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Owner's Manual

EX Series

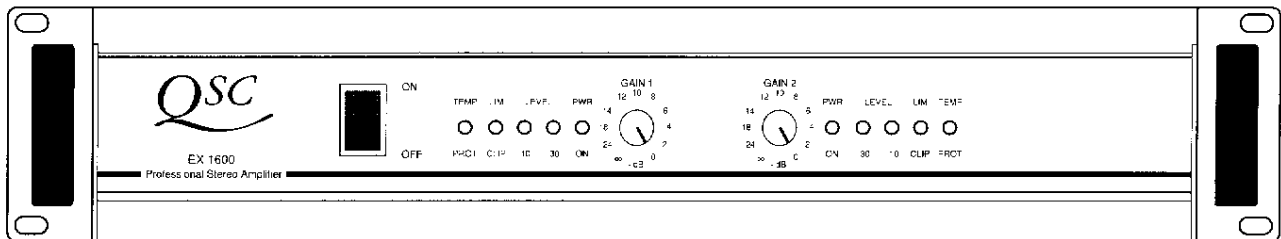
- ▲ EX 800
- ▲ EX 1250
- ▲ EX 1600



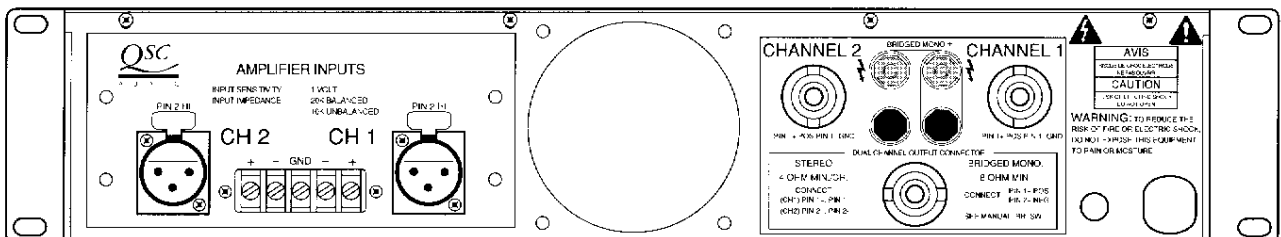
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**EX800 - EX1250 - EX1600
POWER AMPLIFIER
OPERATION MANUAL**



QSC EX 1600 Front Panel (identical to EX 800 and EX 1250 panels)



QSC EX 1600 Rear Panel (identical to EX 800 and EX 1250 panels)

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.



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.



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

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

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

	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.

	AVIS RISQUE DE CHOCK ELECTRIQUE NE PAS OUVRIR	
<p>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.</p>		

	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.

CAUTION

To reiterate the above warnings: 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

CAUTION RISK OF ELECTRIC SHOCK: OPEN ONLY IF QUALIFIED AS SERVICE PERSONNEL

Overall Description

The EX 800, EX 1250 and EX 1600 are high-efficiency professional power amplifiers, with two independent channels, respectively capable of delivering 175, 275 and 400 watts into eight ohm loads. They will also deliver, respectively, 275, 400 or 600 watts into four ohms. A semi-toroidal power transformer is mounted in the front of the amp, as close as possible to the rack ears and rails. Each model occupies two rack spaces, weighs 40 to 44 pounds, 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.

These amplifiers share nearly the same design as the high-end EX 4000, with engineered-in stability and reliability, exceptional sound quality, and Open Input Architecture™ slots.

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

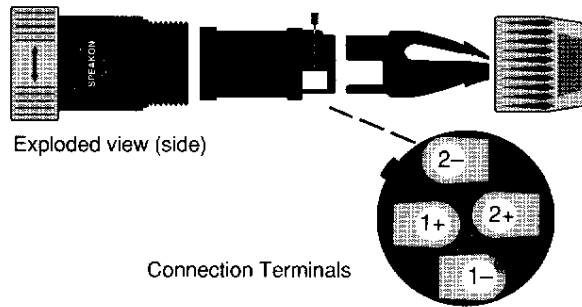


Figure 1-1. Neutrik Speakon Connector Wiring

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 (down to -14 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 higher.

The amplifier can be wired for 100, 120, or 230 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 will light up for both channels, and there will be a 3 second turn-on delay, during which all red LEDs will be bright (TEMP-PROT and LIM-CLIP). If a channel will not come out of mut-

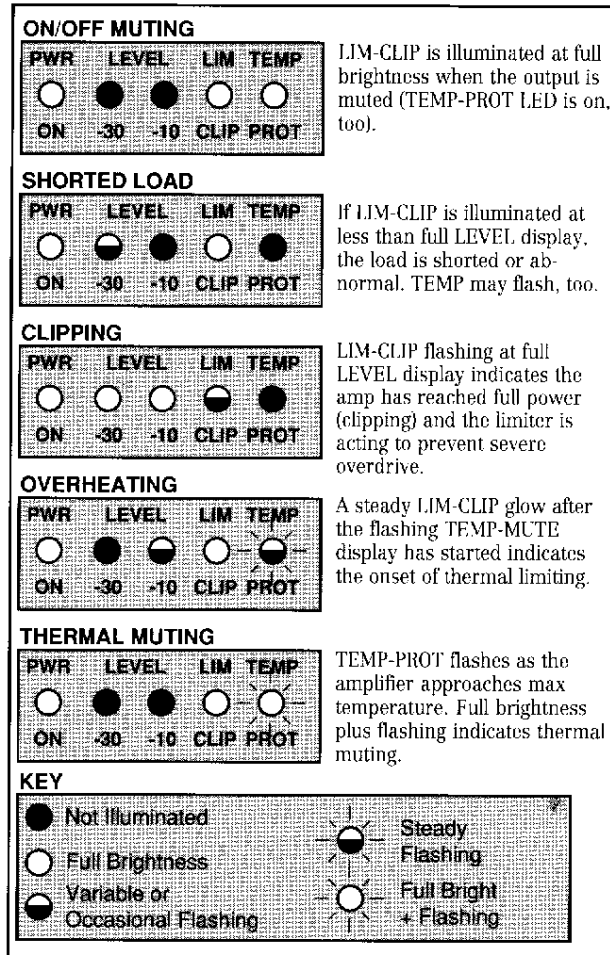


Figure 1-2 LED Displays Further Explained (also see Figure 2-4 on page 8)

ing, 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 instantaneous, 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 or overheated (see below).
- 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 1600, EX 1250 or EX 800 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 1600 OUTPUT POWER (per channel)

8 ohms, 20 Hz to 20 kHz, 0.1% THD:	400 W
8 ohms, 1 kHz, 1% THD:	450 W
4 ohms, 20 Hz to 20 kHz, 0.1% THD:	600 W
4 ohms, 1 kHz, 1% THD:	675 W
2 ohms, 1 kHz, 0.1% THD, (± 1 dB):	800 W

EX 1600 OUTPUT POWER (bridged mono)

8 ohms, 20 Hz to 20 kHz, 0.1% THD:	1200 W
4 ohms, 1 kHz, 0.1% THD, (± 1 dB):	1600 W

EX 1250 OUTPUT POWER (per channel)

8 ohms, 20 Hz to 20 kHz, 0.1% THD:	275 W
8 ohms, 1 kHz, 1% THD:	300 W
4 ohms, 20 Hz to 20 kHz, 0.1% THD:	400 W
4 ohms, 1 kHz, 1% THD:	450 W
2 ohms, 1 kHz, 0.1% THD, (± 1 dB):	600 W

EX 1250 OUTPUT POWER (bridged mono)

8 ohms, 20 Hz to 20 kHz, 0.1% THD:	800 W
4 ohms, 1 kHz, 0.1% THD, (± 1 dB):	1200 W

EX 800 OUTPUT POWER (per channel)

8 ohms, 20 Hz to 20 kHz, 0.1% THD:	175 W
8 ohms, 1 kHz, 1% THD:	200 W
4 ohms, 20 Hz to 20 kHz, 0.1% THD:	275 W
4 ohms, 1 kHz, 1% THD:	325 W
2 ohms, 1 kHz, 0.1% THD, (± 1 dB):	400 W

EX 800 OUTPUT POWER (bridged mono)

8 ohms, 20 Hz to 20 kHz, 0.1% THD:	550 W
4 ohms, 1 kHz, 0.1% THD, (± 1 dB):	800 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 (2 dB for EX 800)

NOISE

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

SENSITIVITY

1 Vrms for rated power (8 ohms)

VOLTAGE GAIN

EX 1600: 56(35dB)
EX 1250: 45(33dB)
EX 800: 35.5(31dB)

INPUT IMPEDANCE

10 kilohms unbalanced, 20 kilohms balanced

CONTROLS

Front: AC switch, Ch 1 & Ch 2 Gain (w/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, 2-step high efficiency
circuit (1 step on EX 800)

POWER REQUIREMENTS

100, 120, 230 Vac, 50-60 Hz.

POWER CONSUMPTION (@ 120 Vac)

Normal Operation: 4 ohms per channel —
All models: less than 12 A, (1.44 kW)
Maximum (full power, 2 ohms per channel) —
EX 1600: 32 A (3.9 kW) / EX 1250: 24 A (2.9 kW) /
EX 800: 18 A (2.2 kW)

DIMENSIONS

19" (48.3 cm) rack mounting,
3.5" (8.9 cm) tall (2 spaces)
17.9" (45.5 cm) deep (rear support ears)

WEIGHT

EX 1600: 44 lbs (20 kg) net, 49 lbs (22.2 kg) shipping
EX 1250: 42 lbs (19.1 kg) net, 47 lbs (21.2 kg) shipping
EX 800: 40 lbs (18.1 kg) net, 45 lbs (20.4 kg) shipping

* For mating cable, use Neutrik NL4FC connector.

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

Specifications subject to change without notice.

Open Input Architecture™ 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 these three models). 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

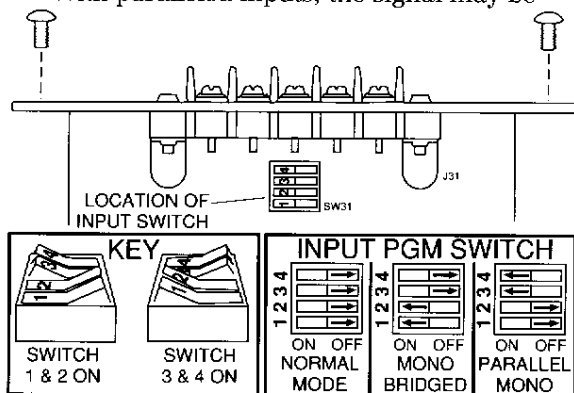


Figure 2-1. To parallel the input jacks or for bridged mono, set the DIP switch behind the connector panel as shown here.

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 150 volts rms are available between the EX 1600’s bridged terminals (103 volts into an 8-ohm load). Fully insulated CLASS-ONE wiring must be used, and the load must be rated up to 1330 watts (8-ohms). While the EX 1250 and EX 800 develop somewhat less power, precautions should be observed nonetheless.

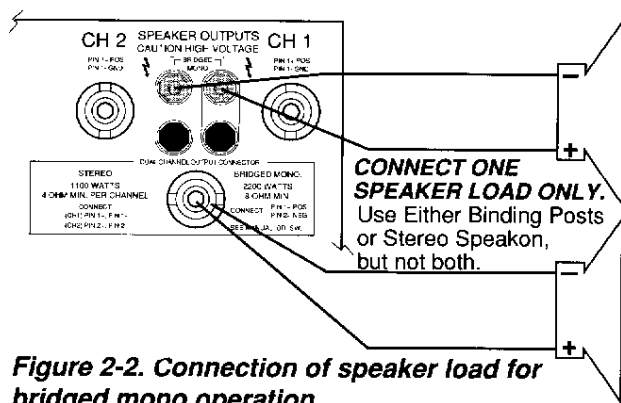


Figure 2-2. Connection of speaker load for bridged mono operation.

Changing the XLR polarity

The EX 1600, 1250 and 800 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.

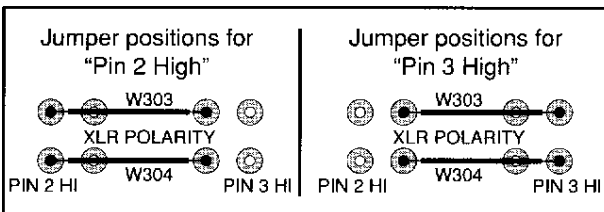


Figure 2-3. Jumper positions for XLR pin 2 high (factory preset), and pin 3 high. Note: Both channels must be modified for proper polarity reversal.

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.

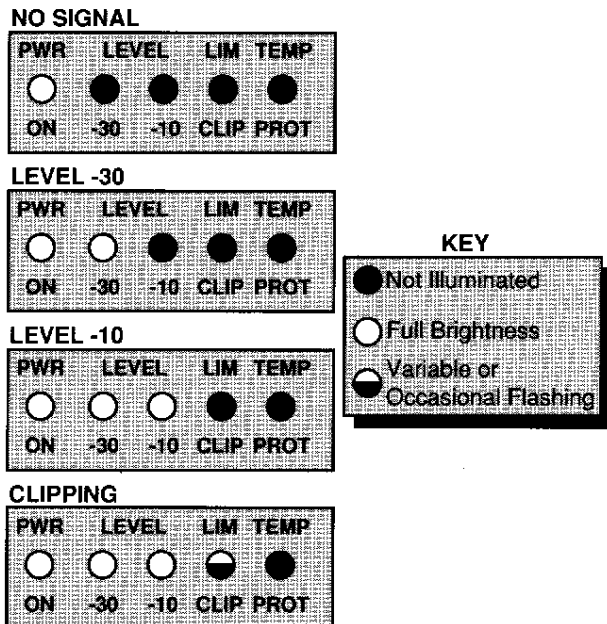


Figure 2-4. Review of level displays (see text, and also see Figure 1-2 on page 4)

Protection Circuits

The essence of high-efficiency, lighter-weight designs is to control more power with fewer or smaller load-bearing components. The EX 1600, EX 1250 and EX 800 represent a considerable step forward, with high efficiency due to the multi-step power supplies. 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 1600, EX 1250 and EX 800 use an advanced version of our Output Averaging™ short circuit protection. This circuit permits full output current (up to 30 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 1600, EX 1250 and EX 800 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.

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 1600, EX 1250 and EX 800 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, 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.

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.



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