ered power and the transformer's rated voltage. This scale also identifies the proper transformer tap to use when a particular constant voltage rating is not provided with the transformer (such as 25, 35, 50, 70, 100 or 140 volts). Other scales include line loss, parallel resistance, dB-SPL vs. distance and dB-SPL vs. power. To obtain a constant voltage computer, call Crown and ask for literature.

6 Principles of Operation

6.1 CH1, CH2, CL1 and CL2

For the sake of simplicity, only channel one of the amplifier is described.

Signal is presented to the Contractor Series amplifier through one of three connectors when using the standard input module. Each channel is outfitted with a balanced XLR / phone jack, and a barrier strip. These connectors are wired in parallel, which allows daisy chaining when needed. The signal is then converted from balanced to unbalanced in the Balanced Input Stage where it also receives RFI protection. Signal then flows into the Variable Gain Stage where the rear-panel level controls are allowed to affect the gain.

Following this stage, the signal is put under the control of a full-time compressor circuit comprised of a symmetrical window detector, a buffer amplifier, and the gating op amp which uses several small components to set the compressor's attack and decay characteristics. The actual compressing is accomplished by an opto-isolator which affects the gain in the signal path.

The signal then travels either through the HP filter module or is bypassed around it depending on the position of the channel operation switch. In the CH1 and CH2, with the switch set in the 70V/100V position, the filter is enabled. The filter is an 18 dB-per-octave high-pass with a –3 dB rolloff at 70 Hz. This provides a measure of protection to step-down transformers used in distributed speakers installations. With the switch set in the 4/8 Ohm setting, the filter is bypassed.

The signal next enters the main amplifier error amp where it is mixed with a small portion of the output signal in such a way as to control the amplifier's overall output performance.

Following the error amp is the LVA stage, where the low-voltage referenced signal gets translated to the output high-voltage rails. The last voltage amplifier, in conjunction with a bootstrap current source, drives both predrivers and the bias servo. The bias servo is mounted in such a way as to translate the output heatsink temperature into a controlled bias current to prevent thermal runaway and hold the amplifier's notch distortion to a minimum.

The predrivers provide enough signal to activate the drivers, which together operate in the class AB range. For the major output current requirements, the drivers feed the various numbers of paralleled output transistors which operate in a class B mode. This is referred to as the Triple-Deep Darlington Output Stages.

The output transistors are protected by the Time Dependent Voltage & Current circuit. This circuit protects the devices from extending beyond their safe area of

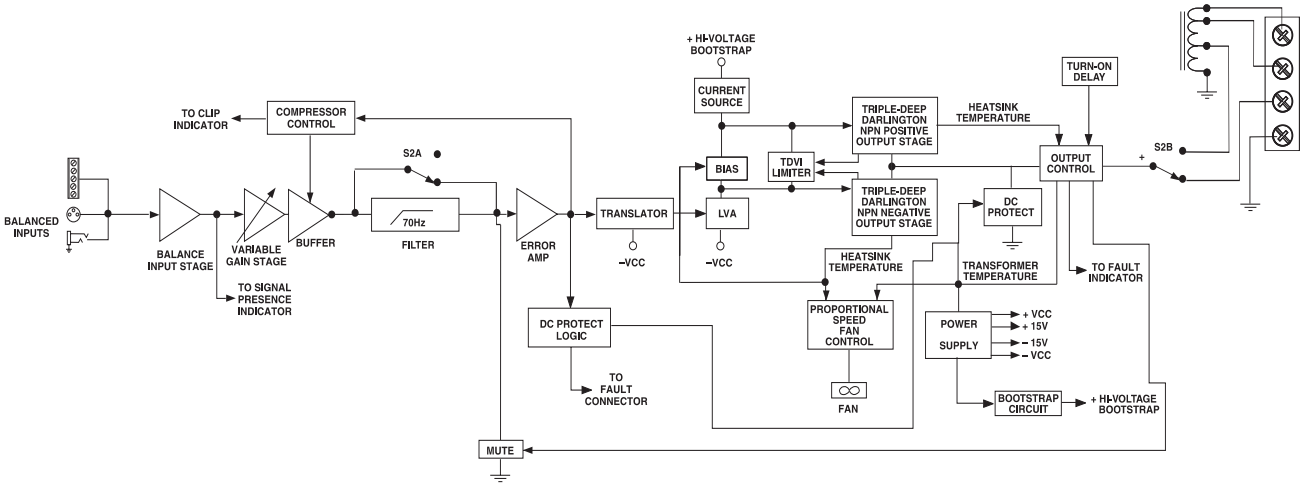

Figure 6.1 CH1 & CH2 Circuit Block Diagram

operation, but allows the devices to provide high bursts of peak power when needed. This amplifier output topology offers a good combination of low quiescent amplifier heating, great distortion performance at high powers, and relative simplicity, with impressive reliability and value.

All output power is delivered through a channel-independent, dead front barrier block on the back panel. When the Channel Operation switch is set to 4/8 Ohm, only the negative and 4/8 ohm connections on the barrier block have audio present. This provides power to low impedance speakers. When the Channel Operation switch is set to 70V/100V, only the negative and 70V and 100V connections on the barrier block have audio present. This provides power to distributed speakers in a high-impedance "constant-voltage" application.

The output relay, in conjunction with input signal mute circuit, assures a quiet turn-on and turn-off. In the event of an amplifier output failure, a triac will activate to turn off the offending channel to protect the speakers.

The turn-on delay circuit functions to keep the output relay open until all the voltages are up and stable, both in the amplifier, and in all the components in the system ahead of the amplifier.

Heatsink temperature is monitored by a thermal probe attached to the heatsink. As the temperature rises, the probe sends a proportional current to the proportional speed fan circuit which starts the fan. Should the power transformer reach its maximum safe temperature, an internal thermal switch opens and the fan circuit turns on full speed to quickly cool down the amplifier. It also disconnects the load via the output relay, removing any output current and further speeding a cool-down cycle. This point is set both to protect speakers and to guard against nuisance tripping.

Whenever the heatsinks or the transformer reach a maximum temperature, or during the normal turn on delay window, the front panel Fault Indicators will blink.

An RJ11 modular jack is mounted on the back panel. Pins 2 and 5 are connected to an opto-isolator which is always in a low-resistance state whenever the unit is on and operational. Should a fault be detected or should the amplifier lose AC power, the opto-isolator will change to a high resistance, allowing the user to remotely detect the status of the amplifier.

The Signal Presence Indicators tap the signal chain just before the level controls and prior to the power amplifier chain. They are not amplifier output indicators and should only be used to indicate the presence of signal at the amplifier front end.

The Clip Iindicator is driven from the output of the compressor circuitry and lights to indicate the onset of audible distortion.

The Power Indicator LED is driven from the low-voltage supply.

A positive and negative regulator form the ±15-volt power supplies. Add to that the main transformer, a full-wave bridge rectifier, and high energy electrolytic to form the main power supply. They are protected by the front-panel line circuit breaker and controlled by the front-panel power switch.

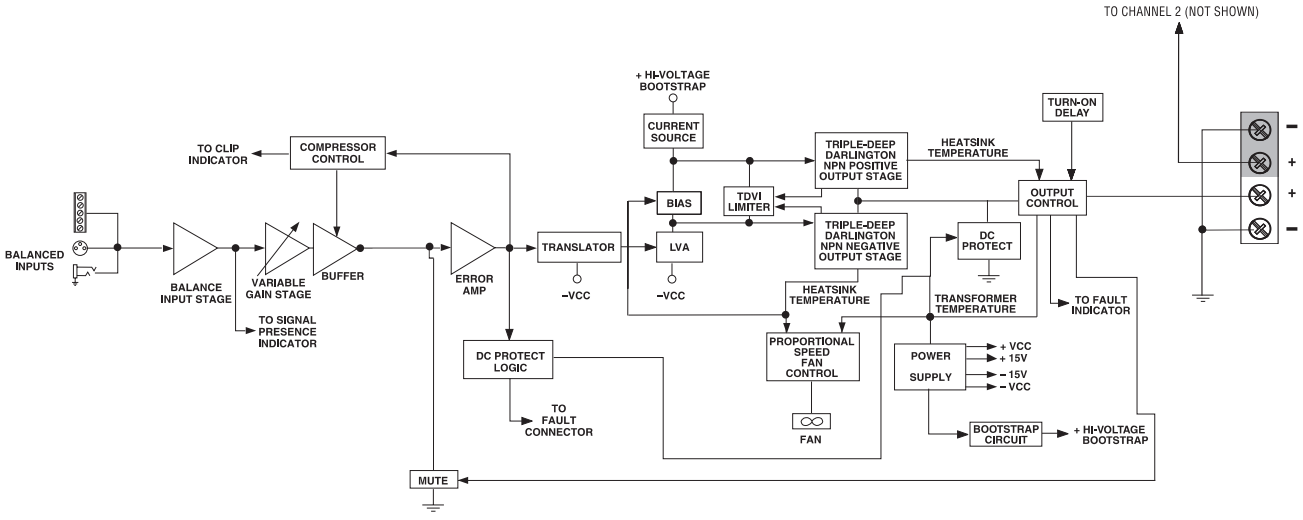

Figure 6.2 CL1 & CL2 Circuit Block Diagram

6.2 CH4 and CL4

6.2.1 Audio Signal Path

For the sake of simplicity, only channel one of the audio signal path is described.

Signal is presented to the CH4/CL4 through one of three connectors when using the standard input module. Each channel is outfitted with a balanced XLR/phone jack, and a barrier strip. These connectors are wired in parallel, which allows daisy chaining when needed. The signal is then converted from balanced to unbalanced in the Balanced Input Stage where it also receives RFI protection. Signal then flows into the Variable Gain Stage where the front panel level controls are allowed to affect the gain.

Following this stage, the signal goes through a gain stage that allows for the various positions of the sensitivity settings. The signal is then put under the control of a full-time compressor circuit comprised of a symmetrical window detector, a buffer amplifier, and the gating op amp which uses several small components to set the compressor's attack and decay characteristics. The actual compressing is accomplished by an opto-isolator that affects the gain in the signal path.

Next, the signal enters a 32-kHz 7th-Order Gaussian Low-Pass Filter. This filter prevents the modulator stage and the output filter (both described below) from receiving signals that are too high. Without the 32-kHz filter, the modulator would be unable to process signals that are too high and the output filter would not yield the proper frequency response behavior. The Gaussian filter type is unique in that it has minimal ringing and excellent phase response so even a high-order filter such as this one does not adversely affect the sonic excellence of the product.

In the CH4, the signal then travels either through the HP filter module or is bypassed around it depending on the position of the channel operation switch. With the switch set in the 70V position, the filter is enabled. The filter is an 18 dB-per-octave high-pass with a –3-dB rolloff at 70 Hz. This provides a measure of protection to step-down transformers used in distributed speakers installations. With the switch set in the 4/8-Ohm setting, the filter is bypassed. The power is delivered to the load cables through the output connector panel which consists of one of several options.

The signal next enters the main amplifier error amp where it is mixed with a small portion of the output voltage and current in such a way as to control the amplifier's overall output performance.

Following the error amp is the modulator stage where the audio signal is compared to an extremely accurate 250-kHz triangle waveform. Comparators output a

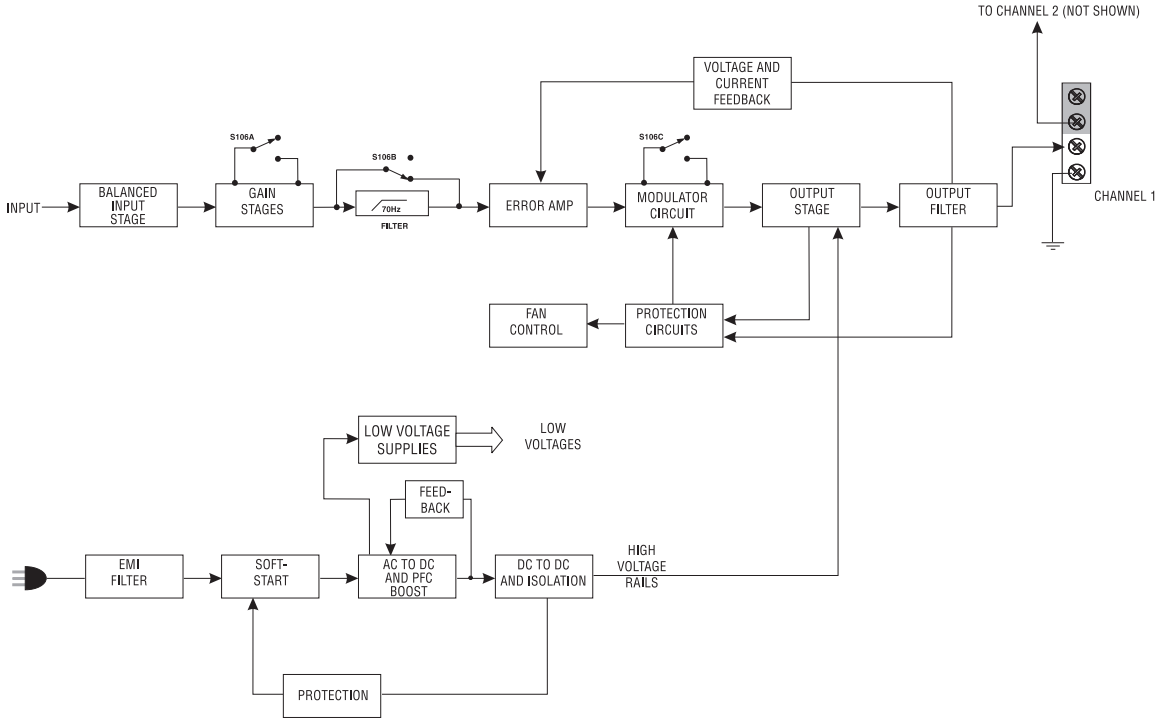

Figure 6.3 CH4 Circuit Block Diagram

Pulse Width Modulated (PWM) string of pulses at 250 kHz that vary in width depending on the level of the input signal. These strings of pulses, one for the positive side and one for the negative side, are connected to the output stage via optocouplers.

The signals from the optos are then passed to gate drivers that amplify the pulses to the level required to drive output devices. The driven output devices are now able to produce PWM pulses that have an output voltage from the negative high-voltage rail (–Vcc) to the positive high-voltage rail (+Vcc). This output voltage is always the same (2 * Vcc) but the width of the pulses is still dependent on the level of the input signal. The positive and negative output PWM pulses then pass through inductors and are summed together. Summing the output signals through inductors reconstructs the audio signal, amplified to the desired level. There is a small amount of ripple on the output that is at double the switching frequency (500 kHz).

The amplified audio signal is then passed through an output filter that removes the residual ripple voltage.

Protection for the output devices is performed by a very precise pulse-by-pulse current limiter circuit that operates each time the output devices switch. The current limiting is “flat” meaning that, regardless of the output voltage, the output current always limits at a certain value.

The turn-on delay circuitry functions to keep the modulators turned off (which keeps the outputs from switching) until all supplies are up and stable.

Thermal probes monitor Heatsink temperatures and power transformer temperature. As the temperatures rise, the probes send a proportional voltage to the fan control circuit and the Thermal Limit Control (TLC) circuit. The fan normally runs at very low speed when the amplifier is idling or when it is being used for low to moderate duty work. If the amplifier is delivering large amounts of power into low impedance loads, the heatsinks or transformer may heat up enough to increase the speed of the fan to medium and possibly to high speed. If the temperature continues to increase, the TLC circuit uses the compressor to reduce the gain of the input stage and thus reduce the power dissipated by the amplifier. As a further protective measure, if the temperature continues to rise (due to blocked airflow for example), the amplifier will stop running and keep the fan on high speed to quickly bring the temperature back to an operational level.

If a signal presented at the input of the amplifier will not be passed through to the output, the Fault LED will blink to get your attention. The turn-on delay, for example, will cause each channel’s LED to blink because the amplifier remains in standby for a few seconds before it allows audio output.

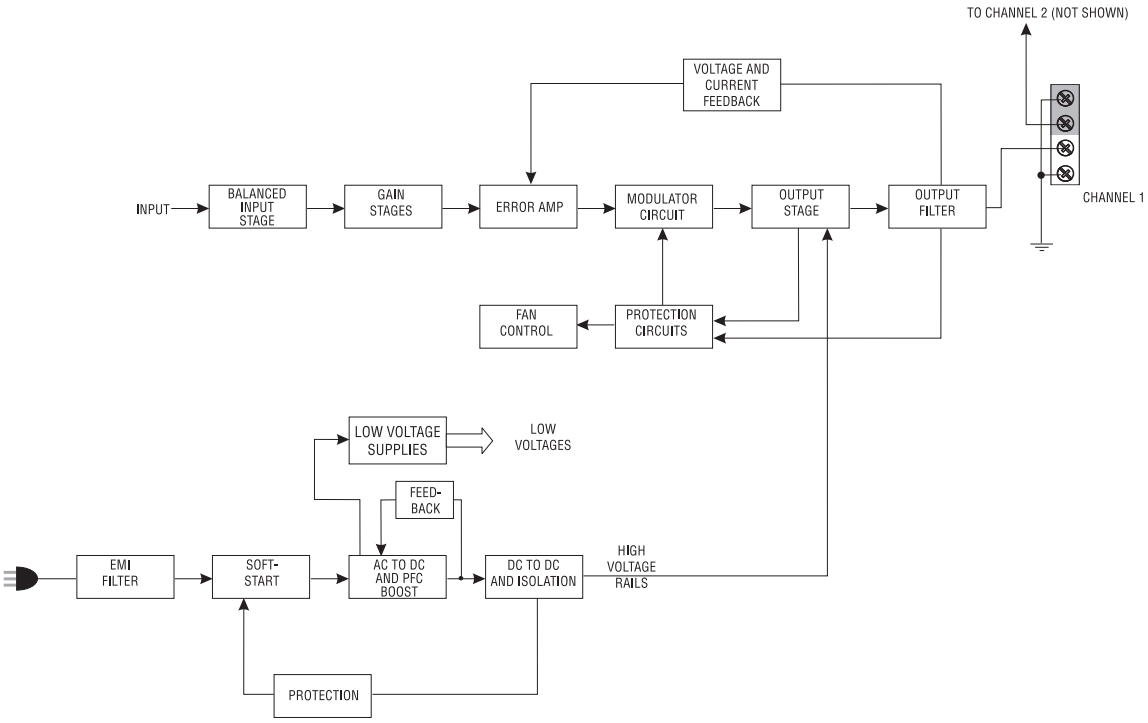

Figure 6.4 CL4 Circuit Block Diagram

An RJ11 modular jack is mounted on the back panel. Pins 2 and 5 are connected to an opto-isolator that is always in a low-resistance state whenever the unit is on and happy. Should a fault be detected or should the amplifier lose AC power, the opto-isolator will change to a high resistance, allowing the user to remotely detect the status of the amplifier.

The Signal Presence Indicators tap the signal chain just before the level controls and prior to the power amplifier chain. They are not amplifier output indicators and should only be used to indicate the presence of signal to the amplifier front end.

The Clip indicators are driven from the output of the compressor circuitry and light to indicate the onset of audible distortion. The Power indicator LED is driven from the low-voltage supply.

6.2.2 Power Supply Operation

AC power enters the amplifier through a power cord equipped with an IEC (unplugable) connector. It then is passed through the EMI filter. Circuits that use switching technology will normally send a small amount of high-frequency noise back down the power cord and into the power distribution system. This noise must be removed in order to sell the unit in certain parts of the world. Since the CH4/CL4 is a worldwide product, the EMI filter removes this noise so that it does not exit the box.

The power then enters the Power Factor Correction (PFC) Boost stage. This stage is what allows the CH4/CL4 to be plugged into any outlet in the world without any modifications to the amplifier. The PFC stage uses switching power supply technology to take whatever AC line voltage comes in, convert it to DC and boost it to 400 Volts. The circuit also uses intelligence to draw the current from the line sinusoidally and in phase with the line voltage. This reduces the load on the power companies and also allows the amplifier to pull more peak power from the power source (the outlet). The power is drawn in small amounts 62,500 times each second and is used to provide power to the isolation stage and to fill the large energy reservoir capacitors.

The power then goes to the “buck” isolation stage. This stage takes the 400 Volt PFC voltage and, again using switching power supply technology, converts it down (“bucks” it down) to the level needed to power the audio output stage. The isolation stage also satisfies a safety requirement by providing isolation, using a transformer, between the AC mains power and the power that is delivered to the speakers. The isolation stage moves power 125,000 times each second from the primary to the secondary to power the audio output stage and keep its large energy reservoir capacitors full.

In order to keep the power supply controllers, protection circuits, and the audio signal path components powered, another switching power supply is used, this one also running at 125 kHz. This one is also a “buck” type supply in that it takes voltage from the 400 Volt PFC bus and converts it down to the low voltages needed. This circuit also uses a transformer to provide safety isolation.

Like the audio signal path parts of the amplifier, there are many ways that the power supply protects itself. Part of the start-up time delay mentioned above occurs while the power supply is ramping up all of its voltages (soft-start) so that large inrush currents are avoided. Current limiters and over-current detectors are used to protect the power supply output devices. The power supply will also detect severe brownouts and shut off the supply until the brown-out is over if the line voltage is drastically less than normal.

7 Specifications

Note: All measurements apply to all models of CH and CL series amplifiers in stereo mode with 8-ohm loads and an input sensitivity of 26-dB gain, 1-kHz at rated power unless other otherwise specified. Specifications for units supplied outside the U.S.A. may vary slightly at different AC voltages and frequencies.

Power

Load Impedance:
Safe with all types of loads.

CH1:
4 and 8 ohm Stereo;
16 ohm at 70V Stereo;
32 ohm at 100V Stereo;
8 and 16 ohm Bridge;
32 ohm at 140V Bridge;
64 ohm at 200V Bridge.

CH2:
4 and 8 ohm Stereo;
8 ohm at 70V Stereo;
16 ohm at 100V Stereo;
8 and 16 ohm Bridge;
16 ohm at 140V Bridge;
32 ohm at 200V Bridge.

CH4:
4 and 8 ohm Stereo;
4 ohm at 70V Stereo;
8 and 16 ohm Bridge;
8 ohm at 140V Bridge.

CL1, CL2 and CL4:
2, 4 and 8 ohm Stereo;
4, 8 and 16 ohm Bridge.

Voltage Gain, 1 kHz, 1.4V sensitivity,

CH1,
30.5 dB (4/8 ohm);
34 dB (70V);
37 dB (100V).

CH2,
32.1 dB (4/8 ohm);
34 dB (70V);
37 dB (100V).

CH4,
34 dB (4/8 ohm);
34 dB (70V).

CL1,
30.5 dB at (4/8 ohm).

CL2,
32.1 dB at (4/8 ohm).

CL4,
34 dB (4/8 ohm).

AC Line Requirements:
Note: North American CH 1, CL 1, CH 2 and CL 2 units are 60 Hz only. All other models are 50/60 Hz. Voltages are ±10%.

AC Line Current,

CH 1 & CL 1:
100 Volts: 7.6 A;
120 Volts: 6.3 A;
230-240 Volts: 3.5 A.

CH 2 & CL 2:
100 Volts: 11.4 A;
120 Volts: 9.5 A;
230-240 Volts: 5.0 A.

CH 4 & CL 4:
100 Volts: 8.5 A;
120 Volts: 7.1 A;
230-240 Volts: 3.7 A.

AC Line Connector: Detachable 15A IEC connector with country-specific plug.

Output Power:
(See Figure 7.1).

Performance

Frequency Response, 20 Hz to 20 kHz at 1 watt,
CH 1, CH 2, CL 1 & CL 2: ±0.1 dB (see Figures 7.2 and 7.3).
CH 4 & CL 4: ±0.25 dB (see Figure 7.4).

Phase Response: ±15 degrees from 20 Hz to 20 kHz at 1 watt.

Signal to Noise Ratio, A-Weighted,
CH 1, CH 2, CL 1 & CL 2: Better than 105 dB below rated 1-kHz power.
CH 4 & CL 4: Better than 102 dB below rated 1-kHz power.

Total Harmonic Distortion (THD), 1 kHz at rated power: 0.5% or less true THD from 20 Hz to 20 kHz.

Intermodulation Distortion (60 Hz and 7 kHz at 4:1): Less than 0.1% at rated power to 30 dB below rated power at 8 ohms.

Damping Factor (8 ohm),
CH 1, CH 2, CL 1 & CL 2: Better than 400 from 10 Hz to 400 Hz (see Figure 7.5).

CH 4 & CL 4: Better than 700 from 10 Hz to 400 Hz (see Figure 7.6).

Crosstalk, 20 Hz to 20 kHz: Better than 50 dB below rated power.

Common Mode Rejection (CMR): Better than 70 dB from 20 Hz to 1 kHz.

DC Output Offset (Shorted Input): ±10 mV.

Controls

Level: A detented rotary level control for each channel located on the rear panel.

Power: An on/off rocker switch located on the front panel.

Mode: A two-position switch located on the back panel which, when turned to "Stereo," operates the amplifier as two independent channels. When "Bridge" is selected, the amplifier bridges the two output channels for twice the output voltage.

Channel Operation Switch (CH Series only): A two-position switch located on the back panel which, when turned to 4/8 Ohm, sets the amplifier to drive low-impedance speaker loads. Turning the switch to 70V/100V (70V only on the CH4) sets the amplifier to drive distributed high-impedance speaker loads and inserts a 70-Hz high-pass filter into the signal chain to prevent step-down transformer saturation (see Section 4.4).

Indicators

Signal: A green indicator for each channel which flashes when a very low-level signal (>-40 dBm) is present at input. May be used for troubleshooting cable runs.

Clip: A red indicator for each channel which turns on when distortion becomes audible in the amplifier output.

Fault: A red indicator for each channel which indicates amplifier has muted output. Normally off. Status may be monitored remotely by plugging into back-panel RJ11 Fault jack.

Power: A blue indicator that turns on when the amplifier has been turned on and has power.

Input/Output

Input Connector (standard module): One Neutrik Combo connector for each channel which features a balanced ¼-inch (6.35-mm) phone jack and a 3-pin female XLR connector, in parallel with a barrier strip termination.

Input Stage: Input is electronically balanced and employs precision 1% resistors.

Input Impedance: Nominally 20 k ohms, balanced. Nominally 10 k ohms, unbalanced.

Input Sensitivity: Channel independent. Factory set at 1.4 volts for standard 1-kHz, 8-ohm power. 26-dB gain and 0.775-volt sensitivity available as a Service Option.

Output Impedance: See Figures 7.7 and 7.8.

Output Connectors,
CH1 and CH2: Four-terminal touch-proof barrier block, one per channel, allows connection of load to 8-ohm, 4-ohm, 70V or 100V outputs.
CH4: Four-terminal touch-proof barrier block.
CL Series: Four-terminal touch-proof barrier block.

Output Signal,
Stereo: Unbalanced, two-channel.
Bridge-Mono: Balanced, single-channel. Channel 1 controls are active; Channel 2 should be turned down.

Protection

CH and CL Series amplifiers are protected against shorted, open or mismatched loads; overloaded power supplies; excessive temperature, chain destruction phenomena, input overload damage and high-frequency blowups. They also protect loudspeakers from input/output DC, large or dangerous DC offsets and turn-on/turn-off transients.

Options

Service Options: SST-SBSC: variable Linkwitz-Riley stereo crossover with mono-summed sub-bass outputs; SST-MX: 100-Hz Linkwitz-Riley crossover with stereo sub-bass output; SST-SX: 80-/120-Hz switchable Linkwitz-Riley crossover with mono summed sub-bass output.

Construction

Rugged steel chassis is formed into a durable package, then coated with environmentally friendly powder for long life and ease of maintenance.

Cooling: Proportional speed fan.

Dimensions,
Width (all models): EIA Standard 19-inch rack mount (EIA RS-310-B);

Height (all models): 5.25-inch (13.34-cm);

Depth (behind front mounting surface),
CH 1, CH 2, CL 1 and CL 2: 12.25-inch (31.11-cm);
CH 4 and CL 4: 16.25-inch (36.56-cm).

Weight,
CH 1: 40.6 pounds (18.4 kg);
CH 2: 48.3 pounds (21.9 kg);
CL 1: 32.6 pounds (14.78 kg);
CL 2: 40.3 pounds (18.28 kg);
CH 4 and CL 4: 33.3 pounds (15.1 kg).

For shipping weight, add 6 pounds (2.7 kg) to each amp.

Output Power

Output Power at 1 kHz at rated THD; Stereo mode, per channel with both channels driven.

	STEREO MODE					BRIDGE MODE			
	2 Ohms	4 Ohms	8 Ohms	70V	100V	4 Ohms	8 Ohms	140V	200V
CH1		450W	275W	300W	300W		900W	600W	600W
CH2		660W	400W	600W	600W		1320W	1200W	1200W
CH4		1200W	600W	1200W			2400W	2400W	
CL1	560W	450W	275W			1100W	900W		
CL2	975W	660W	400W			1950W	1320W		
CL4	1800W*	1200W	600W			3600W*	2400W		

* ≥ 200VAC Line Voltage

Figure 7.1 Contractor Series Output Power

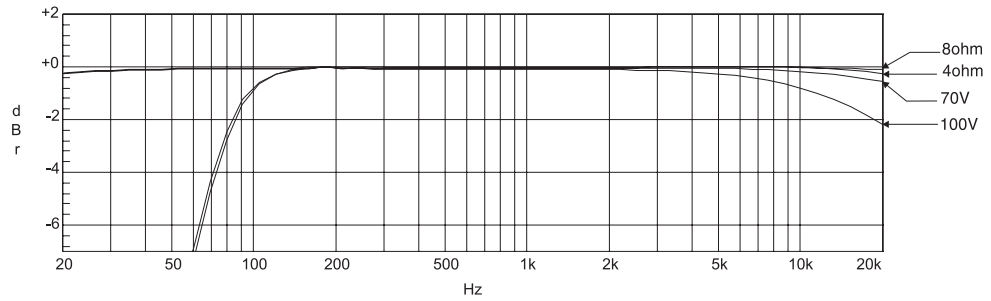

Figure 7.2 CH1 & CH2 Frequency Response

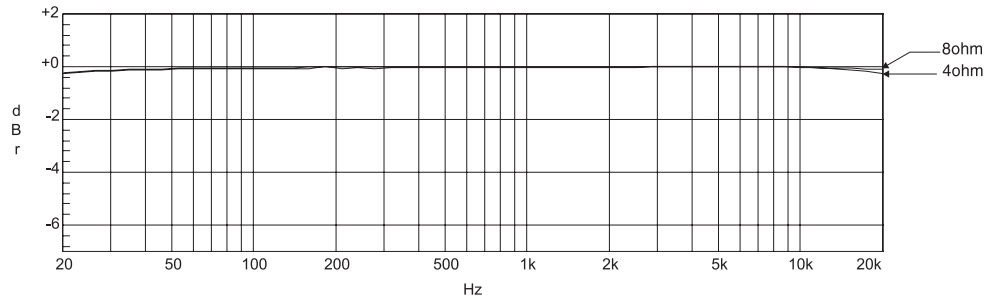

Figure 7.3 CL1 & CL2 Frequency Response