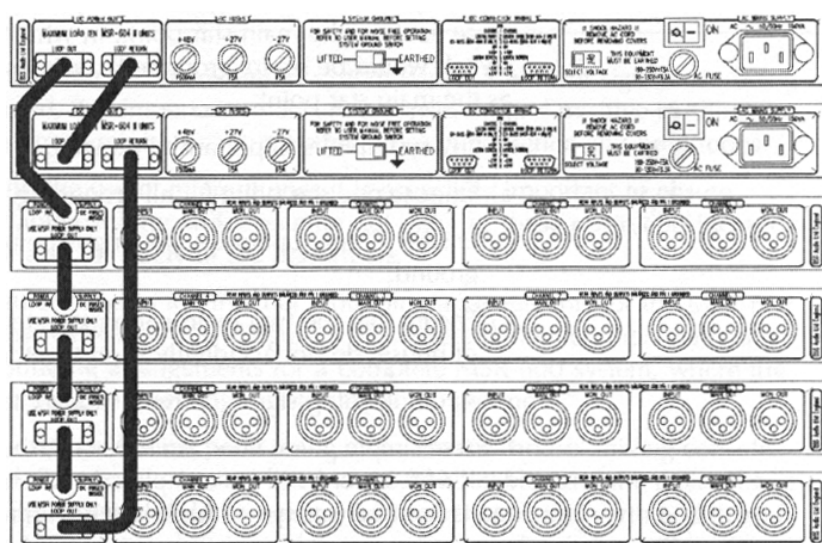
## Dual Power Supply Operation Output Drive Level Setting

### 4.4 Dual Power Supply Operation

The power supply of the MSR-600 system performs a vital role within the sound system and although designed to exacting standards for ultimate reliability, some systems will require a back-up which would automatically take over on failure of the main supply.

This is implemented within the MSR-600 system such that any two MSR-602 II units can be directly connected together. Both units are switched on at all times, and power sharing ensures that the system will continue to operate should either unit fail (see figure 10).

Fig. 10 Dual Power Supply Connection



### 4.5 Output Drive Level Setting

Each MAIN output and MON output can be individually set to drive at mic or line level. A third setting which may be described as 'Hot mic level' is also available in order to provide a headroom structure which is compatible with previous versions of the MSR-604.


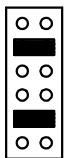
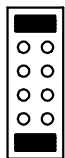
All outputs are set to mic level when the MSR-604 II leaves the factory. Note that the FEED outputs are set for clip at +3dBm (mic level) only and cannot be changed.

The OUTPUT LEVEL SELECT header blocks are clearly marked on the main PCB and are described in Table 1

TABLE 1 OUTPUT LEVEL SELECT JUMPERS

| Function           | Jumper No. | PCB identification |
|--------------------|------------|--------------------|
| Channel 1 MAIN OUT | JP2        | CH1 MAIN O/P       |
| Channel 1 MON OUT  | JP1        | CH1 MON O/P        |
| Channel 2 MAIN OUT | JP6        | CH2 MAIN O/P       |
| Channel 2 MON OUT  | JP5        | CH2 MON O/P        |
| Channel 3 MAIN OUT | JP10       | CH3 MAIN O/P       |
| Channel 3 MON OUT  | JP9        | CH3 MON O/P        |
| Channel 4 MAIN OUT | JP14       | CH4 MAIN O/P       |
| Channel 4 MON OUT  | JP13       | CH4 MON O/P        |

Fig. 11 Output Level  
Select Jumpers

| OUTPUT LEVEL SELECT JUMPERS             |                                                                                   |                                                                                     |                                                                                     |
|-----------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| OUTPUT CLIP LEVEL                       | +3dBm                                                                             | +13dBm                                                                              | +23dB                                                                               |
| JUMPER SETTING                          |  |  |  |
| ONLY USE COMBINATIONS OF SETTINGS SHOWN |                                                                                   |                                                                                     |                                                                                     |

The permissible settings are shown in Figure 11, and the effects of each on system gain and headroom is described in Table 2. Note that combinations of header settings other than those shown should not be used as they do not give a proper balanced drive.

TABLE 2 OUTPUT LEVEL SELECT HEADROOM AND GAIN  
STRUCTURE

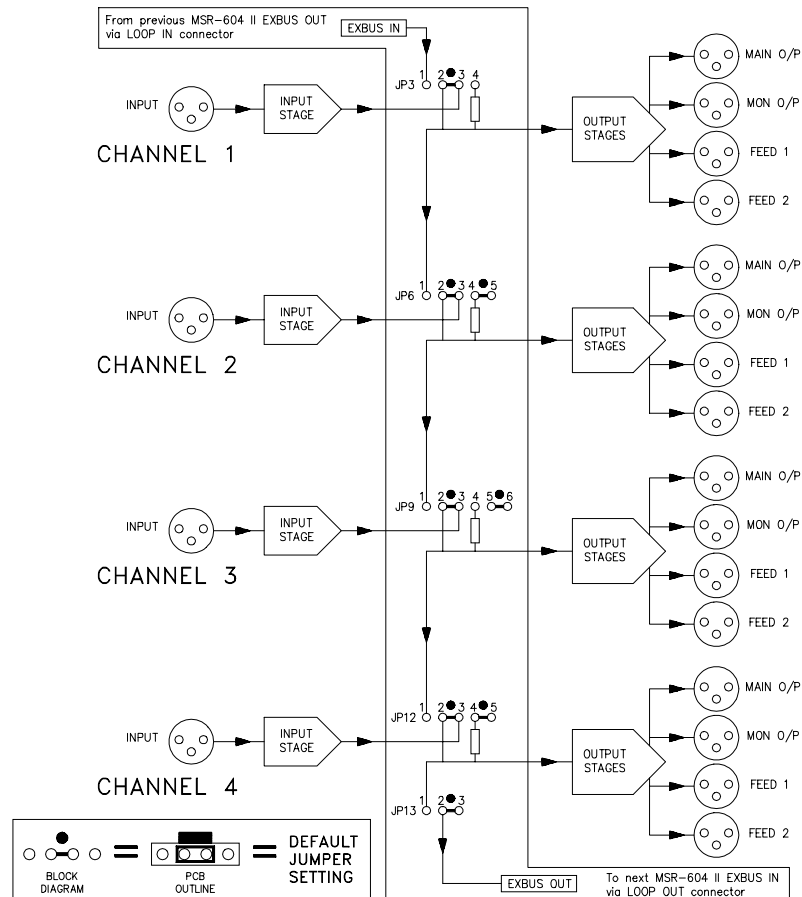
| Setting | Output clip Level | System gain /dB (Note 1) | Description                       |
|---------|-------------------|--------------------------|-----------------------------------|
| 3dBm    | +3dBm             | 0                        | Mic level output. Factory default |
| 13dBm   | +13dBm            | +10                      | MSR-604 pre Mk II compatibility   |
| 23dBu   | +23dBu            | +20                      | Line level output                 |

(Note 1. Gain between input XLR and output XLR with channel Gain switch set to 0dB and input pad set to MIC).

NOTE: The output levels are referred to using both dBm and dBu for different settings. This is because the unit is capable of driving 3dBm or 13dBm into a 600Ω load but the 23dBu output, although capable of driving 600Ω will, drop slightly in level for loads below 2kΩ.

## Multiple Output Distribution Amplifier Configuration

Fig. 12 Bus Linking Block Diagram.  
Default Jumpers



### 4.6 Multiple Output Distribution Amplifier Configuration

For use as a distribution amplifier, or in any situation where more than four outputs per channel are required, the MSR-604 II system may be reconfigured by moving internal jumpers. Up to sixteen adjacent channel sections, a total of sixty four outputs may be driven from a single input stage.

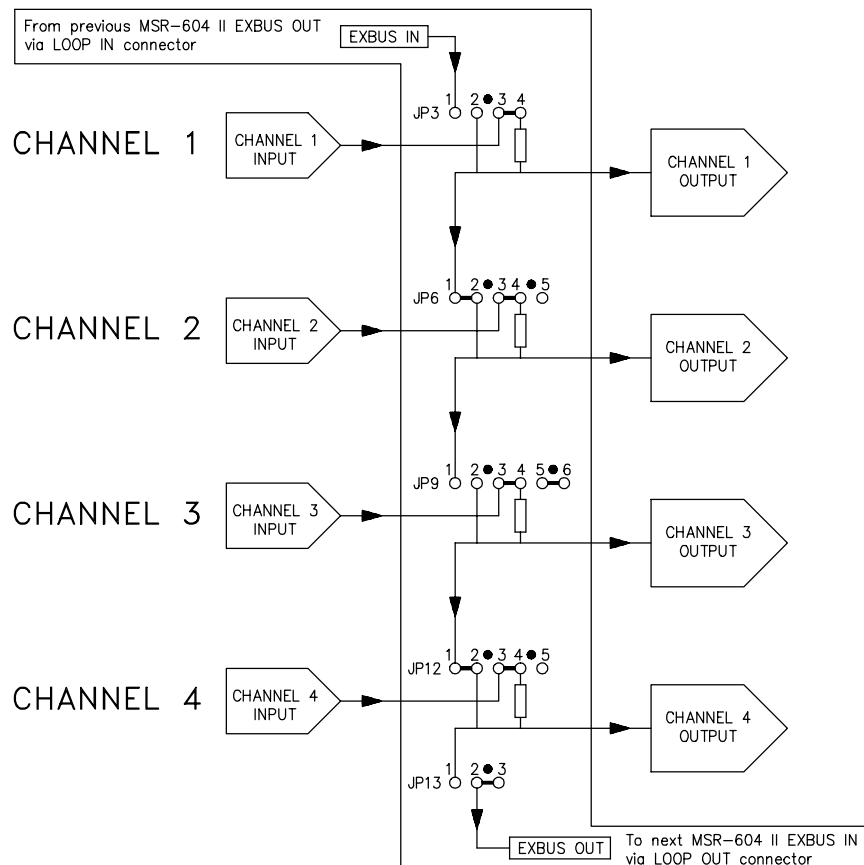
**JUMPER SETTING** The simplified block diagram, Figure 12 shows the segmented internal bus which runs between adjacent channels. This bus is continued via the multiway LOOP connector between MSR-604 II units, allowing blocks of D.A. channel to span several output sections. Figure 12 shows the bus and the bus linking headers in their default settings, i.e. each channel input section is connected to its own output section. The default jumper positions are identified on the PCB by a white block printed adjacent to the relevant jumper pins. By way of example, Figure 13A illustrates a typical distribution amplifier arrangement where Channel 1 input section is used to drive its own and Channel 2's output sections and, likewise, Channel 3 input is driving the outputs of both Channel 3 and Channel 4.





## Multiple Output Distribution Amplifier Configuration Stereo Summing Configuration

Fig. 13B Bus Linking  
In1+In2 Drives Out1 and 2  
In3+In4 Drives Out3 and 4



Note that Jumpers JP3, JP6, JP9 and JP12 have been moved

**CONTROLS** When a group of channels is linked as a D.A., the controls associated with the chosen input section are used to set the required operating conditions. the controls on the other channels are disabled, except for the CLIP LEDs and the LISTEN switches which may be used to confirm that the signal is reaching all the linked output stages.

**4.7 Stereo Summing Configuration** Figure 13B above shows an alternate bus configuration where a stereo pair of inputs is used to drive two output channels in parallel. Each output is a sum of the pair of inputs reduced by 6dB.

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## Compatibility With Pre MkII Systems

### Installing MSR-604 IIs in a Mk 1 System

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## 5.0 Compatibility With Pre MkII Systems

Limited compatibility exists between early MSR-604 systems and MSR604 II units using adaptor leads to interconnect the power cables.

Please order adaptor leads as MSR-604 Mk I adaptor kit Z-MSRIIADK-01. This pair of cables is required for any of the system combinations described below. Only one adaptor set is required per system no matter how many new units are to be installed.

### 5.1 Installing MSR-604 IIs in a Mk I System

The MSR-604 II may be used to extend an existing rack which uses earlier versions of MSR-600 components. Although the Mk II units will perform better than the originals, some of the enhanced performance and features will be lost. In general the dynamic range will be reduced by about 2dB and the LISTEN monitoring function will not be available. Also channel bus linking will be restricted to operating within individual MSR-604 II units.

#### SETTING SYSTEM JUMPERS

Remove the top cover plates on MSR-604 IIs and locate the two jumpers JP14 and JP15 next to the aluminium regulator heatsink. These jumpers will be shipped set to the factory default position, indicated by a solid bar printed on the PCB. Move the jumper blocks away from the default to cover the left and centre pins. It will be noted that yellow LEDs LD9 and LD10 do not now illuminate when power is applied. Replace the cover plate before installing in the rack.

#### RACK INSTALLATION

The new units should be mounted at the top of the rack, away from the MSR-602 power supply. If more than one MSR-604 II is being installed, the LOOP IN/LOOP OUT connectors are 'daisy' chained'

## MSR-600 II Series

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### Installing Pre Mk II MSR-604s Into a New System

### Installing a Mk II Power Supply Into a Mk I System and Vice Versa

#### 5.2 Installing Pre Mk II MSR-604s Into a New System

together as described in section 3.2. Finally the pair of adaptor leads are used to insert the Mk II units into the systems power circuit.

Early MSR-604 units may be added to a Mk II system, but will gain no improvement in performance from the new system. They will run slightly warmer since they will be running from a higher DC voltage supply but there is no danger of damage or impaired reliability.

No changes are required to any internal jumpers or settings and provided that the Mk I units are installed at the 'end' of the DC daisychain, the performance of the Mk II units will not be affected in any way.

#### RACK INSTALLATION

The Mk I MSR-604s should be mounted at the bottom of the rack, away from the power supply. Using the adaptor leads connect the Mk I units between the MSR-602 II LOOP RETURN socket and the final MSR-604 II LOOP OUT socket. If the units are wired into the DC loop wiring at a different point, the LISTEN BUS and the EXBUS-IN/-OUT linking between Mk II MSR units will be broken, disabling these functions.

#### 5.3 Installing a Mk II Power Supply Into a Mk I System and Vice Versa

Mixing Mk I and Mk II power supplies and systems is not generally recommended. Since they are designed to work at different DC rail voltages, performance and facility will be reduced to the lowest common denominator at best. Contact your BSS agent for availability and

## Appendix A

### System Block Diagram and Circuit Description

## 6.0 Appendix A

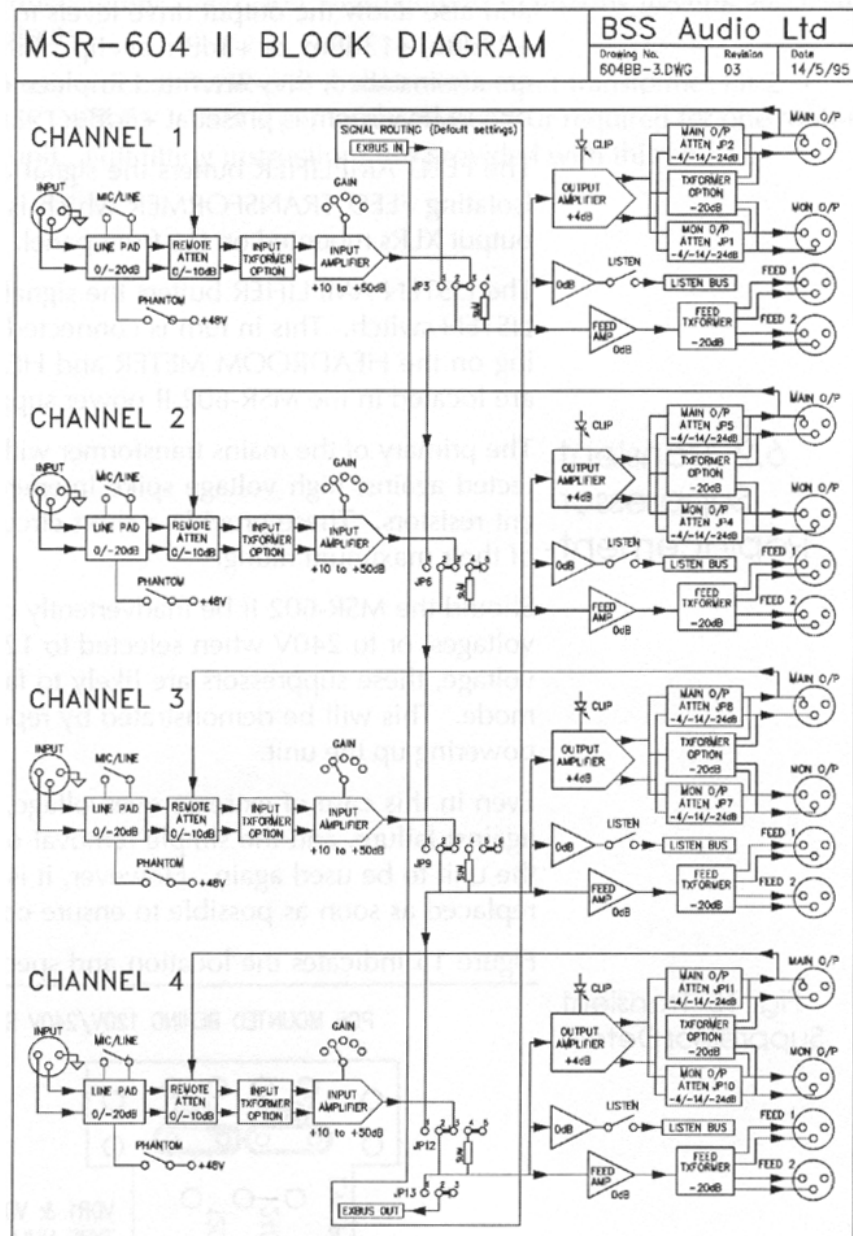
### 6.1 System Block Diagram and Circuit Description

advice if a replacement or a second power supply is required for a Mk I system.

Figure 14 shows the block diagram of the audio section of the MSR-604 II. The DC supply regulator circuits (not shown) are common to all channels. The rails to each channel are protected by fusible resistors so that in the event of a short circuit fault in one channel the other three are not affected.

The input signal passes via RFI filters to the MIC/LINE switch, a balanced 20dB pad, and then to the REMOTE ATTENUATOR. This is a

Fig. 14 MSR-604 II Block Diagram



Transient Suppressor Replacement

6.2 Transient Suppressor Replacement

balanced 10dB pad using a relay controlled by a circuit which monitors the MAIN OUTPUT XLR for the presence of phantom DC voltage. The balanced signal then passes through the optional input transformer, if fitted, and DC blocking capacitors to the low noise INPUT AMPLIFIER. This stage provides the common mode rejection trim, GAIN switch and provides a line level low impedance unbalanced drive signal to the BUS LINKING HEADERS. In the default mode the channel signal is not routed to the bus but is passed to the channel output stages.

The OUTPUT AMPLIFIER has two out of phase line driving outputs which are DC blocked and passed to both the balanced MAIN OUTPUT ATTENUATOR and the balanced MONITOR OUTPUT ATTENUATOR. The signals are then fed to the MAIN OUT and the MON OUT XLRs respectively. The low impedance attenuators ensure that a faulty cable or load on one output will not affect the other and also allow the output drive levels to be independently set to +23dBu, +13dBm, or +3dBm at clip. If the optional output transformers are installed, they are fitted in place of the attenuators and the output headroom is preset at +3dBu.

The FEED AMPLIFIER buffers the signal and drives the dual secondary isolating FEED TRANSFORMER which is connected to the two FEED output XLRs mounted on the front panel.

The LISTEN AMPLIFIER buffers the signal before presenting it to the LISTEN switch. This in turn is connected to the listen bus for monitoring on the HEADROOM METER and HEADPHONE AMPLIFIER which are located in the MSR-602 II power supply.

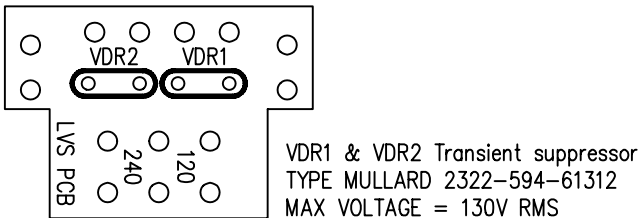
The primary of the mains transformer within the MSR-602 II is protected against high voltage spike interference by two voltage dependent resistors. These provide a short circuit to voltage peaks in excess of their maximum rating.

Should the MSR-602 II be inadvertently connected to 3 phase line/line voltages, or to 240V when selected to 120V, or any other incorrect voltage, these suppressors are likely to fail in a protective short circuit mode. This will be demonstrated by repeated mains fuse failure when powering up the unit.

Even in this case of extreme overvoltage, the MSR-602 II is protected against failure, and the simple removal of these suppressors will allow the unit to be used again. However, it is important that they are replaced as soon as possible to ensure continued protection.

Fig. 15 Transient Suppressor Details

PCB MOUNTED BEHIND 120V/240V SELECTOR SWITCH



## 7.0 Appendix B

**7.1 Input Transformer Balancing** Figure 15 indicates the location and specification for the suppressors. In some situations it might be necessary to provide a transformer balanced input and provision has been made within the MSR-604 II for it's mounting.

Please order as 'MSR-604 II input transformer kit Z-MSRTXIII-01'. This is per channel, with four required for one MSR-604 II unit. Full fitting instructions are provided with this kit.

**7.2 Output Transformer Balancing** Provision has been made within the MSR-604 II to fit 600 ohm transformers to the 'main' and 'mon' outputs to provide floating and isolated outputs.

## Technical Specifications

### 8.0 Technical Specifications

**MSR-604 II** Please order as 'MSR-604 II balanced output transformer kit Z-MSRTX0II-01'. This is per channel with four required for one MSR-604 II unit. Full fitting instructions are provided with this kit.

**Channels** Four: Independent or internally interconnected

**Inputs** XLR-3F Electronically balanced (Transformers optional)

|                  | Microphone   | Line                |
|------------------|--------------|---------------------|
| Impedance        | 2k $\Omega$  | 10k $\Omega$        |
| Max. input level | +13dBu       | +33dBu              |
| CMRR             | >90dB @ 1kHz | >75dB 50Hz to 10kHz |

**Phantom Power** 48VDC via panel switch and LED indicator

**Outputs Main (FOH) & Mon, XLR-3M, Electronically balanced (Transformers optional)**

| Max level (internally preset) |              |              |               |
|-------------------------------|--------------|--------------|---------------|
|                               | +3dBm        | +13dBm       | +23dBu        |
| Impedance                     | <23 $\Omega$ | <71 $\Omega$ | <100 $\Omega$ |
| Max load                      | 200 $\Omega$ | 600 $\Omega$ | 600 $\Omega$  |

**Feeds:** Two, XLR-3M, Transformer balanced

|           |                          |
|-----------|--------------------------|
| Max level | +3dBu                    |
| Impedance | <50 $\Omega$             |
| Max load  | 600 $\Omega$             |
| Isolation | 2.5kV ACrms for 1 minute |

**Gain** -40dB to +50dB in 10dB steps

|                |                                                          |
|----------------|----------------------------------------------------------|
| Gain switch    | -10, 0, 10, 20, 30dB via panel                           |
| Mic/Line pad   | 0/-20dB via panel                                        |
| Remote pad     | 0/-10dB via F.O.H. phantom                               |
| Output scaling | +20/+10/0dB via internal jumper blocks (Main & Mon only) |

**Frequency Response** <+/-0.5dB 20Hz to 20kHz

**Noise (E.I.N.) (20Hz to 20kHz)**

|            |          |
|------------|----------|
| -10dB gain | <-114dBu |
| 0dB gain   | <-121dBu |
| 10dB gain  | <-124dBu |
| 20dB gain  | <-125dBu |
| 30dB gain  | <-126dBu |

**Distortion (T.H.D.)** <0.01% 20Hz to 20kHz @ 10dB below clip

**Level Metering & Monitoring**

|                                     |                           |
|-------------------------------------|---------------------------|
| Channel                             | Clip LED @ 1dB below clip |
| Headroom meter on MSR-602 II PSU    |                           |
| Six point LED meter:                | 0,-1,-3,-6,-12,-26dB      |
| Via Listen switch (momentary)       |                           |
| Headphone monitor on MSR-602 II PSU |                           |
| Via Listen switch (momentary)       |                           |



## Technical Specifications

|            |                           |                                                                 |                                                         |
|------------|---------------------------|-----------------------------------------------------------------|---------------------------------------------------------|
| MSR-602 II |                           | Stereo/Mono                                                     | 1/4in Jack socket                                       |
|            |                           | Load Impedance                                                  | 4Ω to 600Ω                                              |
|            |                           | Max output                                                      | 1W rms                                                  |
|            |                           | Level control                                                   | -90dB to 0dB                                            |
|            | <b>Power</b>              | +/-27VDC, +48VDC from MSR-602 II PSU only                       |                                                         |
|            |                           | Connectors                                                      | 9 pin 'D', with lock jackscrews                         |
|            | <b>Weight</b>             | 3.8kg Net                                                       |                                                         |
|            | <b>Size</b>               | 1.75" x 19" x 11.6" (44 x 482 x 293 mm)<br>excluding connectors |                                                         |
|            | <b>AC Input</b>           | 90-130/180-260VAC 50/60Hz @ 150VAC                              |                                                         |
|            |                           | Connector                                                       | 3 pin IEC with locking clip                             |
|            |                           | Voltage selector                                                | Rear panel 120/240V                                     |
|            |                           | Switch                                                          | Rear panel High-inrush                                  |
|            |                           | Fuse                                                            | Rear panel T3.15AL250V (120V) / T2AL250V(240V)          |
|            | <b>DC Outputs</b>         | +27V unregulated @ 3A max: low ripple                           |                                                         |
|            |                           | -27V unregulated @ 3A max: low ripple                           |                                                         |
|            |                           | +48V +/-5% regulated @ 300mA max                                |                                                         |
|            |                           | Rear panel Fuses                                                | F3AL250V(+27V)<br>F3AL250V(-27V)<br>F300MAL250V(+48V)   |
|            |                           | Connectors                                                      | 9 pin 'D' female Loop out<br>9 pin 'D' male Loop return |
|            | <b>System Ground Lift</b> | Rear panel Slide switch                                         |                                                         |
|            | <b>Indicators</b>         | 3 LEDs, post fuse, on +27V, -27V and +48V outputs               |                                                         |
|            | <b>Headroom Meter</b>     | Via Listen bus and MSR-604 II Listen switch<br>(momentary)      |                                                         |
|            |                           | Six point LED meter 0, -1, -3, -6, -12, -26dB ref clip          |                                                         |
|            |                           | Input via DC Loop out connector                                 |                                                         |
|            | <b>Headphone Monitor</b>  | Via Listen bus and MSR-604 II Listen switch<br>(momentary)      |                                                         |
|            |                           | Input:                                                          | via DC Loop out connector                               |
|            |                           | Connector                                                       | Stereo/Mono 1/4 Jack socket                             |
|            |                           | Load impedance                                                  | 4Ω to 600Ω                                              |
|            |                           | Max output                                                      | 4Ω:860mWrms 200Ω:750mW rms                              |
|            |                           | Level control                                                   | Continuously variable -90dB to 0dB                      |
|            |                           | Headroom                                                        | >MSR-604 II channel clip                                |

# MSR-600 II Series

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## Technical Specifications

|        |                                                                |
|--------|----------------------------------------------------------------|
| Weight | 7.0 kg Net                                                     |
| Size   | 1.75" x 19" x 11.6" (44 x 482 x 293mm)<br>excluding connectors |

**Should you experience any difficulty in operating this equipment please contact your local dealer who will also be able to supply you with information on the full range of equipment manufactured by BSS Audio.**

|            |                                                                          |
|------------|--------------------------------------------------------------------------|
| DPR-402    | 2 Channel Compressor, De-esser, and Peak Limiter                         |
| DPR-404    | 4 Channel Compressor and De-Esser                                        |
| DPR-502    | 2 Channel Noise Gate with Midi Interface                                 |
| DPR-504    | 4 Channel Noise Gate                                                     |
| DPR-901    | Dynamic Equaliser                                                        |
| EPC-760    | High Power Audio Amplifier                                               |
| EPC-780    | High Power Audio Amplifier                                               |
| FCS-926    | Varicurve Dual Equaliser/Analyser                                        |
| FCS-920    | Varicurve Dual Equaliser/Analyser                                        |
| FPC-900    | Varicurve Remote Control System                                          |
| FCS-960    | 2 Channel 30 Band Graphic Equaliser                                      |
| FDS-310    | 2/3/4 Way Variable Electronic Crossover                                  |
| FDS-318    | Stereo Multimode Electronic Crossover                                    |
| FDS-360    | Programmable Electronic Crossover with Limiters<br>and Phase Correction. |
| MSR-604 II | 4 Channel Active Microphone Signal Distribution<br>and Splitting System. |
| AR-116     | Active Direct Injection (DI) Box.                                        |
| AR-117     | Phantom Powering Accessory for AR-116.                                   |
| AR-130     | System Polarity Checker.                                                 |
| AR-125     | Lead and Fuse Checker.                                                   |
| AR-204     | Transformer Line Balancing Unit.                                         |
| AR-416     | 4-Channel Active D.I.                                                    |

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## 9.0 Warranty Information

This unit is warranted by BSS Audio to the original end user purchaser against defects in workmanship and the materials used in its manufacture for a period of one year from the date of shipment to the end user.

Faults arising from misuse, unauthorised modifications or accidents are not covered under this warranty. No other warranty is expressed or implied.

If the unit is faulty it should be sent, in its original packaging, to the supplier or your local authorised BSS Audio dealer with shipping prepaid.

You should include a statement listing the faults found. The unit's serial number must be quoted in all correspondence relating to a claim.

We recommend that you record your purchase information here for future reference.

### **IMPORTANT**

**Dealer Name:**

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**Dealer Address:**

---

---

**Post/Zip Code:**

---

**Dealer Phone No.:**

---

**Dealer Contact Name:**

---

**Invoice/Receipt No.:**

---

**Date of Purchase:**

---

**Unit Serial Number:**

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In keeping with our policy of continued improvement, BSS Audio reserves the right to alter specifications without prior notice.

Harman Music Group, 8760 South Sandy Parkway, Sandy, Utah, 84070

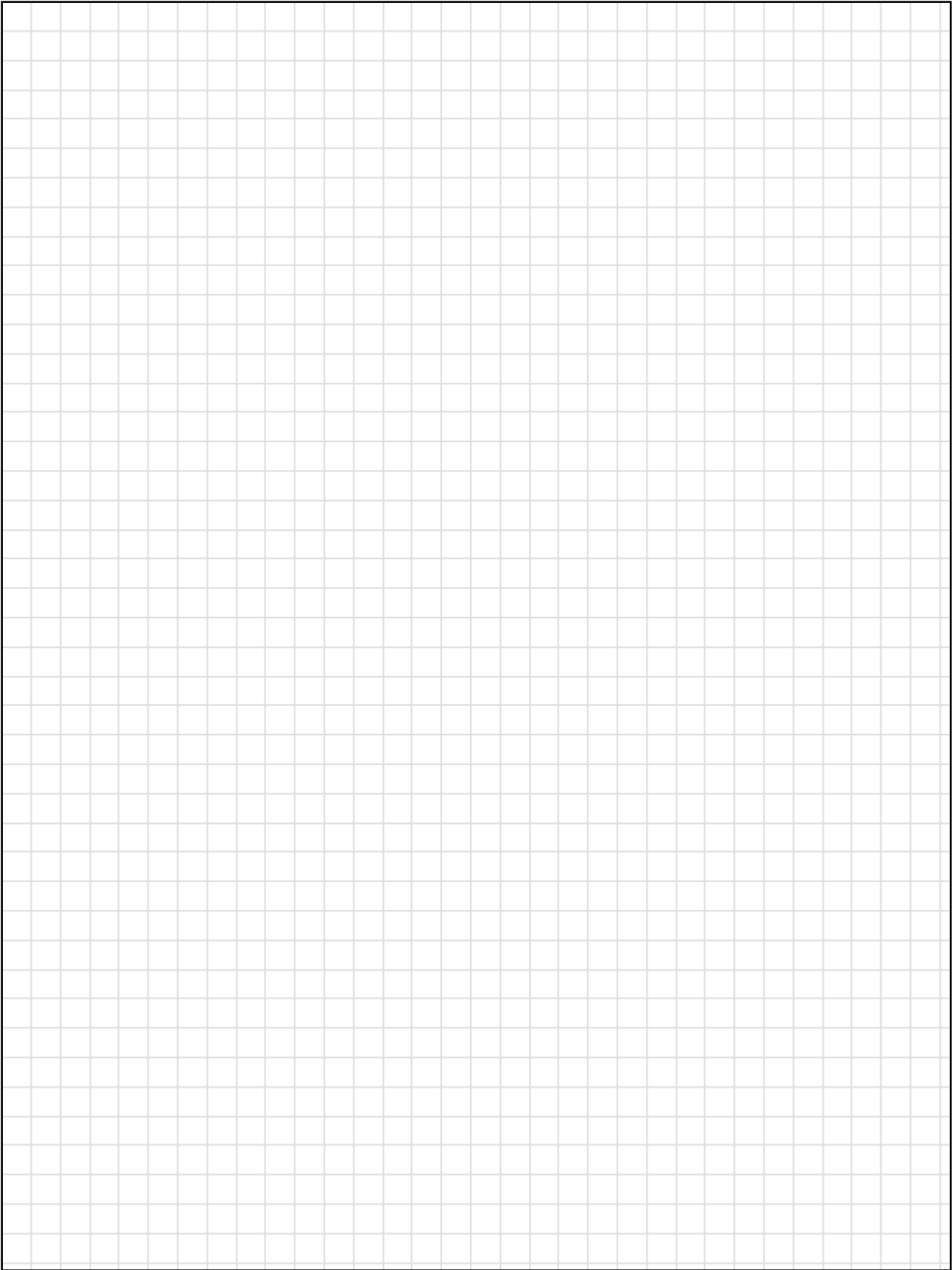
Phone (801) 566-8800.

Fax (801) 566-7005.

World Wide Web address: <http://www.bssaudio.com>

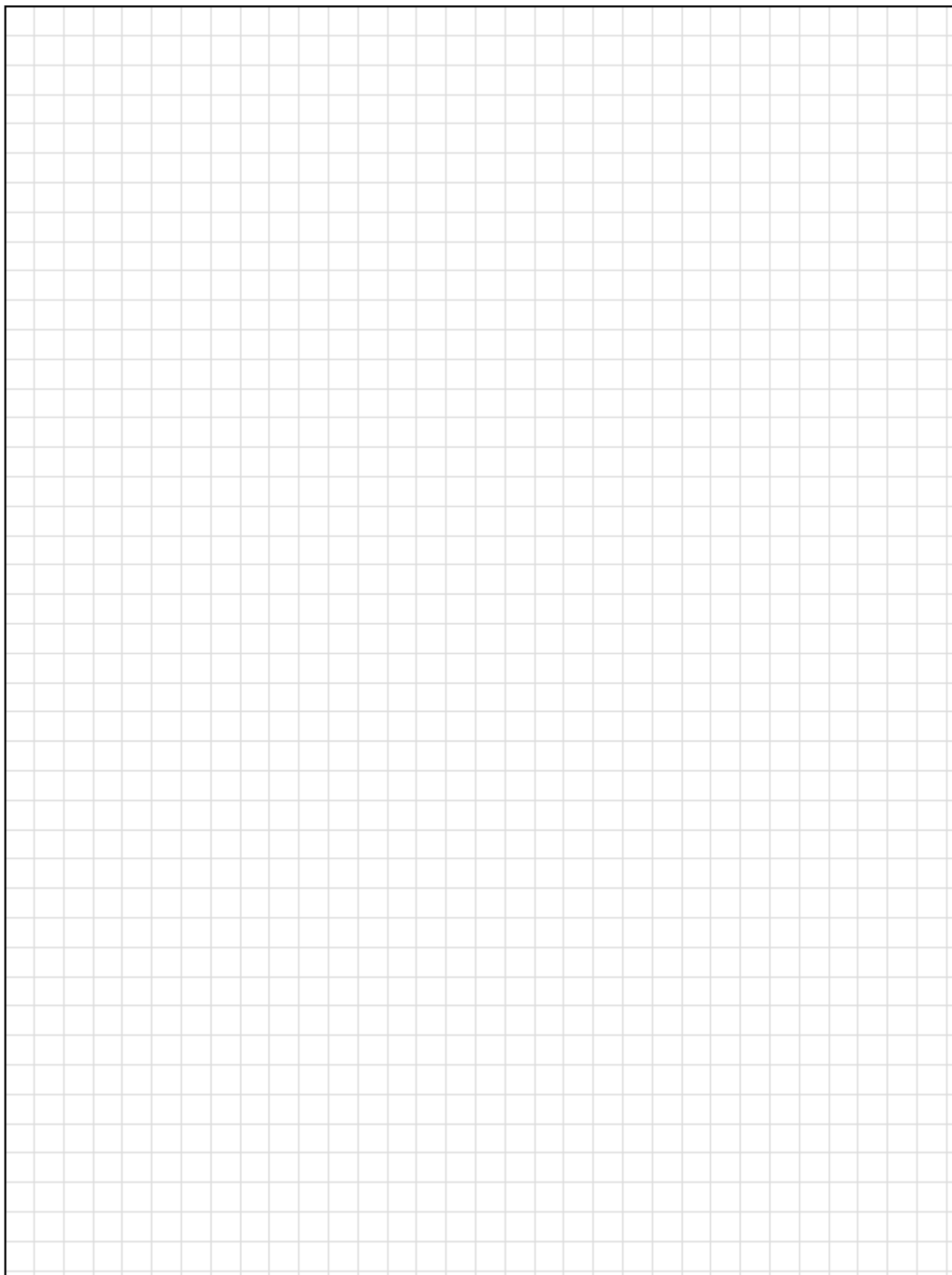
Made in China

USER NOTES



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## USER NOTES



USER NOTES

