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## CROWN POWER LINE FOUR AMPLIFIER

### Manufacturer's Specifications

#### Stereo Specifications

**Power Output:** 165 watts per channel, 8 ohms, 1 Hz to 20 kHz; 265 watts per channel, 4 ohms, 1 Hz to 20 kHz.

**THD:** 0.05%.

**SMPTÉ IM:** 0.01% at rated output, 8 ohms.

**Damping Factor:** Greater than 400, d.c. to 400 Hz, 8-ohm loads.

**Slewing Rate:** 16 V/ $\mu$ S.

**Output Impedance:** Less than 7 milliohms in series with less than 3  $\mu$ H.

**Voltage Gain:** 20.6,  $\pm$ 2%.

**Input Sensitivity:** 1.76 volts for 165 watts into 8 ohms.

**Frequency Response:** D.c. to 20 kHz within 0.1 dB; d.c. to 100 kHz within 1.0 dB.

#### Monaural Specifications

**Power Output:** 330 watts per channel, 16 ohms, 1 Hz to 20 kHz; 530 watts per channel, 8 ohms, 1 Hz to 20 kHz.

**THD:** 0.05%.

**SMPTÉ IM:** 0.01% at rated output, 16 ohms.

**Damping Factor:** Greater than 400, d.c. to 400 Hz, 16-ohm load.

**Slewing Rate:** 32 V/ $\mu$ S.

**Output Impedance:** Less than 15 milliohms in series with less than 6  $\mu$ H.

**Voltage Gain:** 41.2,  $\pm$ 2%.

**Input Sensitivity:** 1.76 volts for 330 watts into 16 ohms.

**Frequency Response:** D.c. to 20 kHz within 0.15 dB; d.c. to 60 kHz within 1 dB.

#### General Specifications

**Hum and Noise:** 112 dB below rated output.

**Phase Response:**  $+0^\circ$ ,  $-15^\circ$ , d.c. to 20 kHz at 1 watt.

**Input Impedance:** 30 kilohms,  $\pm$ 20%.

**Power Requirements:** 100/120/200/220 or 240 V (selectable), 50 to 400 Hz, a.c.; 40 watts at idle, 560 watts at 330 watts output.

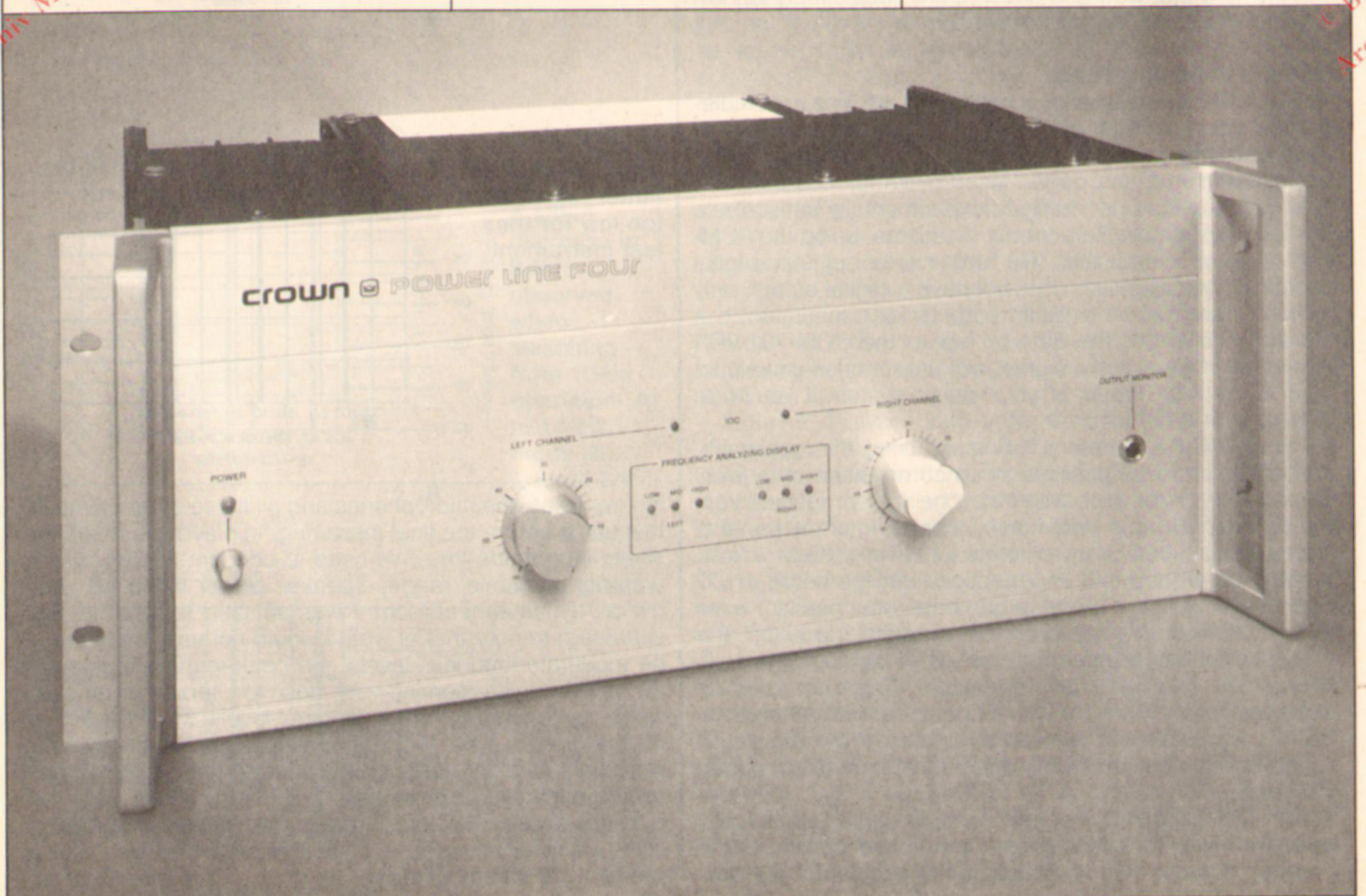
**Dimensions:** 19 in. (48.3 cm) W  $\times$  7 in. (17.8 cm) H  $\times$  10 $\frac{1}{8}$  in. (25.7 cm) D from front panel; handles extend 2.38 in. (6 cm) from front panel.

**Weight:** 55 lbs. (24.9 kg).

**Price:** \$1,199.00.

**Company Address:** 1718 West Mishawaka Rd., Elkhart, Ind. 46517.

For literature, circle No. 92



The Crown Power Line Four amplifier is a single- or dual-channel, high-power unit. It has a power output capability of 165 watts per channel into 8-ohm loads in stereo and of 330 watts into 16 ohms when bridged and operated as a single-channel, mono unit.

Front-panel controls include a power switch and its associated amber indicator lamp, a pair of detented input-level controls, indicator LEDs for Crown's Input/Output Comparator, and three color-coded LEDs per channel for a frequency-analyzing display. Each LED of this frequency display responds to a particular portion of the audio spectrum (lows, mids and highs). This is less significant in analyzing program content (which should be audible) than in noting differences between program content and what is heard. For example, if the high-frequency LED lights normally, yet the highs sound abnormally soft, the problem will be in the speaker (a blown tweeter, or tweeter level turned too low) and not in the program material. A front-panel output-monitor jack is provided, not only for headphone use but to provide access from the front panel to an additional output after the unit has been installed in a rack.

Conventional unbalanced phono-tip jacks are used as input terminals for the amplifier. These jacks are located on the rear panel, along with standard, color-coded, five-way MDP banana jacks, mounted so as to facilitate stereo and bridged-mono connection of output cables.

### Circuit Highlights and Analysis

The output transistor circuitry of the Power Line Four functions as a Class-A circuit at low listening levels, switching to Class A + B at medium-power levels and to Class AB + B at high levels. Protection against shorted and low-impedance loads is incorporated with V-I limiting. Overload protection is also provided for the power supplies, and against input and high-frequency overloads. A thermal circuit automatically places the unit in the standby mode should overheating occur due to inadequate ventilation. To prevent annoying pops or thumps at turn-on, there is a built-in, 4-second mute-delay circuit. A low-frequency interrupt circuit offers additional protection against accidental d.c. being fed through the amplifier and possibly damaging or destroying connected speakers.

At the input of the main amplifier is Crown's Input/Output Comparator (IOC) circuitry which works in conjunction with the error-correcting signal of the main op-amp. Whenever a small "nonlinearity" exists, an error signal appears at the output of the main op-amp, via the feedback loop of the unit. This produces an abnormally high voltage value, exceeding the established "window" of the IOC and illuminating the front-panel LED. Since transient overload can occur very rapidly, a pulse-stretching circuit is added so that the observer can detect that the LED is lit.

A pair of gated switches follow, and provide a means for controlling the signal path through the unit. When a signal is obtained from the control stage, these switches allow it to pass through. However, should the delay, thermal or low-frequency interrupt circuits become activated, the control stage opens these switches, blocking the signal to the output stages.

The current-amplification circuitry, which Crown calls their

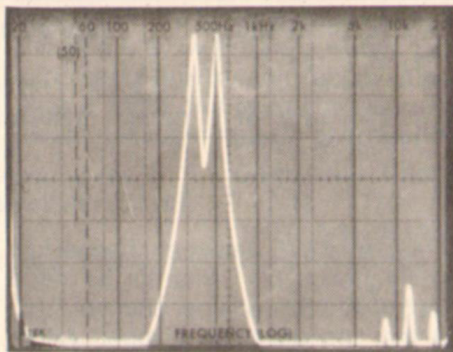


Fig. 1—Twin-tone IHF-IM distortion test. Test signals (9 and 10 kHz) at center, distortion products (0.065%) at right.

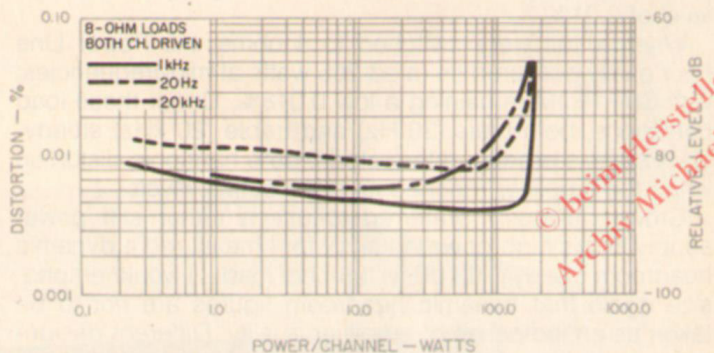


Fig. 2—Distortion vs. power output per channel.

Multi-Mode circuit, consists of the pre-driver, the driver and the output transistor stages. With low-level signals, the circuit has been designed to function in Class A, with pre-drivers always biased "on." As signal levels increase, the circuit changes first to "Class A + B" mode, in which the pre-drivers continue to operate in Class A and are always on while the drivers move smoothly into Class B. Finally, at highest output levels, the pre-drivers and drivers move into the AB mode, with the output devices operating in Class B to develop the higher required power. The protection circuitry is activated when a predetermined amount of voltage and/or current is drawn across the output-stage sensing resistors. A protection signal is then fed back to the limiting circuit, which limits any increase in the bias servo voltage to the power-output devices.

The output signal is also applied to the frequency analyzing display circuitry. Whenever a signal greater than about 0.25 V rms is monitored, one or more of the frequency-analyzing LEDs will light, depending upon the frequency content of the output signal. A portion of the channel-1 output is also sent to the stereo/mono switch located on the rear panel, where it feeds the input of channel 2 when the amplifier is switched to the bridged or mono mode.

"Any way you figure it, the Power Line Four has an inaudible amount of residual background noise or hum."

The power supply of this Crown amplifier is a continuous-duty type. The main d.c. supplies are full-wave, capacitor-input types with heavy-duty diodes heat-sunk to the chassis. Main amplifiers, thermal protection and other supplementary circuits are powered by zener-regulated power supplies.

### Measurements

The Power Line Four delivered 175 watts per channel into 8-ohm loads at a test frequency of 1 kHz for its rated harmonic distortion of 0.05%. At 180 watts per channel, THD rose to 0.1%; beyond that the distortion climbed rather quickly, and the IOC indicators informed me that I was beyond the unit's distortion-free range. The low-frequency end of the spectrum was the determining factor in establishing the "FTC rated power" for this Crown amplifier at a nominal 165 watts per channel with 8-ohm loads. However, using an SMPTE-IM test signal, I was able to pump as much as 180 watts per channel of continuous power (equivalent) into 8-ohm resistive loads before reaching an IM distortion level of 0.01%.

When loads were switched to 4 ohms, the Power Line Four easily delivered its rated 265 watts at mid-frequencies, with SMPTE IM remaining a low 0.018%. Under these load conditions, both bass (20 Hz) and treble (20 kHz) steady state signals produced the rated 0.05% harmonic distortion when the amplifier reached its rated output levels.

Crown obviously preferred to use a rather stiff power supply in this high-powered amp, for I measured a dynamic headroom of only 0.63 dB with 8-ohm loads. I would emphasize again that dynamic headroom figures are *not* to be taken as an indication of amplifier quality. Different designers approach power-supply stiffness from different points of view and, in my opinion, "soft" or "stiff" supplies each offer advantages and disadvantages to the listener. Soft or relatively unregulated supplies yield high dynamic headroom readings. They reproduce short-term peaks or transients without noticeable clipping, even when those bursts drive power levels well beyond nominal FTC power ratings. Audibly, this lends a feeling of crispness to the sound, especially in the treble and upper midrange regions. Stiff power supplies, on the other hand, can support long bursts of power at or slightly above rated power output levels without allowing the supply voltage to collapse. This lends some tightness to the reproduced sound, especially in the bass.

Twin-tone CCIF-IM distortion measured a very low 0.0041%. IHF-IM distortion was also extremely low, with an integrated reading of only 0.065%. This value is obtained from evaluating the dB levels of the IM components generated in the amplifier when it is fed with two tones, 1 kHz apart, as shown in Fig. 1. The unwanted IM components are "summed" by taking the square root of the sum of the squares of all significant components found in the audio band, expressed as a percentage.

As nearly as I could measure it, damping factor at 50 Hz, with 8-ohm loads, did exceed Crown's claimed minimum value of 400, but it takes a mighty short and heavy cable, connected between the output terminals of the amp and a voltmeter, to come up with that figure. Even a couple of feet of 14-gauge wire will have enough resistance to distort the

amplifier's true damping factor figure when we are dealing with such high numbers.

The amplifier's output proved to be unconditionally stable with both inductive and capacitive loads. A 2- $\mu$ F capacitor placed across the output terminals when they were also connected to 8- or 4-ohm resistive loads did not upset the amplifier's stability or significantly alter the appearance of tone-burst or square-wave input signals.

Figure 2 is a plot of power output versus harmonic distortion. While this figure does not include power output in the bridged or mono mode, I did measure this and can report that the amp delivered 345 watts of power into a 16-ohm load and 550 watts into a load of 8 ohms, using the test-signal frequency of 1 kHz for both.

Frequency response of the Crown Power Line Four amplifier extended essentially from d.c. (0 Hz) to 60 kHz for a -1.0 dB roll-off, and out to 110 kHz for an attenuation in response of 3 dB. Input sensitivity referred to 1-watt output measured 137 mV, which corresponds almost exactly to Crown's stated input sensitivity of 1.76 V referred to rated output. Signal-to-noise ratio, referred to 1-watt output with an input level of 0.5 V, measured 106 dB (A weighted). Translated to rated output and a wide-open input-level control, this works out to around 117 dB, or fully 5 dB better than claimed. Either way you figure it, the Power Line Four has an inaudible amount of residual background noise or hum.

### Use and Listening Tests

Because of a rather heavy backlog of products being tested and evaluated in my lab, the Crown Power Line Four has been available as a reference amplifier in my permanent listening setup for nearly two months now. This has given me ample opportunity to subject the unit to all sorts of demanding and challenging program sources, including program material on digital (PCM) tapes. So long as I stayed at levels that did not cause clipping shown by illumination of the IOC indicators on either channel, sound quality of the Crown (hooked up to my reference KEF 105.2 speakers) was absolutely beyond reproach. Bass was tight, and there was no evidence of phase distortion when mid or high frequencies were dominant in the program material. When I exceeded safe levels, however, clipping was rather harsh sounding; that's no great surprise in view of the tight power-supply design and the hard-clipping approach favored by the designers of this amp. I certainly don't want to imply that this condition prevailed under normal listening conditions. With the more than 165 watts of power available per channel at 8 ohms, I really had to push program-source levels to produce any kind of overload and, even with my relatively low-efficiency KEFs, the resulting loudness levels are not anything I'd tolerate for more than a few moments.

If you are planning to use an amp such as this in any sound-reinforcement applications (and many Crown units intended for home use have found their way into such applications over the years), I'd make sure that the IOC indicators do not flash more than once in a great while. If they do, sounds will become audibly distorted and your best solution then would be to operate the Power Line Four in the bridged mono mode—so buy yourself a pair of these if you need two-channel reproduction. *Leonard Feldman*