

Owner's Manual

EX Series

▲ EX 2500

▲ EX 4000



TD-000024-00

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**EX 2500 & EX 4000
 POWER AMPLIFIER
 OPERATION MANUAL**

SEE NOTICE OF ADDITIONAL SAFEGUARDS ON PAGE 2.

WARNING: TO PREVENT FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE.



CAUTION
RISK OF ELECTRIC SHOCK
DO NOT OPEN



CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE THE COVER. NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.



AVIS
RISQUE DE CHOCK ELECTRIQUE
NE PAS OUVRIR



ATTENTION: POUR EVITER LES RISQUES DE CHOCK ELECTRIQUE, NE PAS ENLEVER LE COUVERCLE. AUCUN ENTRETIEN DE PIECES INTERIEURES PAR L'USAGER. CONFIER L'ENTRETIEN AU PERSONNEL QUALIFIE.

VOYEZ NOTIFICATION DES PRECAUTIONS ADDITIONALE SUR PAGE 2.

AVIS: POUR EVITER LES RISQUES D'INCENDIE OU D'ELECTROCUTION, N'EXPOSEZ PAS CET ARTICLE A LA PLUIE OU A L'HUMIDITE.



Explanation of Graphical Symbols

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 humans.



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



Explication Des Symboles Graphiques

Le symbole éclair avec point de flèche à l'intérieur d'un triangle équilatéral est utilisé pour alerter l'utilisateur de la présence à l'intérieur du coffret de "voltage dangereux" non isolé d'ampleur suffisante pour constituer un risque d'électrocution.



Le point d'exclamation à l'intérieur d'un triangle équilatéral est employé pour alerter les utilisateurs de la présence d'instructions importantes pour le fonctionnement et l'entretien (service) dans le livret d'instruction accompagnant l'appareil.

Safeguards

Electrical energy can perform many useful functions. This unit has been engineered and manufactured to assure your personal safety. Improper use can result in potential electrical shock or fire hazards. In order not to defeat the safeguards, observe the following precautions and those on page 1 for its installation, use and servicing.

Precautions

L'énergie électrique peut remplir de nombreuses fonctions utiles. Cet appareil a été conçu et réalisé pour assurer une sécurité personnelle entière. Une utilisation impropre peut entraîner des risques d'électrocution ou d'incendie. Dans le but de ne pas rendre inutiles les mesures de sécurité, bien observer les instructions suivantes et sur le page 1 pour l'installation, l'utilisation et l'entretien de l'appareil.

Speaker Damage

The EX 4000 amplifier has two to three times the power output of most "high-power" professional amplifiers. The EX 2500 is also very powerful. It is the user's responsibility to make sure that the speakers can handle the amp's power.

QSC will not be responsible for blown speakers. Consult the speaker manufacturer for power-handling recommendations.

Special circuitry (Clip-Limit) limits the input signal to prevent heavy clipping. Therefore the amplifier can operate at a high average power without obvious distortion. If your speakers fail and the amplifier is still operating normally, this means that the speakers could not handle the power.

The output power level is determined by the volume of the input signal, and not directly by the amplifier's Gain control. It is still possible to get the amplifier's full output power, even with reduced Gain settings. It is like putting a stronger spring on your car's accelerator pedal. This may reduce the engine's power for "average pressure," but it is still possible to floor the pedal if you push hard enough.

High frequency drivers can be blown almost instantly by a single high-power crescendo. Low frequency drivers will usually withstand high power for a few seconds, but can still be blown if the amplifier is operated continuously at full power. Reduce power immediately if you hear "bottoming" (harsh pops or cracking distortion), as this indicates that the speaker voice coil or diaphragm is striking the magnetic assembly.

QSC recommends that amplifiers of this power range be used for more *headroom* (cleaner sound) rather than for increased volume. Please consult Section Two, "Using the Level Displays," for advice on how to use the front panel LEDs to estimate output power.

Speaker Output Shock Hazard

The EX 4000 and EX 2500 are capable of hazardous output voltages. To avoid electrical shock when using the Binding Posts for speaker connections, do not touch exposed speaker wiring while the amplifier is operating.

The Speakon connectors are polarized, locking, and fully insulated. We recommend them for safety and reliability – especially in portable service. In addition, the Speakon prevents the speakers from being connected out of phase.

Rack Mounting Precautions

To avoid damage to the amplifier mounting ears and/or rack rails, the amplifier must be supported at all four corners when used in portable racks.

Consult QSC Service Dept for availability of Rear Support Brackets.

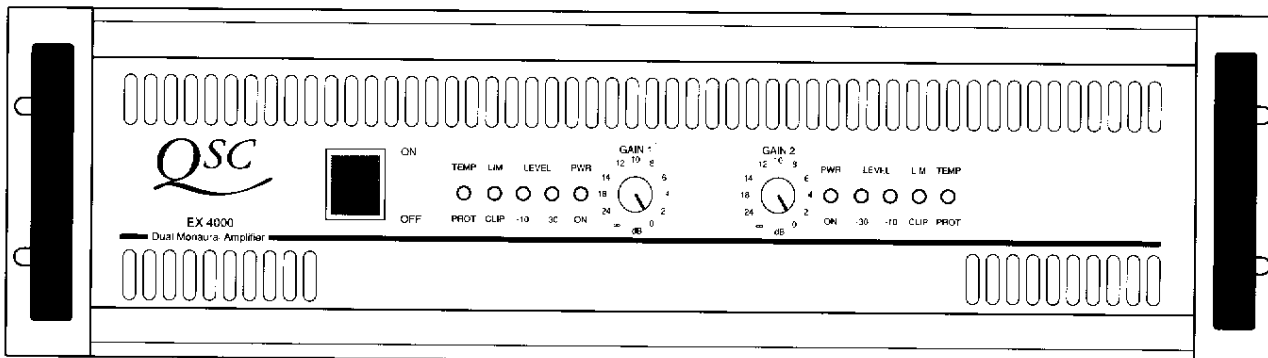


Figure 1-1. QSC EX 4000 Front Panel (identical to EX 2500 panel)

Overall Description

The EX 4000 (and EX 2500) are high-efficiency professional power amplifiers, with two independent channels, each capable of delivering 720 (500) watts into eight ohm loads, 1100 (750) watts into four ohms, and 1400 (1000) watts into two ohms. Semi-toroidal power transformers (one per channel), which reduce the unit's weight, are mounted in each front corner, as close as possible to the rack ears and rails. The amplifier occupies three rack spaces, weighs 64 lbs, and requires a rack depth of 18" to clear the rear support ears. The rear panel is 16.9" behind the front mounting plane, so an extra rack depth allowance (i.e., more than 18") will be needed to clear XLR or Speakon connections. The built-in fan cooling takes air in the rear, exhausting through front vents. Due to the flow-through cooling, amplifiers may be racked with zero clearance in between, which also helps support the weight.

Both amplifiers have the same "footprint" as the QSC MX 1500 and MX 2000, with a depth similar to other popular high -power, low-profile amplifiers. The EX 4000 weighs 16% less than the QSC 3800 or MX 2000, while delivering approximately double the power.

Inputs

Balanced input connections are available via barrier strip or XLR connectors. The unit is shipped with pin 2 high (see Section Two to change polarity). As usual, for unbalanced inputs, the unused terminal should be terminated to ground (the negative input terminals on the barrier strip are located adjacent to the ground terminal for this purpose).

Input sensitivity is 1 Vrms, and impedance is 20 kilohm balanced, 10 kilohm unbalanced, as is typical of QSC amplifiers.

The input jacks are located on a removable panel which has internal switches for (1) bridged-mono or (2) to parallel the inputs. See Section Two for more information about the *Open Input Architecture™* slot.

Outputs

Speaker connections are made via standard red/black 5-way binding posts, or by Neutrik *NL4FC Speakon* connectors. The Speakon for each channel uses the standard wiring of:

- Pin 1- = Speaker Ground
- Pin 1+ = Speaker Hot

In addition, a central Speakon is provided with the standard stereo wiring of:

- Pin 1- = Ch 1 Ground
- Pin 1+ = Ch 1 Hot
- Pin 2- = Ch 2 Ground
- Pin 2+ = Ch 2 Hot

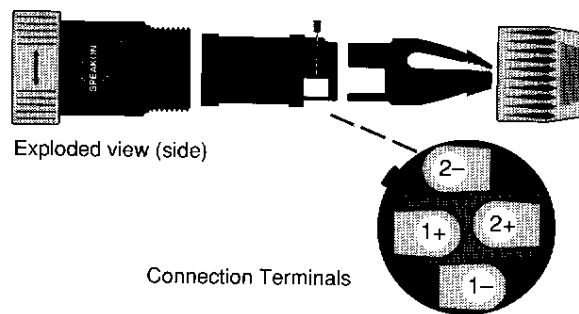


Figure 1-3. Neutrik Speakon Connector Wiring

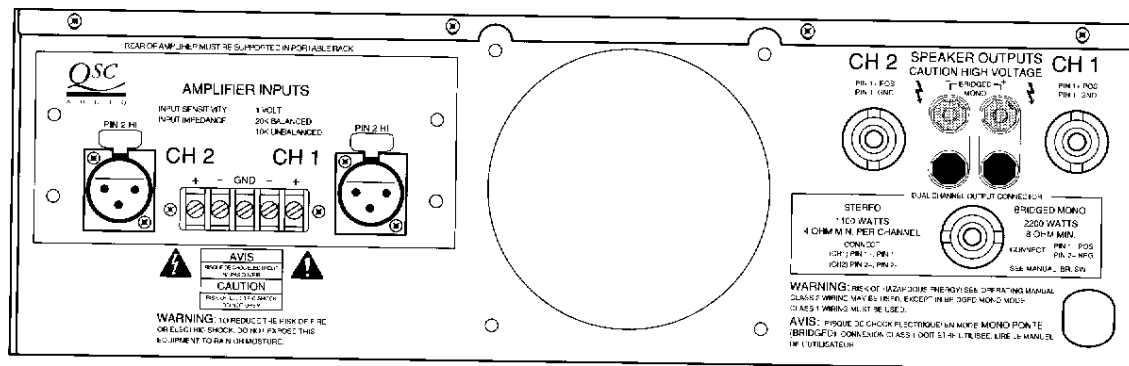


Figure 1-2. QSC EX 4000 Rear Panel (identical to EX 2500 panel except for power ratings)

Controls and Displays

The front-mounted Gain controls have 11 detents for easy matching of levels. The Gain scale shows dB of attenuation from full gain, with positions for 0 (full), -2, -4, -6, -8, -10, -12, -14, -18, -24, and ∞ (full kill). Attenuation is accurate within 1 dB.

The LED displays for each channel operate as follows:

PWR: ON	Green	Main power supply active on this channel.
LEVEL -30	Yellow	Triggers at -30 dB below full output.
LEVEL -10	Yellow	Triggers at -11 dB, goes extra bright at -8 dB.
LIM: CLIP	Red	Shows activity of Limiting circuit, which responds to both clipping and to thermal overload.
TEMP: PROT	Red	Flashes as amplifier approaches max. temp. Illuminated steadily plus flashing during thermal muting. Illuminated steadily during non-thermal muting.

Table 1-1. LED Display Operation

AC Power

AC Connection is made through a standard 120 V, 15 amp grounded plug. While the amplifier meets Safety Agency requirements for current consumption of less than 12 amp, 120 Vac during “normal” operation, peak current consumption can be quite high, and users are requested to read the portion of Section Three titled “AC Power Consumption.”

The amplifier can be wired for 100, 120, or 240 Vac, 50–60 Hz. Units are normally shipped with 120 Vac hookup, unless intended for markets with a different AC voltage.

Operation

When amplifier is first turned on, the green PWR-ON displays should light up for both channels, and there will be a 3 second turn-on delay,

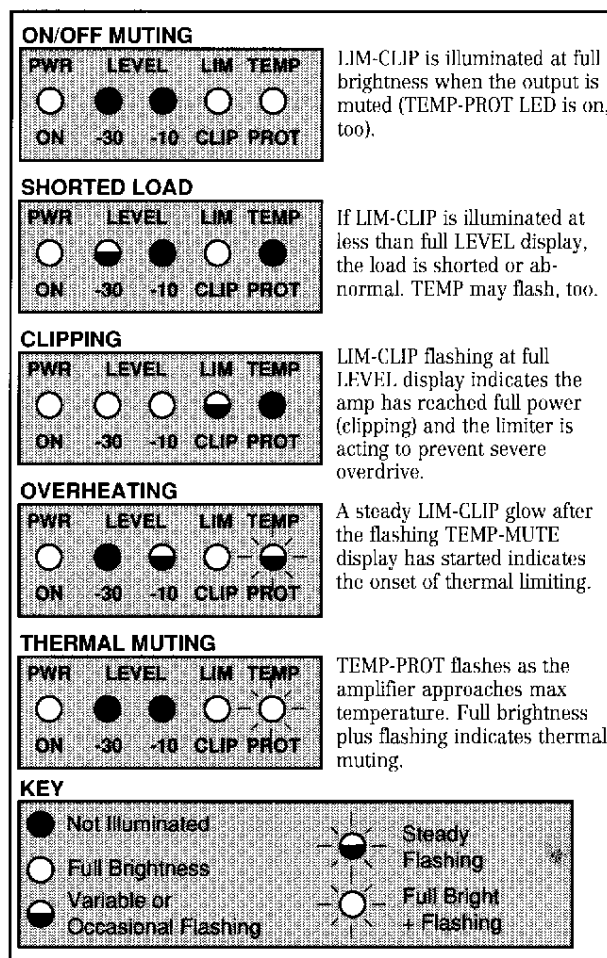


Figure 1-4. LED Displays Further Explained (also see Figure 2-4 on page 8)

during which all red LEDs will be bright (TEMP-PROT and LIM-CLIP). If a channel will not come out of muting, it may be responding to an excessive high frequency level at the input (see Section Three, “Protection Circuits”). Turning down the Gain controls (before you power up the amp is best) allows the muting to release, and is always a good idea to prevent an unexpected input signal from overdriving the load.

Signal Level will be shown on the yellow LEVEL -30 and -10 displays, as explained previously.

When the amplifier is turned off, muting should be virtually instant, with all red LEDs illuminated until the power supply discharges.

Troubleshooting**Channel will not come out of muting:**

- A. If reducing Gain to zero does not release muting, the channel is defective.
- B. If reducing Gain releases the muting, advance Gain slowly while watching the LEVEL displays (in case there is an abnormal signal which could blow the speakers).

No sound is heard:

- A. Is the channel in muting? (TEMP-PROT is bright, see below).
- B. If the LEVEL displays are active, (1) the speaker is open (blown), (2) there is an open circuit in the speaker wiring, or (3) there is an open circuit in the internal output wiring of the amplifier.
- C. If there is no LEVEL or LIM-CLIP displays, there is no input signal.
- D. If the LIM-CLIP display is bright or peaking with little or no LEVEL display, this indicates shorted speaker line (especially if TEMP-PROT starts flashing). If a channel's protection relay is defective and does not click on after the turn-on muting, it will internally short the output and cause the same symptom.

Channel goes into muting (temp-prot led is on):

- A. If flashing of the TEMP-PROT display is visible, amplifier has muted due to extreme overheating. Fan should be running at full speed, and unless ventilation is blocked, operation should resume within a minute.
- B. The amplifier will mute in response to extreme high frequency overdrive, and output will not be restored until the frequency or level is lowered. Try turning down the Gain control to release muting, and determine the source of abnormal frequencies.
- C. Muting which does not respond to either condition suggests DC shutdown or other amplifier fault.

Hum Problems:

- A. Ground lift of the signal is not available in the EX 4000 or EX 2500 due to QSC's grounded-collector transistor mounting, which improves thermal efficiency. Low-emission AC transformers are used, and balanced inputs afford hum rejection. If hum persists despite the balanced inputs, check the tightness of the rear

panel screws which hold the input panel in place (four outer screws, and two screws holding barrier strip). Please report any problems with these screws to QSC Service Dept. If the input wiring is near SCR (silicon controlled rectifier) dimmers, transformer-isolated inputs may be necessary because of the exceptionally high noise field voltages generated by SCRs. Refer to page 7 for further information on optional transformers.

Overheating:

- A. If ventilation is blocked, or if the amplifier is overdriven into low impedance loads, it can overheat. The thermal protection system's normal response to rising temperatures is as follows:

25–50° C:	Fan runs on low speed.
50–60° C:	Fan Speed rises gradually from slow to full.
75° C:	TEMP-PROT LED starts flashing.
80° C:	TEMP-PROT flash rate increases, and LIM-CLIP starts to glow steadily. The limiter will begin to reduce amplifier gain, up to 15 dB.
85° C:	Full muting occurs, as indicated by bright LIM-CLIP display and bright TEMP-PROT display (with rapid flashing superimposed). Full muting should occur only if the load is shorted, ventilation is completely blocked, or the fan fails.

Specifications

EX 4000 OUTPUT POWER (per channel)

8 ohms, 20 Hz to 15 kHz*, 0.1% THD:	720 W
8 ohms, 1 kHz, 1% THD:	800 W
4 ohms, 20 Hz to 15 kHz*, 0.1% THD:	1100 W
4 ohms, 1 kHz, 1% THD:	1200 W
2 ohms, 1 kHz, 0.1% THD, (± 1 dB):	1400 W

EX 4000 OUTPUT POWER (bridged mono)

8 ohms, 20 Hz to 15 kHz*, 0.1% THD:	2200 W
4 ohms, 1 kHz, 0.1% THD, (± 1 dB):	2800 W

EX 2500 OUTPUT POWER (per channel)

8 ohms, 20 Hz to 20 kHz, 0.1% THD:	500 W
8 ohms, 1 kHz, 1% THD:	550 W
4 ohms, 20 Hz to 20 kHz, 0.1% THD:	750 W
4 ohms, 1 kHz, 1% THD:	825 W
2 ohms, 1 kHz, 0.1% THD, (± 1 dB):	1000 W

EX 2500 OUTPUT POWER (bridged mono)

8 ohms, 20 Hz to 20 kHz, 0.1% THD:	1500 W
4 ohms, 1 kHz, 0.1% THD, (± 1 dB):	2000 W

DISTORTION

SMPTE-IM, less than 0.05 %.

FREQUENCY RESPONSE

20 Hz to 20 kHz, ± 0.1 dB
8 Hz to 100 kHz, $+0/-3$ dB

DAMPING FACTOR

Greater than 200

DYNAMIC HEADROOM

3 dB at 4 ohms

NOISE

100 dB below rated output (20 Hz to 20 kHz)

SENSITIVITY

1 Vrms for rated power (8 ohms)

VOLTAGE GAIN

EX 2500: 63 (36 dB) / EX 4000: 80 (38 dB)

INPUT IMPEDANCE

10 kilohms unbalanced, 20 kilohms balanced

CONTROLS

Front: AC switch, Ch 1 and Ch 2 Gain knobs (with 2 dB detents)

Internal: Two DIP switches for parallelling inputs, two DIP switches for bridged output configuration

INDICATORS (each channel)

PWR-ON:	Green LED
LEVEL -30:	Yellow LED
LEVEL -10:	Yellow LED
LIM-CLIP:	Red LED
TEMP-PROT:	Red LED (flashes for over-temp)

CONNECTORS (each channel)

Input:	Barrier strip and XLR
Speakers:	5-way binding posts, Speakon connectors**, stereo Speakon**

COOLING

Continuously variable speed fan, rear-to-front air flow

AMPLIFIER PROTECTION

Full short circuit†, open circuit, ultrasonic, and RF protection, thermal limiting/muting; stable into reactive or mismatched loads

LOAD PROTECTION

On/off muting, clip limiting, DC-fault load grounding relay with internal fault fuses

OUTPUT CIRCUIT TYPE

Complementary linear outputs, 3-step high efficiency circuit (2-step on EX 2500)

POWER REQUIREMENTS

100, 120, 240 Vac, 50–60 Hz.

POWER CONSUMPTION (@ 120 Vac)

Normal Operation: 4 ohms per channel —
Either model: less than 12 A, (1.44 kW)
Maximum (full power, 2 ohms per channel) —
EX 2500: 41 A (5 kW) / EX 4000: 58 A, (7 kW)

DIMENSIONS

19" (48.3 cm) rack mounting,
5.25" (13.3 cm) tall (3 spaces)
17.9" (45.5 cm) deep (rear support ears)

WEIGHT

EX 2500: 55 lbs (24.9 kg) net, 59 lbs (26.8 kg) shipping
EX 4000: 64 lbs (29 kg) net, 70 lbs (31.8 kg) shipping

*Amplifier's output protective circuitry prevents full power output above 15 kHz.

** For mating cable, use Neutrik NL4FC connector.

†Output Averaging™ short circuit protection (US Patent 4,321,554).

Specifications subject to change without notice.

Input Slot

The input jacks are mounted on a removable plate, permitting future upgrades. The ribbon cable which connects this "slot" to the rest of the amplifier carries several levels of DC power, and (for each channel) the input signals, speaker output monitor, muting status, clip activity, thermal status, power-on status, and reserved lines for remote control AC relay (not implemented in the EX 2500 or EX 4000). These signals are adequate to support future remote control and monitoring schemes as they become available. The QSC Marketing department will be happy to entertain suggestions for input modules.

The "standard input board" which is shipped with each amplifier has balanced XLR and barrier strip inputs, bridging and input-parallel switches, and footprints for passive rolloffs and popular input isolation transformers (more info on request).

To Parallel the Inputs

1. Remove the input panel and find the 4-pole DIP switch just behind the barrier strip.
2. Turn on (depress numbered end) switch positions 3 and 4 (1 and 2 must be off). This connects both sets of input jacks together, so that a signal into Ch 1 or Ch 2 input reaches both channels. Each channel is controlled as usual with its Gain control, and separate speakers must be used for each channel (the speaker jacks are NOT paralleled).
3. Securely remount the input panel.

With paralleled inputs, the signal may be

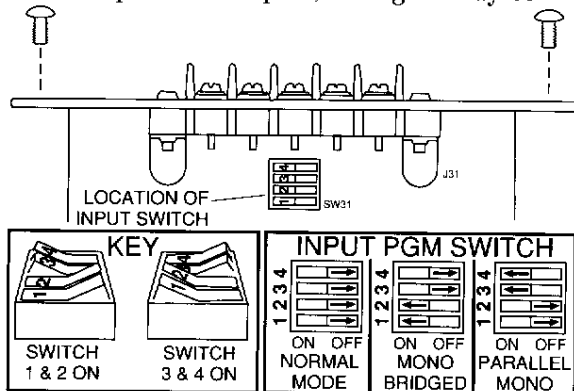


Figure 2-1. To parallel the input jacks or for bridged mono, set the DIP switch behind the connector panel as shown here.

looped through (or "daisy-chained") by going in one channel's inputs and out the other. The amplifier Gain settings will not affect the level at the input jacks.

Bridged-Mono Mode

1. Remove the input panel and find the 4-pole DIP switch behind the barrier strip.
2. Turn on (depress numbered end) switch positions 1 and 2 (3 and 4 must be off), and securely remount the Input Panel.
3. Connect inputs to Ch 1 only. Do not connect anything to Ch 2 inputs.
4. Set Ch 2 Gain on FULL and *regulate Gain with Ch 1 Gain only*. Both channels should display the same LEVEL readouts.
5. A single speaker load is used. The positive lead may be connected to Ch 1 red binding post, and the negative lead to Ch 2 red binding post, but due to the high voltage present (see below) we recommend the use of the fully insulated Speakon connector.

Speakon wiring for bridged mono, using the third, or "stereo" Speakon:

Connect speaker positive to pin 1+.

Connect speaker negative to pin 2+.

BRIDGED-MONO CAUTION: Output voltages up to 200 volts rms are available between the EX 4000's bridged terminals (140 volts into an 8-ohm load). Fully insulated CLASS-ONE wiring must be used, and the load must be rated up to 2400 watts (8-ohms). While the EX 2500 develops somewhat less power, similar precautions should also be observed.

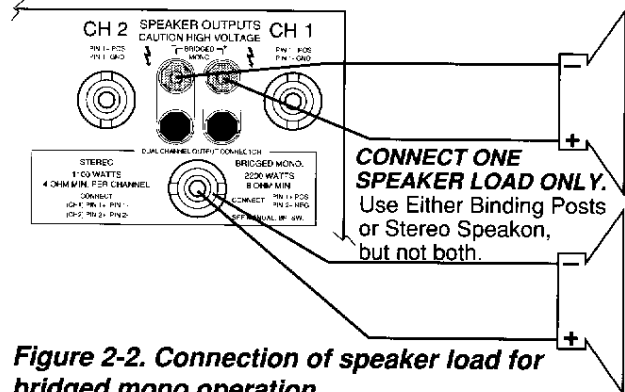


Figure 2-2. Connection of speaker load for bridged mono operation.

Changing the XLR polarity

The EX 2500 and EX 4000 are shipped with XLR polarity set at pin 2 high. To convert to pin 3 high:

1. Remove Input Panel.
2. Find soldered jumpers W303, W304 (Ch 1) and W403, W404 (Ch 2), located behind each XLR jack. These are soldered in positions marked "PIN 2 HI".
3. Desolder each jumper, and move *lengthwise* 0.2 inches to its alternate mounting position (the end marked "PIN 3 HI"), and resolder. Each jumper should fit in its new position evenly without changing its length. All four must be moved or the input signal will not be properly connected.
4. Label the outside of the Input panel to show that pin 3 is now High.

NOTE: This adjustment does not alter the polarity of the barrier strip, which remains as marked on the rear panel.

5. Remount the input panel securely.

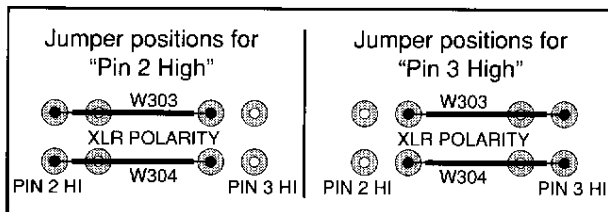


Figure 2-3. Jumper positions for XLR pin 2 high (factory preset), and pin 3 high. Note: Both channels must be modified for proper polarity reversal.

Using the Level Displays

Review of Level Readouts

- A. LEVEL -30 (yellow) triggers at about 0.1% of full output (30 dB below clipping).
- B. LEVEL -10 (yellow) triggers at about 10% of full output (10 dB below clipping).
- C. LIM-CLIP (red) triggers at full rated output power.

Maximum Long-Term Output Power

In most cases, the desired sound level can be obtained without using the full power output of the amplifier. The level displays are then used to confirm that both channels are working as desired.

If the amplifier is operated at extreme power levels, it may overheat or the speakers may be damaged. The following guidelines will help you determine how much power can be delivered to the speakers without thermal limiting (which is indicated by flashing of the red TEMP-PROT display).

8-Ohm Loads

The amplifier can be played at practically any volume without overheating. However, if the amplifier is pushed into continuous triggering of the LIM-CLIP display, the average output power can reach 275 to 500 watts, which is more than most speakers will take.

4-Ohm Loads

The amplifier's maximum long-term power capacity will be reached when the LEVEL -10 is on almost all the time, with occasional flashing of the LIM-CLIP display. If the LIM-CLIP display is on half the time, the amplifier is liable to start thermal flashing in several minutes.

2-Ohm Loads

The LEVEL -10 display should not be on more than about half the time, with only occasional clipping, to avoid overheating.

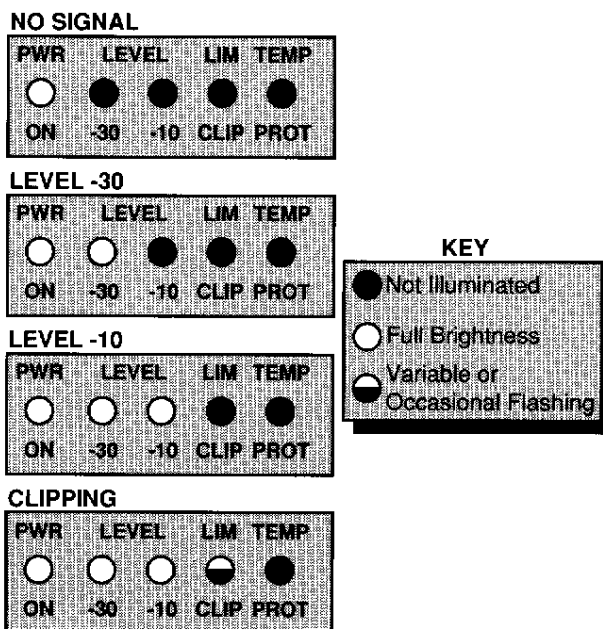


Figure 2-4. Review of level displays (see text, and also see Figure 1-4 on page 4)

AC Current Consumption

A major objective in the design of the EX 4000 and EX 2500 is to permit operation from readily available AC sources. In particular, most users have access to the familiar NEMA 5-15 grounded, 15 amp AC receptacle. The EX 4000's AC consumption is rated at 12 amps (1440 W) under *normal* conditions, yet it can deliver up to 3000 watts of output power. Many users have asked how this is possible — and how much AC service is needed for each amplifier.

To answer this, we must consider average vs maximum AC current draw. The EX 4000 will draw 58 amps when both channels are driven at full power, 2 ohms. However, various protective circuits prevent this high current from lasting more than 1 to 2 minutes. Under real world conditions, the current draw will remain within the safe level for the 15 amp AC plug.

Some background on AC ratings is necessary to fully understand the limitations on current draw. Essentially, there are three ratings of interest: (1) the legal operating current as measured by the Safety Agencies (UL, CSA, and IEC), (2) the maximum expected average under worst-case program material, and (3) the peak current draw at full output power.

UL and CSA (North American safety agencies) have recently changed their standards on "normal operating power" to agree with the European

safety agencies. Now all major safety agencies around the world measure amplifier current and temperature rise under the same "normal operating conditions" using a pink noise signal with an average power equal to one eighth of maximum power. This was in response to industry complaints that the former test level of one third power was unrealistic for high-quality professional amplifiers. To put these levels in perspective, music played at one third average power will be in a state of constant clipping, and this power level is about the greatest one can obtain without completely obliterating the program under clipping. The one eighth power level is about as loud as you can play music while making some attempt to avoid obvious clipping.

In order to rate the EX 4000 for operation with the 15 amp plug, we had to satisfy the following conditions:

1. Meet the safety agency requirements for "normal" current draw.
2. Remain within the functional limits of the plug for "severe program levels".
3. Avoid unsafe conditions at full output power.

The AC consumption for each power level and load impedance is shown in Table 3-1.

		Max. sustained power w/ adequate AC supply.				UL/CSA/IEC rating standard
	Load (Ohms)	Max Power (midband)	AC Current Full power	AC Current 1/3 power	AC Current 1/8 power	AC Current Idle
EX 4000	8 + 8	800 x 2	25 A	10.8 A	5.7 A	1 A
	4 + 4	1200 x 2	40 A	17 A	8.5 A	1 A
	2 + 2	1500 x 2	58 A	24 A	12 A	1 A
EX 2500	8 + 8	550 x 2	19 A	10 A	5 A	1 A
	4 + 4	825 x 2	31 A	15 A	7.5 A	1 A
	2 + 2	1000 x 2	41 A	22 A	11 A	1 A

Table 3-1. QSC EX 4000 and EX 2500 AC Power Consumption vs Load Impedance.

The safety agencies are concerned with the current levels shown under the one eighth power column. In order to be sold with a 15 amp plug, the "normal" current must not exceed 12 amps. This is because building codes prohibit the connection of a single load which exceeds 80% of the capacity of the branch circuit. Since it is legal to use either 15 amp or 20 amp circuit breakers with ordinary 15 amp outlets, this reduces the "legal" maximum current to 12 amps (80% of 15 amps).

Since the EX 4000 current at 2 ohms is right at the 12 amp limit, the minimum impedance marked on the rear of the amplifier is 4 ohms per channel.

QSC Engineering standards call for ability to operate at one third power, in order to meet the demands of "worst-case" heavily compressed, clipped program material. This will use the AC current shown in the one third power column. The amplifier's protective circuits will not permit long-term current draw to exceed about 15 to 20 amps, which is equivalent to severe operation at 4 ohms per channel (long-term capacity at 2 ohms is restricted to about one eighth power). While this exceeds the rated capacity of the 15 amp plug, testing has shown that overheating of the plug is not a problem. In fact, the blade structure of the plug is similar to the 20 amp plug, so the main concern is the capacity of the building's electrical wiring. Usage at this level will require professional "distro" equipment, or heavy-gauge branch circuits with a 20 amp circuit breaker for each amplifier. We have supplied an oversize 12/3 gauge AC cord, so users intending to make maximum use of the amplifier's power have the option of *substituting a heavier-duty plug* such as a twist-lock 20 or 30 amp type.

Finally, the amplifier was tested at full peak AC current. At the maximum of 58 amps, a 30 A wall breaker will trip within 30 seconds. At 50 amps, the amplifier will operate for less than two minutes before thermal cutback occurs. During this time, the temperature of the AC cord (using a 14/3 sample as a worst case) stabilizes at a temperature well below the rating of the insulation.

Protection Circuits

The essence of high-efficiency, lighter-weight designs is to control more power with fewer or smaller load-bearing components. The EX 4000 represents a considerable step forward, with

typical efficiency (at one third or one eighth power) about 2.5 to 3 times better than "conventional" linear designs, and about 50% better than the EX 2500 or our previous 2-step high efficiency designs. The EX 4000, for example, has almost twice the power as the MX 2000, in the same size chassis, with 16% less weight. Because of the higher power flow, effective protection circuits become even more important.

A number of refinements have been added to the usual QSC protective circuits.

Like all QSC amps, the inputs are resistively buffered for overload and RF protection. Chassis bypass capacitors have been added at inputs and outputs to improve RF rejection.

The EX 2500 and EX 4000 use an advanced version of our Output Averaging™ short circuit protection. This circuit permits full output current (up to 50 amps peak) into resistive or reactive 2-ohm loads, but if the output is shorted, the current is cut back to a safe level of about 25%.

Turn-on/off muting blocks transients from the amplifier or preceding devices from reaching the speakers. The EX 2500 and EX 4000 use simultaneous relay and electronic muting to guarantee minimum possible on/off noise. The limiter (see below) is fully activated during muting, so that its release time cushions the onset of full volume. The turn-on delay has been extended somewhat, and the turn-off muting has been quickened, to ensure muting even of poorly designed preceding components. On/off muting is equally effective whether the amplifier is turned off with its own switch or with a remote switch.

Inrush current is limited by an NTC resistor (Negative Temperature Coefficient) which starts at a high resistance and then diminishes after turn-on to avoid loss of power. The amplifier's inrush current is no more severe than amplifiers of one half to one third its power rating.

DC Fault protection uses a load grounding relay similar to those in QSC Series Three and MX amplifiers. However, at this power level, ordinary relays are incapable of interrupting the worst-case DC fault without arcing and destruction. Therefore, the relay grounds the output, forcing a 20 amp, 250 V fault fuse to blow. While the relay circuit is designed to avoid false triggering, if this should

occur during normal operation, the electronic muting and/or short circuit limiting will prevent the fuse from being blown, avoiding "nuisance replacement". One advantage of this scheme is that there are no relay contacts in series with the audio.

We have significantly upgraded the thermal tracking and response. Sensors are located on each power transformer, as well as each channel's heat sink, so that overheating of either component will trigger the thermal defenses. Instead of an abrupt amplifier shutdown at the temperature limit, we now have 4 levels of response. At temperatures of 50° to 65° C, the fan speed is elevated from slow to full, to improve cooling as needed with the minimum possible noise. At temperatures of about 75° C, the red TEMP-PROT LED begins to flash at a gradually increasing rate. At 80° C, the limiter circuit (see Clip-Limit, below) begins to reduce gain, which is shown by progressively brighter illumination of the red CLIP-LIMIT LED. At 85° C, gain is reduced by the maximum amount of 15 dB. If this does not arrest the temperature rise (in case of an output short or blocked ventilation), the amplifier will finally enter full muting, which causes full shutdown of the output bias circuit. All temperatures above 50° C can be monitored at the input slot (see below).

In addition, new circuits have been added to the EX 2500 and EX 4000 for further control and protection.

Clipping now activates a "Clip-Limit" circuit. This permits the amp to reach the point of clipping without premature limiting, for full "rock and roll" headroom capability. However, once clipping is reached (for any reason), input volume is then limited to prevent gross clipping. This circuit limits distortion caused by clipping to about 1% to 10% (depending on degree of overdrive), which is audible but not severe.

An ultrasonic detector mutes the amplifier in case of gross overloads above 20 kHz, to prevent load or amplifier burnout. The amplifier will reproduce high frequencies into normal loads without muting (with some limitation of peak power at 20 kHz as noted), but if the amp is turned on with high-level, high frequency input above 10 kHz, the amplifier will not come out of turn-on muting (this applies to full-level pink noise as well).

This feature is intended to protect high frequency drivers from accidental burnout due to high frequency system oscillations, etc.

As noted in the specifications, the amplifier is guaranteed to deliver rated power up to 15 kHz. Maximum available power is gradually limited at frequencies above 15 kHz without affecting the frequency response at normal signal levels. This is intended to reduce the potential for severe high frequency overloads while still permitting the EX 4000 to deliver up to 600 watts per channel at 20 kHz.

While not a protection feature in its own right, the remote monitoring capability built into the input slot (see above) provides the foundation for computer control and monitoring as such systems become available. The input slot has lines to read the status (for each channel) of power-on, speaker level, temperature, clip/limit, mute, and AC voltage.

CAUTION

These servicing instructions are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than that contained in the Operation Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel



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