ASHLY

MOS-FET POWER AMPLIFIERS

OPERATING INSTRUCTIONS

ASHLY AUDIO INC.

TABLE OF CONTENTS

INTRODUCTION

The Ashly FET-200 and FET-500 represent an entirely new breed of power amplifiers which are destined to replace conventional amps in virtually every application. Far from being just another variation on well worn designs, these amplifiers have been engineered from the ground up to take full advantage of an exciting new semiconductor technology which has recently become available—the Power MOS-FET (metal-oxide-semiconductor, field-effect-transistor). Combining many of the desireable operating characteristics of vacuum tubes with the efficiency of transistors, the MOS-FET offers superior audio fidelity and introduces an entirely new level of field reliability. Ashly power amplifiers put all of these features together into a carefully thought out, roadworthy, user-oriented package which will provide years of maintenance-free service.

WHY MOS-FET'S?

Conventional power amplifier design as typically produced a circuit which consists of two parts; 1) the amplifier itself, and 2) a collection of protective circuits which keep the amplifier from destroying itself and the speakers it is driving. Some of the more common protective circuits include VI limiting, thermal feedback, detectors that monitor DC at the output terminals, short circuit protection and turn-on delay circuits that keep the speakers from jumping out of their cabinets when power is applied. The result has typically been a compromise in audio performance, greatly compounded electronic and mechanical complexity, and amplifiers which are intolerant of less than ideal operating environments.

The basic weakness of these amplifiers has always been the power output transistors themselves, which are prone to failure as a result of "thermal runaway". This breakdown occurs when the amplifier is delivering a lot of power and begins to heat up. Increasing temperature produces an increase in collector current in the output transistors, which in turn produces more heat. If this cycle is unchecked, the transistor will be destroyed.

Probably the greatest advantage of power MOS-FET's for professional audio use is their complete immunity to thermal runaway. Not only does this remove the primary failure mechanism of the conventional amplifier and eliminate the need for elaborate thermal protection circuits, it also allows the design engineer to use a much higher quiescent current in the amplifier's output stage, thereby insuring that the output devices are always operating in their most linear region. This results in consistently lower distortion.

In addition, the simpler input drive requirements of the MOS-FET devices makes possible a clean, concise amplifier design. The resulting reduction in component count and internal wiring provides for a compact design and enhanced reliability.

THE ASHLY DESIGN

Our goal in designing the FET-200 and FET-500 was to produce amplifiers that combine the sonic excellence of a high-end stereo amp with the ruggedness and stamina necessary in pro audio.

ELECTRONIC

Both amplifiers are fully complementary, push-pull type with totally discreet, high voltage, wide bandwidth electronics. This approach inherently assures low noise, low distortion, and excellent transient response. Inputs are bridging, active balanced (transformerless), equipped with both 1/4" jacks and XLR-type connectors of both sexes to facilitate linking several amplifiers together. All input connections can, however, operate as balanced or unbalanced. This is determined by the connector used in conjunction with the input. Stereo, mono and bridging modes are user selectable by means of rear panel switches, requiring no internal modifications or additional components.

All electronic components are conservatively rated and are mounted on a rugged glass-epoxy circuit board. An efficient U-I laminated power transformer saves space and minimizes magnetic flux leakage, permitting other low-level equipment to be mounted above or below the amplifier with no danger of induced hum. Large value, computer grade electrolytic capacitors assure long service. Two 10-segment, 27 dB range LED meter displays provide an easily viewed indication of power levels, and a seperate LED indicates thermal overload.

MECHANICAL

The Ashly MOS-FET power amplifiers are packaged in a rugged, one-piece welded 16 gauge steel chassis with an anodized aluminum front panel and an easily removed steel top cover. The chassis and all internal components are integrated into a single, rigid unit. The FET-500 requires 5 1/4" of rack space and the FET-200 requires only 3 1/2". The power transformer is located near the front of each amplifier, reducing mechanical stress on the chassis. Each channel's electronics and heat sink are combined into a compact, plug in module which can be removed from the amplifier in seconds. Hard wiring is at an absolute minimum.

Large heat sinks and an aerodynamic internal design permit the use of an ultra-quiet, slow speed fan which pulls air in through the front panel directly across the heat sinks and power transformer, and out through the rear panel. It is unnecessary to provide space or ventilation above or below the amplifier, allowing for economical use of rack space.

The amplifier's output connectors are conveniently arranged on standard 3/4" spacing for quick interconnect via banana plugs. Selecting the bridging output involves only moving the banana plug to the two center (RED) connectors. Both the AC line and the speaker terminals are fused protected. Fuses can be removed instantly without tools. There are no internal fuses.

IN USE

The result: better sounding amplifiers, remarkably un-fussy about how you use them. They will tolerate low impedance, highly reactive loads and hot, crowded racks. They are highly immune to RF interference and will not be damaged by intermittent short circuits--sustained shorts will simply blow the output fuse. Due to their balanced circuit design, the use of delay circuits and output relays are unnecessary. There is no turn-on thump and the volume controls can remain up when power is applied and removed. Both amps will keep on running right through a brown-out, even when line voltages fall to as low as 20 volts!

This manual will explain the proper installation and use of Ashly amplifiers and their controls. Please read it carefully and refer to it in case of difficulty.

UNPACKING

As part of our system of quality control, every Ashly product is carefully inspected before leaving the factory to ensure flawless appearance. After unpacking please inspect for any physical damage. Save the shipping carton and all packing materials, as they were carefully designed to reduce to a minimum the possibility of transportation damage should the unit again require packing and shipping. In the event that damage has occurred, immediately notify your dealer so that a written claim to cover the damages can be initiated.

THE RIGHT TO ANY CLAIM AGAINST A PUBLIC CARRIER CAN BE FORFEITED IF THE CARRIER IS NOT NOTIFIED PROMPTLY AND IF THE SHIPPING CARTON AND PACKING MATERIALS ARE NOT AVAILABLE FOR INSPECTION BY THE CARRIER. SAVE ALL PACKING MATERIALS UNTIL THE CLAIM HAS BEEN SETTLED.

INSTALLATION

Ashly MOS-FET amplifiers are designed to mount in a standard 19" equipment rack. Since forced-air cooling is employed, it is not necessary to leave any ventilation space above or below the amplifier. This permits efficient use of rack space and multiple stacking of amplifiers. The only precaution to observe is to leave the front panel air inlets and rear panel fan outlet unobstructed.

The use of four front panel screws is recommended to evenly distribute the stress on the panel. The amplifier chassis is sufficiently strong to support itself by the front panel alone in permanent installations or where the rack is moved only occasionally. For amplifiers which will spend much of their time in transit, it is suggested that some method of rear support be used.

Connect all amplifiers to a 3-wire grounded outlet supplying 120 Volts 50-60Hz Maximum power consumption is 600 watts. Maximum current required is 5 amps.

INPUT AND OUTPUT CONNECTIONS

STEREO OPERATION

Connections for stereo operation are shown in Figure 4 below.

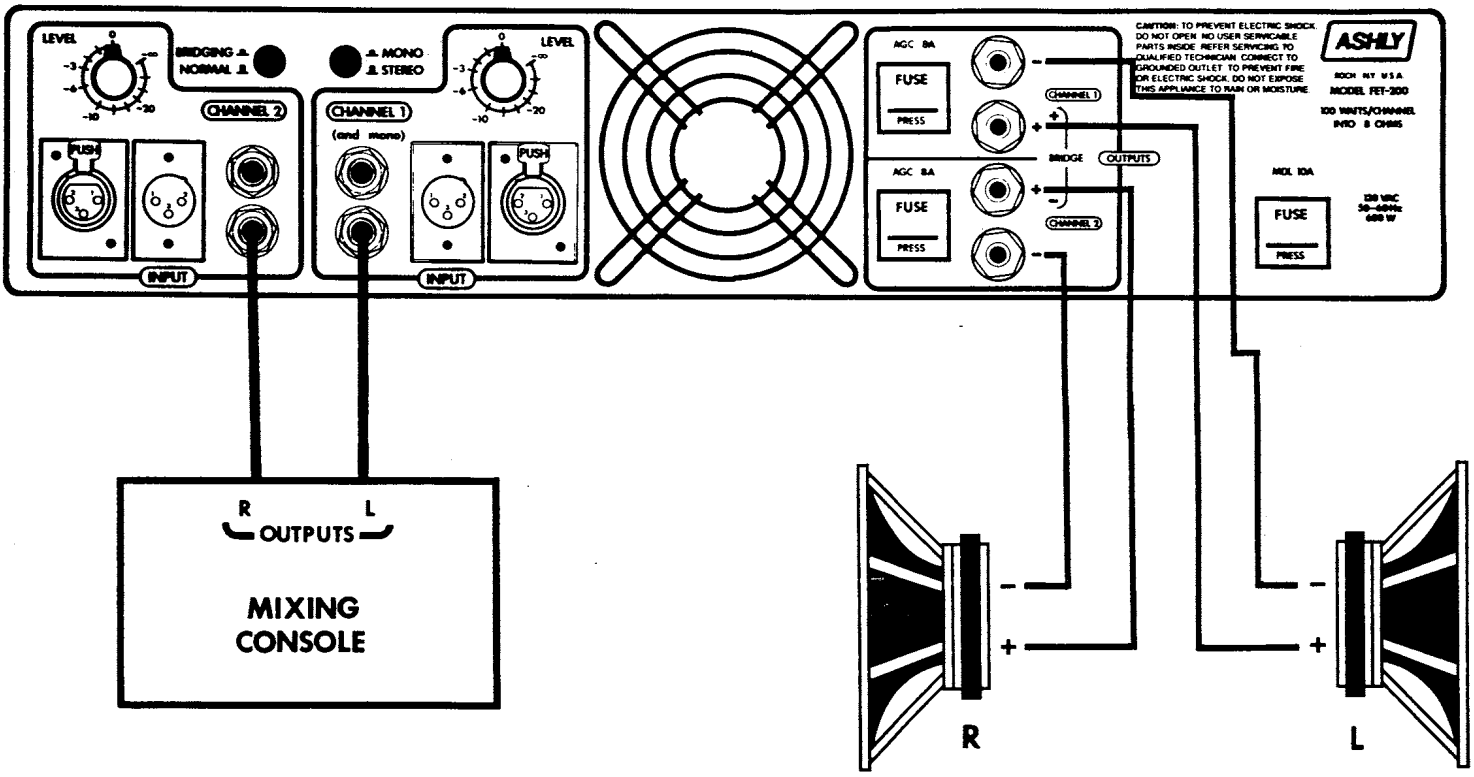


Figure 4 Stereo Operation

INPUTS

The input of Asnly amplifiers is a balanced bridging type, with an input impedance of 10k ohms. Use of the balanced input provides superior hum and noise rejection while eliminating ground loops. The input may also be used in a single-ended, unbalanced mode by simply using unbalanced input connectors.

Each channel provides a choice of either 1/4" jacks or XLR input connectors. All four connectors are in parallel. Since only one of the four connectors is used as an input at any one time, the others may be used to jumper other amplifiers to the same source.

Signal connections are as follows:

The (+) or in-phase connection is on the tip of the 1/4" stereo phone jacks, and is on pin 3 of the XLR connectors. The (-) or out-of-phase connection is on the ring of the phone jacks and on pin 2 of the XLR's. Chassis ground and shield is on the sleeve of the 1/4" jacks and pin 1 of the XLR's.

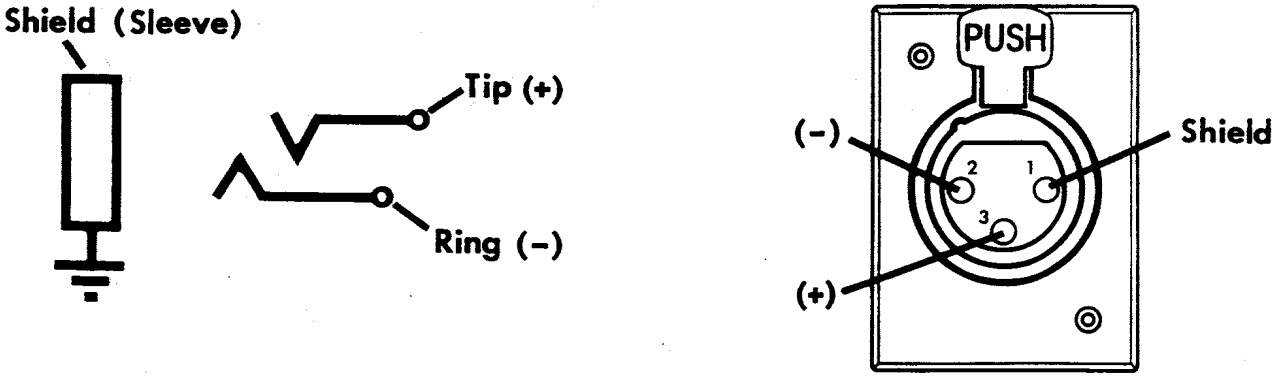


Figure 5

When feeding the amplifier from an unbalanced source, use either an XLR connector or a standard stereo 1/4" phone plug and connect the signal "hot" connection to XLR pin 3 or to the phone plug tip. Connect signal ground to the XLR's pins 1 and 2 or to the phone plug's ring and sleeve. The latter may also be accomplished by simply inserting a standard 1/4" mono phone plug, which automatically connects ring and sleeve together.

In the special case where the amplifier is physically mounted in the same rack with the signal source that is feeding it, you may wish to use an alternate connection system to avoid ground loops: connect the signal hot to XLR pin 3 or to the phone plug tip. Connect signal ground to XLR pin 2 or to the phone plug ring. Leave the XLR's pin 1 and the jack sleeve unconnected.

SPEAKER OUTPUTS

The speaker output connections are combination banana jacks/binding posts spaced on standard 3/4" centers. Speaker connections may be accomplished either by inserting banana plugs or by feeding bare stranded wire into the binding posts.

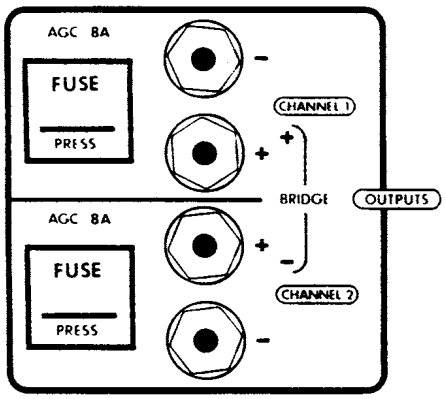


Figure 6

MONO OPERATION

With the MONO switch depressed, the Channel 1 input will feed both sides of the amp. Volume for both sides is controlled with the channel 1 LEVEL control.

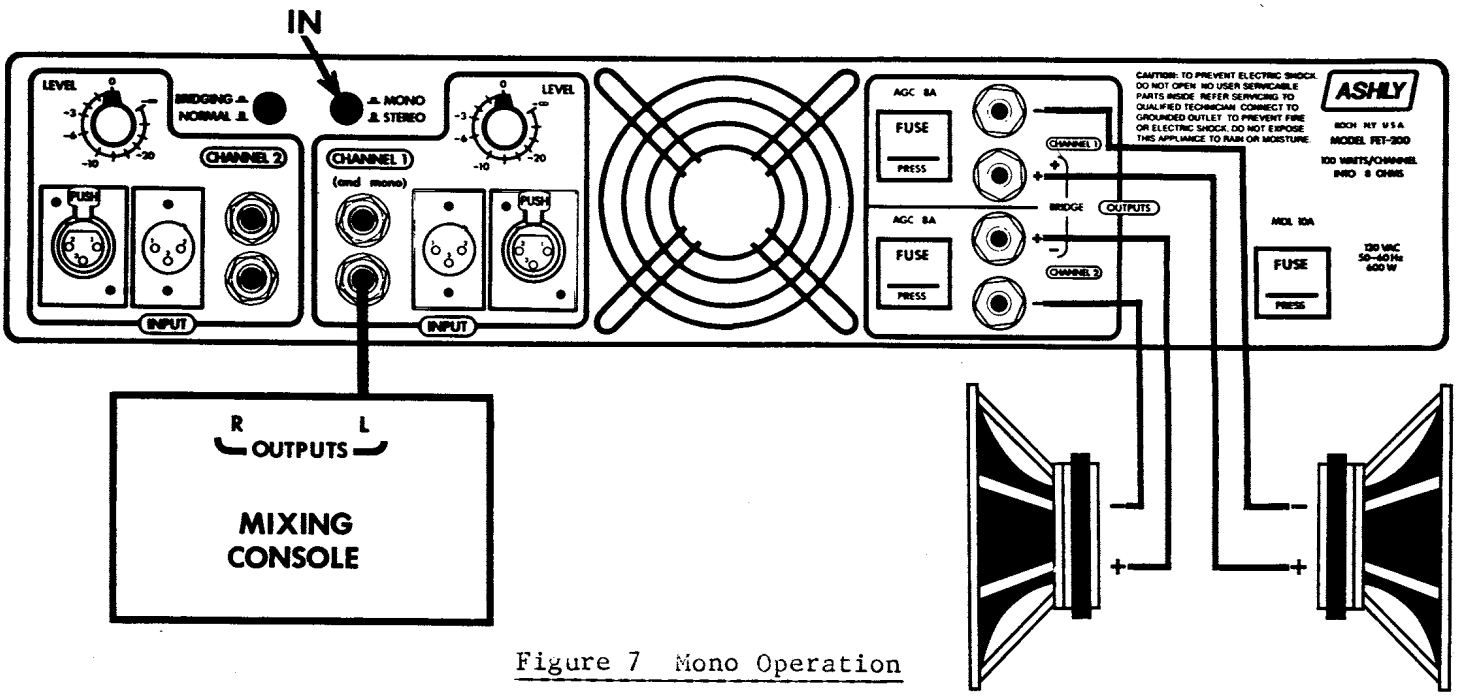


Figure 7 Mono Operation

BRIDGING OPERATION

Ashly amplifiers are in the bridging mode when both the MONO switch and BRIDGING switch are depressed. In this mode, the channel one input feeds both sides of the amp, but the phase of the channel two amplifier is inverted 180 degrees, so that the two amplifiers' outputs are out of phase. The speaker connection is then made to the two RED output jacks, as shown in Figure 8. The black output jacks are not used.

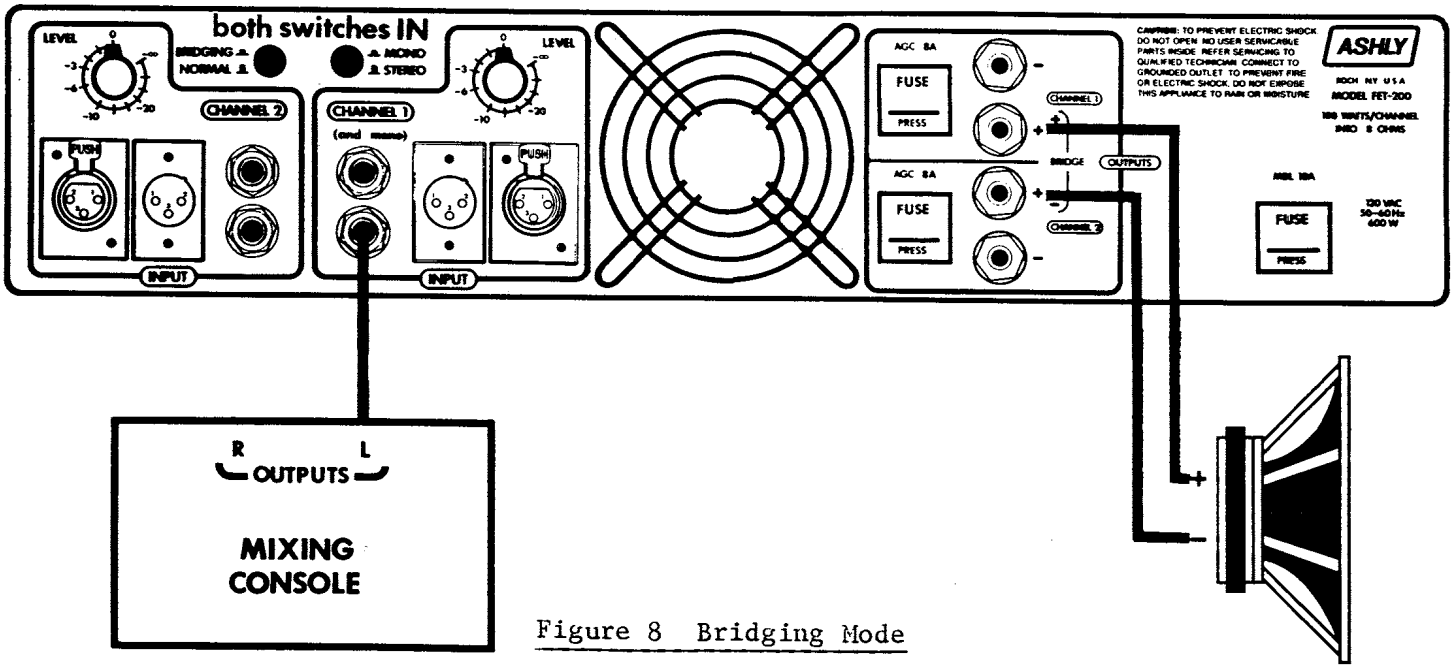


Figure 8 Bridging Mode

METERS

The meters on the front panel respond to the peak output voltage of the amplifier as measured at the speaker terminals. A ten segment, three color LED display covers a twenty-seven decibel range.

If all of the LED's on one channel light up and stay on with only a small input signal, a blown speaker fuse or faulty speaker wiring is indicated.

THERMAL STATUS INDICATOR

In the event that the amplifier overheats, it will automatically shut down and the green THERMAL STATUS LED will turn off. The fan will continue to run, and when the heat sink temperature returns to normal the green THERMAL STATUS LED will come back on and the amplifier will turn itself back on.

It is extremely unlikely that any combination of musical program material and load conditions will activate the thermal shutoff mechanism in normal use. Should overheating occur, check to be sure that the air flow in front of and behind the amplifier has not been blocked.

Note that there is a very generous safety margin between the temperature required to activate the thermal cutouts and temperatures which could damage components in the amplifier.

SPECIFICATIONS:

FET-200

RATED POWER	100 Watts/channel Both channels driven into 8 ohms 160 Watts/channel Both channels driven into 4 ohms 320 Watts into 8 ohms bridged mono
FREQUENCY RESPONSE	±.5db 10Hz-50kHz
HARMONIC DISTORTION	< .05% 20Hz-20kHz, 100 watts, 8 ohms
IM DISTORTION (SMPTE)	< .01% 100 watts, 8 ohms
DAMPING FACTOR	> 100 20Hz-20kHz
SLEW RATE:	50V/ µsec
RISE TIME	2 µsec 10%-90%

FET-500

RATED POWER	250 Watts/channel Both channels driven into 8 ohms 400 Watts/channel Both channels driven into 4 ohms 800 Watts into 8 ohms bridged mono
FREQUENCY RESPONSE	±.5db 10Hz-50kHz
HARMONIC DISTORTION	< .05% 20Hz-20kHz, 100 watts, 8 ohms
IM DISTORTION (SMPTE)	< .01% 100 watts, 8 ohms
DAMPING FACTOR	> 100 20Hz-20kHz
SLEW RATE:	50V/ µsec
RISE TIME	2 µsec 10%-90%

DEFINITION OF TERMS AS USED IN THIS MANUAL

ACTIVE

Electronic circuits which use devices such as transistors and integrated circuits, and which are capable of voltage and power gain as well as loss. Circuits using only resistors, capacitors, transformers, etc., are referred to as passive.

AMPLITUDE

The voltage level of a signal. May be measured in volts or decibels. Generally corresponds to the volume or intensity of an audio signal.

BALANCED

A 3-wire circuit arrangement in which two conductors are designated as signal lines (+ and -), and the third is a shield and chassis ground. The signal lines are of opposite polarity at any given moment, and are of equal potential with respect to ground. Balanced input amplifiers are used on all Ashly SC series products to improve hum and noise rejection. Jumpering signal minus (-) to ground provides an unbalanced input.

BREATHING

A usually undesirable fluctuation of background noise resulting from compressor action. (Also called "Pumping.")

BUTTERWORTH

The name of a particular filter response shape. The response is essentially "flat" within the pass-band, is 3dB down at the cutoff frequency, and continues to attenuate at a constant slope. Also called a "maximally flat" or "critically damped" filter shape, it is very popular for crossovers and shelving filters.

CENTER FREQUENCY

The frequency (or pitch) at which a filter is most effective. In a parametric equalizer, it refers to the frequency where a particular boost/cut control has maximum effect.

COMPRESSOR

An amplifier which reduces its gain as its input is increased beyond a predetermined "threshold."

DAMPING

A force which opposes the tendency of a system to oscillate.

dB

A unit by which audio levels can be COMPARED. Often thoroughly misunderstood are the concepts that decibels represent the level of a signal compared to some reference level (15 dB cut means a certain level less than a previous level --- the absolute level of the signal need not be known), and that decibels are a logarithmic unit. Some handy numbers to remember when dealing with decibels:

+3 dB = Double Power	+10 dB = 10X Power
+6 dB = Double Amplitude, Quadruple Power	+20 dB = 10X Amplitude, 100X Power

dBm

A unit of measurement in decibels where 0 dBm = a power level of 1 milliwatt into a 600 ohm load. Originally defined by the telephone company to measure line levels.

dBV

Decibel Volts, an update of the dBm definition where 0 dBV = the same voltage level as 0 dBm, but with no regard to power or impedance. 0 dBV = 0.775 Volts. This unit is much more appropriate for modern audio equipment with high impedance inputs and low impedance outputs.

DISTORTION

Generally refers to ANY modification of an audio signal which produces new frequencies which were not in the original. Examples are harmonic distortion, where a circuit adds overtones to a fundamental signal, and intermodulation or IM distortion, where two frequencies beat together to produce sum and difference frequencies.

EQUALIZATION

Modification of the frequency response of an audio system for either corrective or enhancement purposes.

FEEDBACK

Generally refers to any process where an output is in some form routed back to an input to establish a loop. Negative feedback tends to be be self stabilizing, while positive feedback causes instability.

FILTER

A circuit designed to pass some frequencies, but not others. There are three general categories of filters: High-pass, band-pass, and low-pass. The high-pass filter passes frequencies above a certain limit, the low-pass passes frequencies below a limit, and the band-pass passes one group of frequencies without passing those above or below. Our equalizer uses band-pass filters, crossovers use high and low-pass filters.

FREQUENCY

The repetition rate of a waveform. Frequency is measured in Hertz. One cycle per second (cps) is one Hertz (Hz). The higher a note on a musical scale, the higher its frequency.

FREQUENCY RESPONSE

Refers to relative gain and loss at various frequencies across the audio band. May be illustrated by a graph called a frequency response plot, usually graphing decibels vs. Hertz or octaves.

HERTZ (Hz)

The unit of frequency measurement. (Formerly called Cycles-per-Second: this explains it perfectly)

HEADROOM

Refers to the increase in level above normal operating level that can be obtained without clipping. Usually expressed in dB.

IMPEDANCE

Essentially the AC equivalent of resistance. It describes the drive capability of an output, or the amount of drive required for an input at any given signal level.

KHz

Kilohertz. 1,000 Hertz.

LEVEL

The magnitude of a signal, expressed in decibels or volts.

LIMITER

An amplifier which reduces its gain as its input is increased beyond a predetermined threshold. Usually used to protect audio systems against sudden, high level signals, and possible overload.

LINE LEVEL

Meaning "somewhere around 0dBV" as opposed to MIC level of around -40dBV.

MILLISECOND

1/1000th of a second

MICROSECOND

1/1,000,000th of a second

OCTAVE

A logarithmic unit to compare frequencies. +1 Octave means double frequency, -1 Octave means half frequency.

OHM

The unit of electrical resistance or impedance.

PHASE

Describes how well two signals are in step. In-phase means that positive and negative peaks in two signals occur together, while out-of-phase means they do not occur together. Variations in signal timing as well as polarity can make two signals in or out of phase, or anywhere in between. Phase is usually measured in degrees where 0 degrees is in-phase, 180 degrees is out-of-phase, and 90 degrees is in between (sometimes called quadrature).

PREAMPLIFIER

The first stage of amplification, designed to boost very low level signals to line level.

"Q"

A measurement describing the sharpness or broadness of a filter.

RESONANCE

The tendency of an electrical or mechanical system to vibrate (or oscillate) at a certain frequency.

SATURATION

The point at which the magnetic storage capability of a piece of recording tape is exceeded.

SIBILANCE

The distortion caused by loud high frequency signals, such as the "Ssss..." sounds in human speech.

SHELVING

Describes an equalization action where all frequencies above or below a particular frequency are boost or cut.

SLOPE

In a filter or equalizer, a description of the rate of boost or attenuation. Usually specified in dB/octave (6, 12, 18, and 24dB/octave slopes are most common). The steeper the slope, the higher the "Q" in a filter.

THRESHOLD

An arbitrary signal level, above which a limiter or noise gate activates.

TRANSIENT

A sudden burst of energy in an audio signal, such as a breath blast in a microphone, the sound of a snare drum, or a deep scratch in a record. Transients frequently reach peak levels of 10 to 30 dB above standard operating level, and may cause distortion or even damage to equipment.

UNITY GAIN

Output level = Input level.

VCA

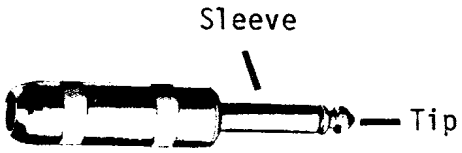
Voltage Controlled Amplifier. An amplifier capable of both gain and loss, controlled by a variable DC voltage.

WIRING, PHONE PLUG AND XLR

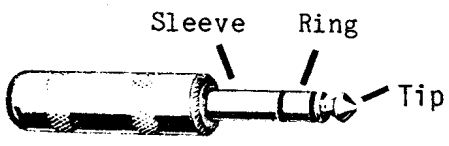
A stereo phone plug is wired + to the tip, - to the ring, and shield to the sleeve. For a mono phone plug, combine - and shield, and connect both to the sleeve.

An XLR (3 Pin) connector is wired + to pin 3, - to pin 2, and shield to pin 1.

Mono Phone Plug:
(for unbalanced inputs and outputs)



Stereo Phone Plug:
(for balanced inputs and outputs)



XLR Type Connector:
(Male Shown)

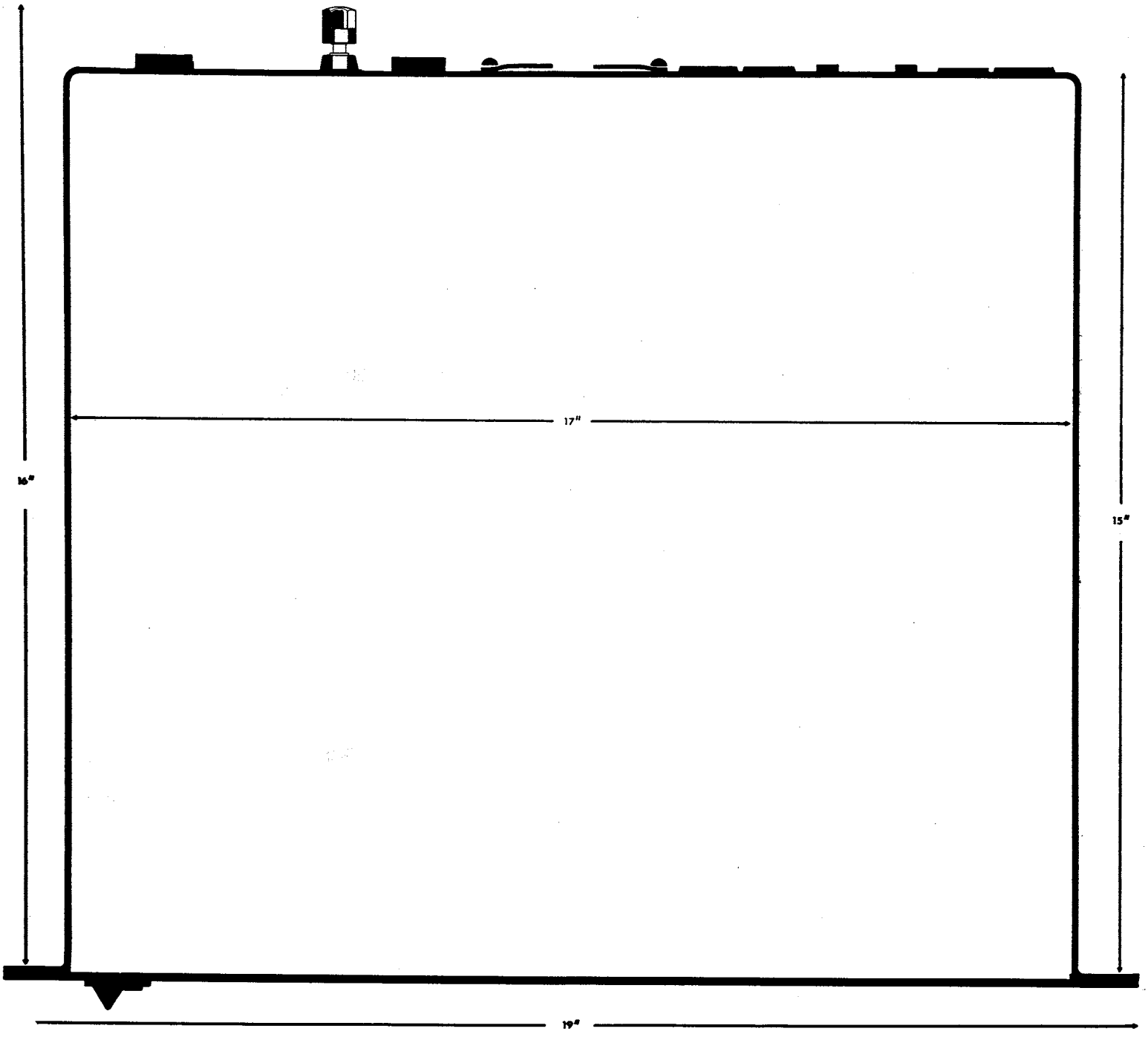


Figure 3