
Obtaining Other Language Versions: To obtain information in another language about the use of this product, please contact your local Crown Distributor. If you need assistance locating your local distributor, please contact Crown at 574-294-8000 or www.crownaudio.com.

This manual does not include all of the details of design, production, or variations of the equipment. Nor does it cover every possible situation which may arise during installation, operation or maintenance.

The information provided in this manual was deemed accurate as of the publication date. However, updates to this information may have occurred. To obtain the latest version of this manual, please visit the Crown website at www.crownaudio.com.

Trademark Notice: Crown, Crown Audio, IQ, BCA, and Amcron are registered trademarks of Crown International. HiQnet is a trademark of Harman International Industries, Inc. Other trademarks are the property of their respective owners.

Some models may be exported under the name Amcron.

I-Tech HD DriveCore Series Power Amplifiers

Important Safety Instructions

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with a dry cloth.
7. Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
8. Do not install near any heat sources such as radiators, stoves, or other apparatus (including amplifiers) that produce heat.
9. Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
10. Only use attachments/accessories specified by the manufacturer.
11. Unplug this apparatus during lightning storms or when unused for long periods of time.
12. Do not expose this apparatus to dripping or splashing液体, such as vases, are placed on the apparatus.
13. Refer all servicing to qualified service personnel. Servicing by unqualified personnel is dangerous and can result in electric shock.
14. Unplug this apparatus during lightning storms or when unused for long periods of time.
15. Do not expose this apparatus to severe shock, such as rain or moisture.
16. The mains plug of the power supply cord shall remain readily operable.

Wichtige Sicherheitshinweise

1. Lesen Sie diese Anweisungen.
2. Bewahren Sie diese Anweisungen auf.
4. Folgen Sie allen Anweisungen.
6. Reinigen Sie es nur mit einem trockenen Tuch.
8. Installieren Sie es nicht in der Nähe von Wärmequellen wie Heizkörpern, Herdplatten oder anderen Geräten (einschließlich Verstärker) die Wärme produzieren.
10. Verwenden Sie nur Zubehörteile und -zubehörteile, die vom Hersteller empfohlen werden.
11. Stecken Sie das Gerät während Gewitter oder längere Zeit, ohne Verwendung, aus.
13. Wenden Sie sich an qualifiziertes Personal, falls Reparaturen erforderlich sind.
15. Setzen Sie das Gerät nicht in der Nähe von Erschütterungen, etwa Regen oder Feuchtigkeit.
16. Das Netzkabel des Netzteils muss leicht zugänglich bleiben.

Operation Manual

FCC Compliance Notice

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

ATTENTION AUX SIGNES SIGNIFICATION: Cela signifie que l'appareil est conforme à la classe B de la réglementation pour les appareils numériques. Il peut néanmoins causer des interférences radioélectriques à d'autres utilisateurs.

ATTENTIO N AU CES SIGNES SIGNIFICATI ON: El é que el aparato está conforme a la clase B de la regulación para los dispositivos numéricos. Sin embargo, puede causar interferencias radiotelevisivas a otros usuarios.

ATTENTION AUX SIGNES SIGNIFICATI ON: El dispositivo cumple con la clase B de la regulación para los dispositivos numéricos. No obstante, puede causar interferencias radiotelevisivas a otros usuarios.

ATTENTION AUX SIGNES SIGNIFICATI ON: O dispositivo está conforme à classe B da regulamentação para os dispositivos numéricos. No entanto, pode causar interferências radioelétricas a outros usuários.

ATTENTION AUX SIGNES SIGNIFICATI ON: El dispositivo cumple con la clase B de la regulación para los dispositivos numéricos. No obstante, puede causar interferencias radioeléctricas a otros usuarios.

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1. Welcome

The Crown® I-Tech HD DriveCore Series offers amazing power, light weight and ease of use for touring sound applications. Unlike other amplifiers, it features built-in high def. processing capabilities that can handle an entire system's processing demands. Computerized, on-board DSP delivers a digital signal processing (DSP) engine with a large number of features. The DSP is a powerful tool for your audio gear and is packed with features you can expect in your home audio system. The on-board DSP can complete complex tasks like equalization, compression, and de-convolution, allowing you to control or CobraNet digital audio transport. This “Single Plug” connection allows HiQnet networking the amplifier’s attenuation and muting, configure amplifiers in a multi-amp system and recall DSP presets to reconfigure the amp for various applications.

1.1 Features

- Global Power-Delivery with IRC (Power Factor Correction) works in conjunction with IRC.
- High power density, up to 12,000 watts in 24 channels.
- Output voltage of 185Vpk provides clean correction. (125Vrms output with 0.35% THD, all channels driven.
- Correction) works anywhere in the world.
- Correction) works anywhere in the world.
- Onboard high-definition analog devices are configured in conjunction with IRC.
- EtherCon® Ethernet connector for HiQnet™ networking.
- HiQnet connectivity allows for HiQnet™ control in a multi-amp system and recall DSP presets to reconfigure the amp for various applications.
- Comprehensive array of indicators provide detailed information to safely and correctly setup and service your amplifier.
- Five-Year, No-Fault, Fully Transferable Warranty completely protects your investment for which they were designed.
- Front-panel USB connector accepts a USBthumb drive to transfer presets from the drive to the amplifier DSP, and vice versa. This feature also allows you to update the amplifier's firmware.
- LCD Control Screen is used to adjust the amplifier's attenuation and muting, configure amplifiers in a multi-amp system and recall DSP presets to reconfigure the amp for various applications.
- Comprehensive array of indicators provide detailed information to safely and correctly setup and service your amplifier.
- Five-Year, No-Fault, Fully Transferable Warranty completely protects your investment for which they were designed.
- Front-panel USB connector accepts a USBthumb drive to transfer presets from the drive to the amplifier DSP, and vice versa. This feature also allows you to update the amplifier's firmware.
- LCD Control Screen is used to adjust the amplifier's attenuation and muting, configure amplifiers in a multi-amp system and recall DSP presets to reconfigure the amp for various applications.
2 Setup

2.1 Unpack and Install Your Amplifier

Please inspect and unpack your amplifier for any damage that may have occurred during transit. It is imperative that you notify the transportation company immediately. Only you can initiate a claim for shipping damage. Crown will not be happy to help you. Save the shipping papers as evidence of damage for the shipper’s inspection.

We also recommend that you use all packing materials so you will have them if you ever need to transport the unit. Never ship the unit without the factory pack.

YOU WILL NEED (not supplied):

• Input wiring cables
• Output wiring cables
• Ethernet cables
• Rack for mounting amplifier (or a stable surface for stacking)

33.4 cm x 19 In. (8 inches) away from the amplifier.

Figure 2.1

Dimensions

16.95 In.
43.1 cm

19 In.
48.3 cm

2.2 Connecting to AC Mains

WARNING! Before you begin, make sure your amplifier is disconnected from the power source, with the power switch in the ‘off’ position and all front panel control knobs turned completely down (power meters off).

Use a standard 14-50 (or 6-50) equipment plug (3A or 6A). See Figure 2.1 for amplifier dimensions.

You may also stack amplifiers on top of each other. NOTE: When transporting, amplifiers should be supported at both front and back.

CAUTION! Do not locate sensitive high-gain equipment such as preamps or tape decks within the specified frequency requirements (indicated on the amplifier’s specifications) without proper shielding (the outer conductor). The field is strongest on the right side and right rear corners. Avoid placing unshielded devices that are located nearby. Amplifiers do not create energy. The AC mains voltage and current must be sufficient to deliver the power you expect. You must operate your amplifier at a power output level that is within the specified frequency requirements. Do not attempt to disable this ground connection by using an adapter or other methods.

• Turn the entire sound system off before changing any connections.

Figure 2.2

Airflow

Figure 2.3

Power Connector

CAUTION! Crown recommends that high gain equipment such as a preamp or in an amplifier is located directly in front of the amplifier. Because the amplifier has high power density, if it is using magnetic shielding, there can be induced voltages in conductors that are located directly in front of the amplifier. The field is stronger on the right side and right rear corners of the amplifier.

When using any power level, make sure your amplifier is disconnected from the power source, with the power switch in the ‘off’ position and all front panel control knobs turned completely down (power meters off).

When using unbalanced lines keep the cables as short as possible. Avoid cross connections. A shield (the outer conductor) the better. Spiral wrapped shield is not recommended.

When using network connections, pass the CAT 5 cable five times through the cable. Radio frequency interference, ground loops, and feedback oscillation is lessened the chance of hum and noise.

• Do not run audio input cables together with high-level wiring such as loudspeaker wires or AC cords. (This lessens the chance of hum and noise.

• When using network connections, pass the CAT 5 cable five times through the cable. Radio frequency interference, ground loops, and feedback oscillation.

Figure 2.4

Pass the CAT 5 cable five times through the front panel.

2.3 Wire Inputs and Outputs

2.3.1 Wiring basics

32A Neutrik® powerCON

Figure 2.5

CAUTION! Do not use shielded audio cables together with high-level wiring such as loudspeaker wire or AC cords. (This lessens the chance of hum and noise.)

• Turn the entire sound system off before changing any connections.

Figure 2.6

Amplifier Application Guide.

For additional information or toaux input wiring please refer to the Crown Amplifier Application Guide. This document is available online at www.crownaudio.com. It contains helpful information on preventing unwanted subsonic frequencies, radio frequency interference, ground loops, and feedback oscillation.

When using networks connections, pass the CAT 5 cable five times through the cable. (This lessens the chance of hum and noise.)

Figure 2.7

Neutrik® powerCON

Figure 2.8

Transformer/Phase Shift.
2.3.2 Choose Input Wire and Connectors

Crown recommends using pre-built or professionally wired, balanced or unbalanced line (two-conductor plus shield), 22-24 gauge cables and connectors. Use 3-pin male XLR connectors. Unbalanced line may also be used but may result in noise over long cable runs.

Figure 2.3 shows connector pin assignments for balanced analog wiring or AES3 digital wiring. The use of standard analog cables provides immunity to EMI (electromagnetic interference). Typically cable lengths should not exceed 115 ft., however, balanced line can be used up to 180 ft. with minimal degradation. AES3 signals are recommended for longer runs, however, AES3 cables are more expensive than balanced analog cables. Figure 2.4 shows connector pin assignments for unbalanced analog wiring. In multiple-room systems, the AES3 distribution over a single AES3 source, the following shows the number of AES3 connections in parallel based on AES3 switching frequency.

<table>
<thead>
<tr>
<th>Frequency</th>
<th># of Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>96kHz</td>
<td>4 AES3 Pairs</td>
</tr>
<tr>
<td>48kHz</td>
<td>8 AES3 Pairs</td>
</tr>
<tr>
<td>44.1kHz</td>
<td>8 AES3 Pairs</td>
</tr>
</tbody>
</table>

***Please note with good quality 110 ohm shielded digital cable, it is possible to obtain a higher number of connections than stated. It is up to the user to test this based on their use case. The connections stated here are based on worst case analysis.

NOTE: Custom wiring should only be performed by qualified personnel.

2.3.3 Choose Output Wire and Connectors

Crown recommends using pre-built or professionally wired, high-quality, 2-, 4-, or 8-conductor, heavy gauge speaker wire and connectors. Use Class 2 output wiring. You may use a 4-pole Speakon® connector (Figure 2.7) or banana plugs, spade lugs, or bare wire for your output connectors (Figure 2.8). To prevent the possibility of short circuits, wrap or otherwise insulate exposed loudspeaker cable connectors.

CAUTION – SHOCK HAZARD: Potentially lethal voltages exist at the output connectors when the amplifier is turned on and is passing a signal.

Using the guidelines below, select the appropriate size of wire based on the distance from amplifier to speaker.

<table>
<thead>
<tr>
<th>Distance</th>
<th>Wire Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 25 ft.</td>
<td>16 AWG</td>
</tr>
<tr>
<td>26-40 ft.</td>
<td>14 AWG</td>
</tr>
<tr>
<td>41-60 ft.</td>
<td>12 AWG</td>
</tr>
<tr>
<td>61-100 ft.</td>
<td>10 AWG</td>
</tr>
<tr>
<td>101-150 ft.</td>
<td>8 AWG</td>
</tr>
<tr>
<td>151-250 ft.</td>
<td>6 AWG</td>
</tr>
</tbody>
</table>

CAUTION: Never use shielded cable for output wiring.

2.3.4 Stereo Mode Wiring

Typical input and output wiring is shown in Figure 2.9. IMPORTANT: Turn off the amplifier and unplug its power cord.

INPUTS: Choose one of these options:

• Connect analog input wiring for all channels.
• Connect AES3 digital signal to the AES3 connectors.

OUTPUTS: Maintain proper polarity (+/−) on output connectors. Use Class 2 output wiring.

Figure 2.9 shows how to wire stereo speakers to the binding posts. Connect Channel 1 loudspeaker’s positive (+) lead to Channel 1 positive (red) terminal of amp; repeat for negative (–). Repeat Channel 2 wiring as for Channel 1.

To wire stereo speakers to the Speakon® connectors, use this method:

Table 2

<table>
<thead>
<tr>
<th>Channel 1</th>
<th>Channel 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loudspeaker</td>
<td>Loudspeaker</td>
</tr>
<tr>
<td>Channel 1</td>
<td>Channel 2</td>
</tr>
</tbody>
</table>

Figure 2.10 Wiring Two Stereo Speakers to the Top Speakon® Connector

Table 1

<table>
<thead>
<tr>
<th>Frequency</th>
<th># of Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-150 kHz</td>
<td>4 AES3 Pairs</td>
</tr>
<tr>
<td>200-250 kHz</td>
<td>8 AES3 Pairs</td>
</tr>
</tbody>
</table>

CAUTION: Never use shielded cable for output wiring.
2.5 Bridge-Mono Mode

Overview: Turn on the amp, enable Bridge-Mono mode using the LED-Control Screen, turn off the amp, and select on blacks. Then:

1. Turn on the amp, disable the speaker by selecting one amplifier and turn on the other amplifier.
2. Under the LED-Control Screen, press the Menu/Exit button and select OUTPUT MODE as shown in Figure 2.10. As shown in Figure 2.10, all LED screens are linked to each other.
3. Press the Encoder keys to select MONO MODE.

2.6 Power Saving

Note: In Bridge-Mono mode, the Channel 1 Level control sets the level; the Channel 2 Level control is defeated. All Channel 2 objects and

3.3 Green Savings

Here’s an example of the energy savings achieved by Crown’s Class-I for products:

- Crown Amps AR-M500T 7.2kW at full output.
- Final output 1.35kW at 20%.
- The overall power savings would be approximately 85%.

3.2 The Sound of Efficiency

As mentioned earlier, there are more than 1.5 billion vehicles on the road today. Since vehicles are responsible for 93% of the world’s greenhouse gas emissions and cost businesses over $170 billion a year in wasted fuel, it’s clear that reducing fuel consumption is the key to reducing the global carbon footprint. By reducing fuel consumption, you not only lower your carbon footprint but also improve fuel efficiency, reduce pollution, and cut costs.

3.1 Going ‘Green’

Go green today to reduce your impact on the environment and take advantage of: Effortless, energy-saving benefits such as:

- GreenEdge technology initiative allows partners to take advantage of world-class branded audio and infotainment products. The Crown Audio Application Guide offers the latest in high-quality, innovative design and technology, including access to a range of world-class branded audio and infotainment products. The Crown Audio Application Guide is available at www.crownaudio.com.

- Connect an AES/EBU digital signal source to the Digital Input IN connector.
- Connect an analog signal source to the Channel-1 and/or Channel-3 amplifier (Figure 2.11):
- Turn on the amp, enable Bridge-Mono mode using the LED-Control Screen, turn off the amp, and select Bridge-Mono mode.
- Use Class 2 output wiring. There are two ways to wire the amplifier output connectors for Bridge-Mono mode:
- Table 2: Speaker Wiring for Bridge-Mono

3.3 High-Efficiency Designs

The patented Universal Power Supply with Power Factor Correction combined with the patented Class-I PWM output stage technology allows for maximum efficiency. This can result in energy savings of over 90% compared to a standard Class-I amplifier at 100VAC.

- Reduced weight benefits the consumer by reducing shipping costs and benefits the environment by reducing emissions from vehicles because the shipper is able to reduce the amount of fuel consumed to transport the goods or the vehicle is lighter.
- Shipping costs and benefits the environment by reducing emissions from vehicles because the shipper is able to reduce the amount of fuel consumed to transport the goods or the vehicle is lighter.
- The average weight of a Class-I Tour Amp is approximately 220 kg. The average weight of a MA5002VZ Tour Amp is approximately 100 kg. The average weight of a MA5002VZ Tour Amp is approximately 100 kg.
- ’Green’ is no longer an option – it’s a necessity. Protecting the world we live in is key to addressing climate change and protecting future generations. It’s critical for us to act now to reduce greenhouse gas emissions and protect our environment.

- Draw an average of 100W of power greatly reducing your power bills.
- Draw state when not in use. When in this mode, the I-Tech HD series automatically enters Standby mode.
- An average of 100W of power greatly reducing your power bills.
- Draw state when not in use. When in this mode, the I-Tech HD series automatically enters Standby mode.
- Power Savings – The I-Tech HD Series has both manual and automatic standby modes that put the amplifier into a low AC current state when not in use. This reduces energy consumption by up to 95%.
- Environmental Responsibility – By integrating HAAR’s GreenEdge systems into your business model, you are promoting responsible governments, businesses and individuals everywhere.

- Low weight benefits the consumer by reducing shipping costs and benefits the environment by reducing emissions from vehicles because the shipper is able to reduce the amount of fuel consumed to transport the goods or the vehicle is lighter.
- The average weight of a CA500-2 Tour Amp is approximately 100 kg. The average weight of a MA5002VZ Tour Amp is approximately 100 kg.
- ’Green’ is no longer an option – it’s a necessity. Protecting the world we live in is key to addressing climate change and protecting future generations. It’s critical for us to act now to reduce greenhouse gas emissions and protect our environment.

- Draw an average of 100W of power greatly reducing your power bills.
- Draw state when not in use. When in this mode, the I-Tech HD series automatically enters Standby mode.
- Power Savings – The I-Tech HD Series has both manual and automatic standby modes that put the amplifier into a low AC current state when not in use. This reduces energy consumption by up to 95%.
- Environmental Responsibility – By integrating HAAR’s GreenEdge systems into your business model, you are promoting responsible governments, businesses and individuals everywhere.

- Low weight benefits the consumer by reducing shipping costs and benefits the environment by reducing emissions from vehicles because the shipper is able to reduce the amount of fuel consumed to transport the goods or the vehicle is lighter.
- The average weight of a CA500-2 Tour Amp is approximately 100 kg. The average weight of a MA5002VZ Tour Amp is approximately 100 kg.
- ’Green’ is no longer an option – it’s a necessity. Protecting the world we live in is key to addressing climate change and protecting future generations. It’s critical for us to act now to reduce greenhouse gas emissions and protect our environment.

- Draw an average of 100W of power greatly reducing your power bills.
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- Environmental Responsibility – By integrating HAAR’s GreenEdge systems into your business model, you are promoting responsible governments, businesses and individuals everywhere.
4 Integrated DriveCore™ Technology

Class D and Class I amplifiers are notable for extraordinarily high efficiency and well suited for driving difficult reactive loads such as subwoofers.

Crown engineers developed DriveCore™ Technology - a proprietary hybrid analog-digital integrated circuit (IC) leveraging 12-bit Texas Instruments that drives the “front end” of the Class D or Class I output stages. Over 60 years of Crown's design knowledge and experience went into the development of this technology resulting in truly remarkable benefits.

DriveCore™ Technology provides an extremely wide-tolerance with regards to sagging or "dirty" AC line conditions providing consistent performance without affecting audio quality. This means that your performance will not be compromised by fluctuating generator power or overloading by lighting rigs, backline gear, etc.

In addition, DriveCore™ Technology’s patented feedback and PWM modulation circuits establish recovery at peak transients, accurate reproduction of low-level detail, and precise tracking of low-frequencies at high power levels for maximum subwoofer output.

5 Powered by Crown

This I-Tech HD Series amplifier is compatible with the Powered by Crown app. For more information visit:

http://www.crownaudio.com/mobileapplications/index.htm

The New System Control App from Crown, Available at the Apple App Store.

Visit crownaudio.com for more information.
6 Operation

6.1 Protecting Your Speakers

1. Before use, your amplifier first must be configured for proper operation, including input and output wiring hookup. Improper configuration may result in premature clipping and speaker damage. Usually this means that the amplifier must be turned off and is passing a signal.

2. Use care when handling or transporting your amplifier. The amplifier may be damaged or destroyed during transportation if it is not properly protected according to the manufacturer’s specifications.

3. Do not short the ground lead of an output cable to the input signal ground. This may form a ground loop and cause oscillations.

4. Monitor the power supply, battery or power supply. Electrical shock may result.

5. Tamper with the electrical circuitry on the mixer input. Signals may be transmitted with extreme accuracy, and loudspeaker damage may result.

6. Tamper with the electrical circuitry on the mixer input. Signals may be transmitted with extreme accuracy, and loudspeaker damage may result.

7. Do not overdrive the mixer, which will cause clipped signal to be sent to the amplifier. Such signals will be reproduced with extreme accuracy, and loudspeaker damage may result.

8. Do not operate the amplifier with less than the rated load impedance. Due to the amplifier’s output protection, such a configuration may result in premature clipping and speaker damage.

9. Use care when handling or transporting your amplifier. The amplifier may be damaged or destroyed during transportation if it is not properly protected according to the manufacturer’s specifications.

6.2 Startup Procedure

When first turning on your amplifier, follow the procedures in the Quick Start Guide on pages 4 (stereo) or page 5 (bridge). If your network is any type of valid configuration, set the IP address, subnet mask, and router’s IP address. Leave the “Ready” indicator on when the amplifier is registered. Leave the “Network” indicator on when the amplifier is set to obey a static IP address.

6.3 Precautions

1. Before use, your amplifier must be configured for proper operation, including input and output wiring hookup. Improper configuration may result in premature clipping and speaker damage.

2. The LCD Display Screen and its controls let the user recall DSP presets.

6.4 Front Panel Controls and Indicators

A. LCD Display Screen

Integrated 4.3” color LCD with backlight, displays all user interface menus and update firmware from the drive to the amplifier and vice versa.

B. LCD Display Screen

Front-panel LCD is low-power backlit display adjustable for settings.

C. Thermal Indicator

Red LED, one per channel, illuminates when the channel has shut down due to thermal stress or overloading.

D. Bridge Mode Indicator

Yellow LED indicates network data activity. Data activity indicator can be turned on or off from the touch screen.

E. Fault Indicator

Red LED, one per channel, illuminates when the amplifier output channel has stopped operating.

F. Thermal Indicator

Red LED, one per channel, illuminates when the amplifier output channel has stopped operating.

G. Clip Indicator

Red LED, one per channel, illuminates when the amplifier output channel has stopped operating.

H. Level Control (Encoder)

Usually this means that the amplifier must be turned off and is passing a signal.

I. Menu/Exit Button

Selects next item in the menu. "Menu" enters the main menu. "Exit" leaves the menu.

J. Power Indicator

Blue LED indicates amplifier has been turned on and AC power is available. The LED turns off when the AC voltage is 5% above or below the rated nominal range. This indicator can be turned on or off from the touch screen.

K. Next

Selects next item in the menu. "Next" moves the cursor to the next item.

L. Signal Indicators

These can be disabled during Blackout mode. Three green LEDS per channel indicate the amplifier’s output is turned on and is producing a signal. Usually this means that the amplifier must be turned off and is passing a signal.

M. Ready Indicator

Green LED is on channel, illuminates when the channel is initialized and ready to produce audio.

N. Data Indicator

Green LED is on channel, illuminates when the channel is initialized and ready to produce audio.

O. Data Indicator

Green LED is on channel, illuminates when the channel is initialized and ready to produce audio.

P. Bridge Mode Indicator

Yellow LED indicates network data activity. Data activity indicator can be turned on or off from the touch screen.

Q. Bridge Mode Indicator

Yellow LED indicates network data activity. Data activity indicator can be turned on or off from the touch screen.
**6 Operation**

**6.5 Back Panel Controls, Indicators and Connectors**

A: Fan
- Press to load in-batch firmware for cooling.

B: Analog Input Jacks
- Front panel Control of High, Medium, Low, output banana binding posts. Accepts banana plugs, wire or spade lugs.

C: Power Card Connector
- 32 amp PowerCon® AC Inlet. Voltage range is 90-150 VAC. Use only with I-TECH 4x3500 | 2300W equipment, not with other models.

D: LED Meter Display Type
- Selection of one of the LED display types. Change the selection to suit the building.

E: Screen Configuration
- Change the display screen.

F: Default Display View
- Selection of the default display view.

G: Sample Rate
- Selection of the sample rate.

H: Menu Tree
- A menu tree is used to navigate through the menu options.

**7 Advanced Operation**

**7.1 Introduction**

This LCD display screen allows you to configure the operation and function of the amplifier via a local user interface or through a remote computer. Also, you can recall DSP presets via the remote panel. Once DSP parameters are configured and saved to the LCD display screen, this is a menu in a System architecture.

**7.2 LCD Display Screen**

- Figure 7.1 shows the LCD display screen.
- Shows the configuration of the amplifier and the network settings in the LCD display screen.

**Operation Manual**

**7 Advanced Operation**

**7.1 Introduction**

This LCD display screen allows you to configure the amplifier and the network settings to connect through a remote computer. It is not recommended to loop through more than four amplifiers.

**NETWORKING SECTION**

**7.2 LCD Display Screen**

- Shows the configuration of the amplifier and the network settings in the LCD display screen.

**ATTENTION**

- To reduce the risk of electric shock, grounding is required.

**CLASS 2 OUTPUT WIRING**

- Provides front-to-back forced airflow for cooling.

**OUTPUT CONNECTORS**

- Two high-current, 50A Neutrik® Speakon® NL4MLP output connectors.

**BALANCED ANALOG XLR INPUTS**

- Provides front-to-back forced airflow for cooling.

**6 Operation**

**6.5 Back Panel Controls, Indicators and Connectors**

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- Selection of the default display view.

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- Selection of the sample rate.

H: Menu Tree
- A menu tree is used to navigate through the menu options.
### 7 Advanced Operation

#### 7.2 Operation Examples

##### Operation Example 1

1. After power-up, when the default display screen appears, press Menu/Exit.
2. Press Next twice to reach the Advanced Menu, press Menu/Exit to select.
3. Press Next once to reach the Analog Input Sensitivity menu, then press the encoder wheel to select.
4. Press Next to reach the desired channel press the encoder wheel to select a channel and turn the encoder knob to adjust the sensitivity.
5. When finished, press and hold the Menu/Exit button to return to the default display view.

##### Operation Example 2

1. After power-up, when the default display screen appears, press Menu/Exit.
2. Press Next twice to reach the Main Menu, press Menu/Exit to select an item.
3. Press Menu/Exit to reach the Main Menu, then press Next to reach the Advanced Options menu.
4. Press Next to select a desired channel press the encoder wheel to select.
5. When finished, press and hold the Menu/Exit button to return to the default display view.

#### 7.2.1 Basic Selections

##### Opening Screen

On power-up, the LCD Display Screen displays the Crown logo. After a few seconds, the firmware version appears, then the Analog Inputs screen appears.

##### Analog and Bar Meters

This screen shows the channels in dB. To view each channel press Menu/Exit twice to reach the Advanced Menu, then Menu/Exit to select and turn the Encoder knob.

To view the channel, press the encoder wheel to select a channel and turn the encoder knob to adjust. When finished, press and hold the Menu/Exit knob to return to the default display view.

#### Multi-Channels

- For the Analog screen:
  - To move channel: the display will alternate between MAX and the alternative channel. While the amplifier is active, you can adjust the sensitivity for each channel by using the encoder knob to select and turn the encoder knob.
  - To move the channel: Press and hold the encoder wheel for 1 second.

- For the Attenuation screen:
  - The current preset name is displayed in the lower left corner. The encoder knob is used to navigate up or down to select a channel or press Menu/Exit to return to the top menu.

#### 7 Advanced Operation

#### 7.3 Sample Rate

- To adjust the sample rate, press Menu/Exit to go to the Sample Rate screen in the advanced mode.
- On power-up, the LCD Display Screen displays the Crown logo. After a few seconds, the firmware version appears, then the Analog Inputs screen appears.
- Press and hold the Menu/Exit button to return to the default display view.

#### Analog Input Sensitivity

- For the Analog screen:
  - To move channel: the display will alternate between MAX and the alternative channel.
  - To adjust sensitivity, press the encoder wheel to select a channel and turn the encoder knob.
  - The current preset name is displayed in the lower left corner. The encoder knob is used to navigate up or down to select a channel or press Menu/Exit to return to the top menu.

- For the Attenuation screen:
  - The current preset name is displayed in the lower left corner. The encoder knob is used to navigate up or down to select a channel or press Menu/Exit to return to the top menu.

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Input Sources: For each channel, turn the Encoder to select analog, digital, or CobraNet options. Options are:

- Analog
- Digital
- Digital with analog backup
- Digital with analog override

Digital with analog backup:
The I-Tech HD is being fed a digital signal and an analog signal. The input is currently switched to the digital signal. If it fails, the I-Tech HD switches instantly to the analog signal.

Digital with analog override:
The input is switched to the digital signal, and no analog signal is applied. If an analog signal is sent, the I-Tech HD switches instantly to the analog signal. If the analog signal fails, the I-Tech HD switches to the digital signal after a delay set by the Hold Time slider in the Input Section of the System Architect page.

Maximum Analog Input:
Use Next and press the encoder wheel to select +21 dBu or +15 dBu. Note: Changing this value changes the range of sensitivities available to the amplifier.

For more information see Figure 7.2 and the I-Tech Specifications Chart in the Appendix of the I-Tech Applications Guide. It is available online at www.crownaudio.com/pdf/amps/137327.pdf.

Attenuator Limits:
You can set the maximum attenuation from 0 dB to –100 dB. This feature allows you to set a limit on the attenuation. Once set, attenuation cannot be uploaded to the head unit.

NOTE: The attenuation setting must be below the attenuation limit that you are trying to set. For example, if the attenuation is set to –2 dB, you cannot set the attenuation level above –2 dB unless you decrease the attenuation level.

Attenuator Link:
You can set the attenuation to be independent or linked. Turn an Encoder knob to choose one of those options, then press the knob to save your choice.

AES Input Status:
"Lock" indicates that an AES cable is plugged in and the amplifier is receiving (and locking to) the AES signals. "No Lock" means that the amplifier is not locking to the AES clock.

AES Input Trim:
Turn the Encoder knob to vary the gain of the AES digital signal for Channel 1: -100.0 dB to +20 dB. See Figure 4.4 for more information.

AES Input Taps:
Turn the Encoder knob to vary the gain of the AES digital signal for Channel 1: –100 dB to +20 dB. See Figure 4.4 for more information.

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LED Meter Display Type: Here you can set the LED bar meters to display averages or peak levels. Turn the Encoder to select the option, then press the knob to confirm your selection.

LevelMax - RMS Voltage Limiter: Limits the output rms voltage to an amount that is set, either OFF or 0 to 1500 Volts, for each channel. Press the Encoder to turn the limiter on or off. Then use the Encoder knob to set the level.

Front Panel Display: This screen lets you select the front panel display type. Pressing the up or down arrow button on the Encoder changes between the two types. Select the option, then press the knob to confirm your selection.

Pink Noise Generator: Press Next to enter the encoder wheel to select a channel icon to turn on the generator. Its level will read –100 dB. Adjust the noise level from –100 dB to +20 dB in 0.5 dB steps by turning the Encoder. To turn off the generator, select a channel icon or go to another menu item.

LevelMax - RMS Voltage Limiter: Limits the output rms voltage to an amount that is set, either OFF or 0 to 1500 Volts, for each channel. Press the Encoder to turn the limiter on or off. Then use the Encoder knob to set the level.

Front Panel Display: This screen lets you select the front panel display type. Pressing the up or down arrow button on the Encoder changes between the two types. Select the option, then press the knob to confirm your selection.

Load Monitoring: Press Next and the encoder wheel to select a channel icon to turn speaker load monitoring on or off for a channel. When load monitoring is on, a dot will appear next to the channel icon in the System Architect – System > System > Load Monitoring page. To turn off load monitoring, select a channel icon or go to another menu item.

Thermal %: This indicates the amplifier temperature in percent, where 100% is the maximum allowable temperature. If Thermal % reaches 100%, the amplifier will shut down (or will very soon). Measurements are shown for Channel 1, Channel 2, Channel 3, Channel 4, and the PSU.

Thermal Temp deg. C: This screen displays the temperature in degrees Celsius for the CH. 1 output devices, CH. 2 output devices, CH. 3 output devices, CH. 4 output devices, the PSU, and the power supply.

Thermal Temp deg. C: This screen displays the temperature in degrees Celsius for the CH. 1 output devices, CH. 2 output devices, CH. 3 output devices, CH. 4 output devices, the PSU, and the power supply.

7.2.2 MONITOR MENU
This menu lets you monitor the status of the amplifier.

Load Monitoring: Press Next and the encoder wheel to select a channel icon to turn speaker load monitoring on or off for a channel. When load monitoring is on, a dot will appear next to the channel icon in the System Architect – System > System > Load Monitoring page. To turn off load monitoring, select a channel icon or go to another menu item.

AC Voltage: This shows the AC line voltage at the AC cord inlet to the amplifier.

Operating Time: This displays the number of hours the amplifier has been on since manufacture. Like a car’s odometer, it shows the total amount of operating time and cannot be reset. All I-Tech HD amplifiers come with a variable amount of operating time on them due to burn-in and testing before shipping.

7.2.4 ALERT MENU
This menu displays a wide variety of errors in the signal, amplifier, or load.

Amp Output Clip Errors: A clip error occurs if the number of clip events in the amplifier output exceeds the value set with the Count slider (within the time set by the Time slider) on the Amplifier Settings page in System Architect. When an error occurs, the count displayed in this screen is incremented, and the operating time since the error is displayed. To clear this error, select a channel icon.

Any Output Clip Error: If clip error occurs on the channel connected to the amp, then only that channel will be displayed, even if the Clip Output on the System Architect is active. When an error occurs, the count displayed in this screen is incremented, and the operating time since the error is displayed. To clear this error, select a channel icon.

7 Advanced Operation

Load Monitoring: Press Next and the encoder wheel to select a channel icon to turn speaker load monitoring on or off for a channel. When load monitoring is on, a dot will appear next to the channel icon in the System Architect – System > System > Load Monitoring page. To turn off load monitoring, select a channel icon or go to another menu item.

Thermal %: This indicates the amplifier temperature in percent, where 100% is the maximum allowable temperature. If Thermal % reaches 100%, the amplifier will shut down (or will very soon). Measurements are shown for Channel 1, Channel 2, Channel 3, Channel 4, and the PSU.

Thermal Temp deg. C: This screen displays the temperature in degrees Celsius for the CH. 1 output devices, CH. 2 output devices, CH. 3 output devices, CH. 4 output devices, the PSU, and the power supply.

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5.4 NETWORKING MENU

This menu has functions to set up your amplifier (or node in the network). In this section, we discuss the Networking Menu.

Network Info: This screen shows information about the audio network: IP address, Subnet Mask, and MAC address. See Section 12 of this manual for more information.

DHCP: Turn on an Encoder knob to turn DHCP on or off. When DHCP is enabled, the IP address of the amplifier might change at power-up. See System Architect Help files for more information on DHCP.

IP Address: You set the IP address of the amplifier here. See Section 12 for more information on this. A function is disabled when DHCP is enabled.

1. Tap the Encoder knob icon to access the left three digits, then turn the Encoder knob to set the number.
2. Tap the Encoder again to access the middle three digits, then turn the Encoder knob to set the number.
3. Tap the Encoder again to access the right digit, then turn the Encoder knob to set the number.
4. Tap the Encoder again to access the next digit to the right, then turn the Encoder knob to set the number.
5. Tap the Encoder again to access the rightmost digit, then turn the Encoder knob to set the number.

Subnet Mask: You set the Subnet Mask of the amplifier here. See Section 12 for more information on Subnet Mask. This function is disabled when DHCP is enabled.

1. Tap the Encoder knob icon to access the left three digits, then turn the Encoder knob to set the number.
2. Tap the Encoder again to access the middle three digits, then turn the Encoder knob to set the number.
3. Tap the Encoder again to access the next digit to the right, then turn the Encoder knob to set the number.
4. Tap the Encoder again to access the rightmost digit, then turn the Encoder knob to set the number.

Manufacturing Info: This screen shows information about your I-Tech HD and your network node (model number, firmware version, serial number, and amplifier date code).

1. Tap the Encoder knob icon to access the left three digits, then turn the Encoder knob to set the number.
2. Tap the Encoder again to access the middle three digits, then turn the Encoder knob to set the number.
3. Tap the Encoder again to access the right digit, then turn the Encoder knob to set the number.
4. Tap the Encoder again to access the next digit to the right, then turn the Encoder knob to set the number.
5. Tap the Encoder again to access the rightmost digit, then turn the Encoder knob to set the number.
7 Advanced Operation

7.3 Presets

7.3.1 Introduction

Your I-Tech HD amplifier has a wide variety of onboard Digital Signal Processor (DSP). Some applications in this DSP are speaker configuration (setting the drive levels, frequency bands, delays and limiting for your particular speakers); EQ, filter compression, and more. System Advanced software lets you adjust your DSP settings, such as filter shape, compression ratio, EQ frequency bands, and more.

A preset is a group of DSP settings that configure the amplifier for a specific application. For example, you might use one preset that optimizes the amplifier’s EQ for a JBL VerTec Line Array, another preset for a stereo pair of JBL speakers, and so on. The preset will automatically set the DSP parameters as you set them up in the control software.

1. User presets are DSP presets that are configured manually.

2. Downloadable presets are DSP presets that are optimized for various JBL loudspeakers, such as VerTec Line Arrays. To use them, follow this procedure in System Architect:


   b. In System Architect, double-click on I-Tech HD4. Go to File › Open Preset, find a 2 Channel preset by selecting 2 Channel Preset from file “file of type” drop down menu. Open the Preset from the file and use controls options in Panel to channel 1 or 2.

   c. 7.3.3 Downloadable Presets

   Crown and JBL engineers have designed I-Tech HD DSP presets that are optimized for various JBL loudspeakers, such as the VerTec Line Array. You can download preset files using a USB drive. To do this:

   a. 7.3.4 Loading I-Tech HD 2 Channel Presets into the I-Tech HD 4 Channel

   In System Architect, double-click on I-Tech HD4. Go to Preset in the toolbar. Select the preset file using your computer's file manager.
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7.4 List of Pop-Up Boxes and Descriptions

If N/A is displayed, the particular menu has been
(Press and Hold)
Confirm Change
(Hold knob)
Press and Hold
Loading File
USB Fault
Selected
No Change
Device File
Successful!
cancelled
Changed
Address
Disabled
Changes
DHCP
Lockout
USB
Failed!
Change
Subnet
Loaded
Preset

The selected preset has been successfully loaded.

The selected preset has been modified. Applies to history, scene, address, and submenu mask.

The current state of DHCP has been changed to either ON or OFF.

The selected preset has been cancelled.

The selected change was not made. It may have been out of range or invalid.

An invalid subnet mask was selected.

An invalid IP address was selected.

This message indicates that the encoder
button was not properly pressed and/or held down.

Displayed after the second button press. To continue, the user must continue to hold
the button for at least 2 seconds.

Displayed after the first button press has been released. To continue, the user must release the button
for at least 2 seconds.

Displayed after the first button press. To continue, the user must release the button
and press it again.

Displayed after the first button press has been released. To continue, the user must press the button again.

Displayed after the second button press. To continue, the user must continue to hold
the button at least 2 seconds.

Displayed after the second button press. To continue, the user must continue to hold
the button at least 2 seconds.

To modify this parameter, the encoder button must be pressed twice with the second
press being held down for at least 2 seconds. This message indicates that the encoder
button was not properly pressed and/or held down.

The selected object to change has not been modified from the current value.

This display does not present a change to this parameter. The display appears. Highlight
cursor right, update, scroll to item to make changes, exit to previous display. 

Changes Enabled

Changes Disabled

Locked

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7.7.1 Amplifier DSP Selection Screen
On the left of this screen is the Input and Output Signal Level Monitor (explained later on this page). On the right side are rows of DSP selection buttons for each channel. When you double click on a button, a control panel opens for that button’s function.

Also on the right are buttons that open control panels for these functions:
- Amplifier mode (dual, bridge mono, input Y)
- Signal generator (pink noise and sine wave)
- Amplifier inter-mode
- Recall and store presets
- Prewarm
- Apply to others (apply the amplifier’s DSP settings to other devices)

We’ll explain each of these functions on the next several pages.

7.7.2 Amplifier Mode
This is accessed by double clicking the mode button.

7.7.3 Input Level, Fades, Mutes, Link, I/O Level Meters, and Indicators
This panel is on the left side of the I-Tech HD’s main control panel shown above. Channels 1, 2, 3, and 4 Level Controls set the input signal level of each channel. Each channel can be muted, and both faders can be linked with the Link button.

Input Signal Level Meter (green)
The measurement range is from 0dBFS to –40dBFS with 0.5dB resolution. Each audio channel has a separate input signal level meter. The switched audio input is the level that is monitored after the Input Audio Router.

Output Signal Level Meter (blue)
The measurement range is from 0 dB to –40 dB with 0.5 dB resolution. The monitors are scaled so that 0 dB is referenced to the full rated output voltage of the amplifier. The wider left meter is rms and the right meter is peak for each channel. An output clip indicator is provided.

Indicators:
- Temp: Lights if the temperature of the amplifier is too high and the amplifier is near shutdown.
- Limit: Thermal headroom used up less than 59%.
- Yellow: Thermal headroom used up 60-80%.
- Red: Thermal headroom used up more than 81%.
- Load: Lights when the load impedance is out of range.
- Fault: Lights when the amplifier is in a fault mode service may be required.

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7.7.4 Input Signal Router
Each channel of the I-Tech's signal processing has an Input Signal Router that lets you choose the audio signal that will be used by the channel. Choose one of the following configurations:

- **Analog Audio**: This is the audio input from the audio connector on the back panel of the amp. Choices for the Analog Audio input are Channel 1, Channel 2, or a sum of Channels 1, 2, 3, 4, or a sum of 3 and 4.

- **Digital Audio**: This is the audio input from the AES/EBU connectors or CobraNet connector on the back panel of the amp. It can be set up for Digital with Analog Backup or Digital with Analog Override:
  
  - **Digital with Analog Backup**: The input takes the digital signal as its source when the digital signal is present. If the digital lock is lost, the input switches to the selected Analog Source. Once the digital lock is re-established, the input switches back to the selected digital source. This continues as long as the digital signal has no audio content or is below the threshold.

  - **Digital with Analog Override**: The input takes the digital signal as its source. If the analog signal level is greater than the Analog Signal Detect Threshold set in the user defaults, the input switches to the analog signal. As long as the analog signal level exceeds the threshold, the input remains in the analog state.

- **Analog Signal Detect Threshold** (-100 dB to 0 dB): This parameter is not displayed unless override is selected. If the selected analog signal exceeds the threshold level, the analog signal becomes the source for the input rather than the selected digital signal source. Use the numeric spin box or the fader provided to set the threshold.

- **Hold Time (0 - 60 seconds)**: This parameter is not displayed unless override is selected. Once an overriding analog input signal falls below threshold, the Hold Time determines how long the input will continue to use the selected analog signal before reverting to the selected digital signal input. Use the numeric spin box or the fader provided to set this time.

The control operation will vary based on the mode that is selected.

---

7 Advanced Operation

7.7.5 Source Configuration
In this screen you can configure the levels and settings of the analog, AES, and CobraNet inputs. The input signals of each channel can be independently routed.

This I-Tech HD amplifier can be set to work as a fixed gain amplifier: any input signal is given a fixed amount of gain, either 26dB or 32dB. In addition, you can set the input sensitivity to determine how much gain is provided. See Section 4.8.20 for more details.
7.7.6 CobraNet Advanced Settings

In the CobraNet Advanced Settings screen you can set the parameters shown here. Indicators that are green can’t be modified.

The latency on this screen is the CobraNet transport latency or buffering. This latency must be set to the same latency as the source CobraNet device.

The Foldback control panel lets you select the item to transmit on CobraNet. Selections available are the tossing tripping, Amplifier Outputs or AES input signal. The audio can be routed out through only one bundle.

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7.7.7 Input Signal Compressor

An input signal compressor is available for each channel. Several parameters control this feature:

- **On/off button**: Enables or disables this function.
- **Threshold**: Sets the level, in dBu, above which the compressor begins to attenuate the input signal. This level corresponds to the input level meter reading. The compressor is “feed-forward,” meaning that the level detection point is located before the gain control stage. The range is from +20 dBu to –50 dBu.
- **Attack Time**: Sets the attack time of the compressor. The attack time is defined as the time it takes for the compressor to increase the signal gain by 20 dB. The range is from 0.1 millisecond to 0.1 second.
- **Release Time**: Sets the release time of the compressor. The release time is defined as the time it takes for the compressor to decrease the signal gain by 20 dB. The range is from 10 milliseconds to 10 seconds.
- **Compression Ratio**: Sets the ratio of the compression. The ratio is the relationship between the amount of attenuation applied by the compressor versus the amount that the input signal is over the threshold. The available setting are 2:1 to 32:1.
- **Makeup gain**: The amount of gain you want to apply to the compressed signal to raise it to a higher level.
- **Knee width**: The point at which the compression begins to take place. The wider the knee, the more gradual is the transition — compression is less obvious when the signal is close to the threshold.

Beyond the controls for each channel, a single-control *Compressor Link* connects the compressors together. The compressors can detect their own input signals, meaning that the greater of the two input signals will be used as the input to each compressor. Each compressor will still compress based on its individual threshold, attack, release and ratio settings.

7.8.8 Input Delay and Driver/Output

In these screens you can set the signal delay for each channel in seconds, feet or meters.
7 Advanced Operation

7.7.9 Input EQ and Output EQ

These screens let you adjust channel equalization for up to 16 frequencies. You can select filter type, frequency, gain, and bandwidth in octaves or Q as set by the user preferences in System Architect. Changes to the equalizer’s frequency response can be done by typing in parameters or by click-dragging the equalizer curve.

7 Advanced Operation

7.7.10 Crossover Filters

The Crossover section lets you use infinite impulse response (IIR) or finite impulse response (FIR) filters for the crossover.

IIR advantages:
• IIR has a longer processing latency but has less phase artifacts compared to FIR. The latter filters are more flexible in terms of Butterworth, 48 dB/octave filters with or without phase shift.

FIR advantages:
• FIR has one processing block per channel; IIR has one or more. For example, you can place an FIR filter as a single filter for the whole system or one per channel. This is done to avoid the unwanted combination of filters.

The amplifier contains four FIR blocks which can be used in various configurations:
• In Duplicate mode the same settings are used on both channels, allowing two FIR filters per bandpass. In Unique mode the FIR filters are limited to one per bandpass. However, if the High Pass of Channel 1 and Low Pass for Channel 2 are set to identical slopes and proportions, you can use two FIR filters for both bandpasses. This setting for this operation is called the software controls. In addition, the processing (FIR) latency sets the minimum frequency that can be set on an FIR filter.

A polarity inverter button lets you change the polarity of each channel independently.

Each audio channel has three separate places where filters can be placed in the system: input EQ (16 filters), crossover, and output EQ. Up to 24 filters per channel are available, plus crossover filters. The following filters are available:
• Lowpass: Bessel 2-4, Butterworth 1-4, Linkwitz-Riley 8
• Highpass: Bessel 2-4, Butterworth 1-4, Linkwitz-Riley 8
• Lowshelf: Low-frequency shelving EQ
• Highshelf: High-frequency shelving EQ
• Lowpass EQ: Variable bandwidth, can be expressed as Q (0.1 to 35) or Octaves (0.041 to 6.672)
• Highpass EQ: Variable Q form 0.1 to 25
• Parametric EQ: Variable Q form 0.1 to 35
7 Advanced Operation

7.7.11 LovelMax Suite

This is a low level circuit that monitors whether the amplifier can maintain a voltage output sufficient to drive the load impedance.

A clip detector is provided each channel. These monitors are used in conjunction with the average power limiter to determine the expected power limits.

Transducer Thermal Limiting

This limits the voltage supplied to the amplifier to a safe output level, based on the thermal characteristics of the transducer.

You can modify the RMS threshold, Speaker Thermal threshold, and Thermal time constant. Everything else is automatically set. You can modify only the RMS threshold, Speaker Thermal threshold, and Thermal time constant. Everything else is automatically set. You can modify only the RMS threshold, Speaker Thermal threshold, and Thermal time constant. Everything else is automatically set.

A clip detector is provided each channel. These monitors are used in conjunction with the average power limiter to determine the expected power limits. The time constant is defined per the defined unit of time.

The I-Tech HD can be configured to report an excessive number of count sets per channel and errors in the AC line voltage. Each error type defines the amount of time that the events are counted before the error is reported. The range is 1 to 100.

The measured load impedance is compared against the user-defined high and low limits. When enabled, the measured load impedance will be sent via the network to System Architect. Otherwise the measured load impedance will be used to determine the expected power limits. You can modify only the RMS threshold, Speaker Thermal threshold, and Thermal time constant. Everything else is automatically set.

7.12 Front Panel Security

Here you can choose which alarm the LCD screen is to reflect.

• Fan: Enables or disables the fan. You'll set the parameters below.

• Threshold: Sets the level in absolute voltage, which the limiter will allow from the amplifier. The range is from 0 Vpk to 255 Vpk.

• Attack Time: Sets the attack time of the limiter. The attack time is defined as the time it takes the limiter to increase the output signal by 20 dB. The range is from 10 milliseconds to 10 seconds.

• Release Time: Sets the release time of the compressor. The release time is defined as the time it takes the limiter to decrease the output signal by 20 dB. The range is from 1 second to 30 seconds.

• Advanced mode: You can modify only the RMS threshold, Speaker Thermal threshold and Thermal time constant. Everything else is automatically set.

• Automatic mode: You can modify only the RMS threshold, Speaker Thermal threshold and Thermal time constant. Everything else is automatically set.

The software determines the best settings based on the signal characteristics.

7.13 Amplifier Settings

The Amplifier Export tab is used to set the channel on or off.

Error Reporting

The I-Tech HD can be configured to detect any error condition per channel and errors in the AC line voltage. Each error type defines the amount of time that the events are counted before the error is reported. The range is 1 to 100.

You can modify only the RMS threshold, Speaker Thermal threshold and Thermal time constant. Everything else is automatically set.

Clip: A clip detector is provided each channel. These monitors are used in conjunction with the average power limiter to determine the expected power limits. The clip detectors also can indicate Transducer Thermal limiting.

The I-Tech HD can be configured to report an excessive number of count sets per channel and errors in the AC line voltage. Each error type defines the amount of time that the events are counted before the error is reported. The range is 1 to 100.

The software determines the best settings based on the signal characteristics.

Average Power Limiter

This limits the peak voltage output of the amplifier.

• Release Time: Sets the release time of the compressor. The release time is defined as the time it takes the limiter to decrease the output signal by 20 dB. The range is from 10 milliseconds to 10 seconds.

• Advanced mode: You can modify only the RMS threshold, Speaker Thermal threshold and Thermal time constant. Everything else is automatically set.

• Automatic mode: You can modify only the RMS threshold, Speaker Thermal threshold and Thermal time constant. Everything else is automatically set.

The software determines the best settings based on the signal characteristics.

Peak Voltage Limiter

This limits the voltage supplied to the amplifier.

• On: Enables or disables the function. You'll set the parameters below.

• Threshold: Sets the level in absolute voltage, which the limiter will allow from the amplifier. The range is from 0 Vpk to 255 Vpk.

• Attack Time: Sets the attack time of the limiter. The attack time is defined as the time it takes the limiter to increase the output signal by 20 dB. The range is from 10 milliseconds to 10 seconds.

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The software determines the best settings based on the signal characteristics.
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7.7.14 Amplifier Information
Information about the amplifier is stored in the software system inventory and is displayed on the software control panels. Information includes manufacturer, model, date code, and serial number. The green items cannot be edited.

Channel Labels: These blue text areas in the amplifier’s control panel can be edited. You can enter a label for the channel of your amplifier. These names will appear in the individual processing blocks.

Attenuator Limits: The green items cannot be edited. If you enter a limit for an attenuator, it cannot be edited. The limits must be below the current attenuator setting.

NOTE: The attenuator setting must be below the attenuator limit for the attenuator to be set. If you input a number greater than the current attenuator setting, it cannot be set.

Front Panel Display: This button lets you control the front panel display. A front panel button and all front panel LEDs and power supply will light up. Ambient display will turn off. Pressing this button will return to blackout mode.

7.8.15 Apply to Others
This screen lets you apply System Architect settings for your I-Tech HD amplifier to other I-Tech HD amplifiers in the venue file.

7.8.16 Delay (Latency)
Due to the nature of DSP processing, there is some inherent delay or latency within the I-Tech HD's DSP. These latencies are shown in Table 3 below:

Table 3  I-Tech HD latencies at two sample rates

<table>
<thead>
<tr>
<th>Sample Rate</th>
<th>ADC DSP DAC Amplifier Total Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>48 kHz</td>
<td>250 µs 666 µs 196 µs 54 µs 1.166 ms</td>
</tr>
<tr>
<td>96 kHz</td>
<td>94 µs 333 µs 48 µs 54 µs 1.13 ms</td>
</tr>
</tbody>
</table>

These latencies do not include CobraNet Transport Latency and FIR Processing Latency.

7.8.17 Preset Manager
The control settings in all the limiters can be stored as presets. These presets can be assigned to the I-Tech HD's washback areas. Each preset can be named with upto 36 characters. A preset can be assigned to a mixing desk or to any output or input area.

• Store Preset Control: This button stores the current settings in the specified preset. A preset can appear in the Active Preset field. If you change the settings after recalling a preset, the Store button will turn yellow.

You can change the position to place them in logical order. Also, you can color-code the presets to organize them.

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7.7.18 Signal Generator

All channels share a noise generator that allows noise to be mixed into the audio signal. This is useful for noise masking applications and testing. Each channel has the following controls:

- **Mode On/Off**: Turns the noise generator on or off.
- **Noise Type**: Selects full-spectrum white noise or pink noise.
- **Master**: Sets the noise level with a fader.

The sine-wave signal generator lets you mix a single tone into the audio signal. Its controls are listed below:

- **Sine Frequency**: Sets the frequency anywhere from 20Hz to 20kHz.

The noise generator and sine-wave generator cannot be used at the same time.

7.7.19 Fixed-Gain Mode in the I-Tech HD

Fixed-gain mode makes any I-Tech HD model have the same gain, regardless of output power.

To do that, fixed-gain mode sets the Analog Input Sensitivity to 0 dB gain, then adjusts the Fixed Gain Compensation fader, and the Maximum Analog Input, to achieve 26 or 32 dB of gain (if the Maximum Analog Input is set Low), or to achieve 32 or 38 dB of gain (if the Maximum Analog Input is set High), no matter what model the amplifier is.

However, in fixed-gain mode, the input trims (Analog, AES, Cobranet) can still be adjusted.
8 Troubleshooting

**CONDITION:** Power indicator is off and power switch is not illuminated.

**POSSIBLE REASON:**
- The amplifier has lost AC power.
- The amplifier is not plugged into the power receptacle.
- Rear-panel breaker is off.

**CONDITION:** Power indicator is off and power switch is illuminated.

**POSSIBLE REASON:**
- The amplifier's power switch is off.

**CONDITION:** Power indicator is flashing.

**POSSIBLE REASON:**
- The AC line voltage has dropped below 15% or has risen above 15% of the rated range.

**CONDITION:** Thermal indicator is on.

**POSSIBLE REASON:**
- The amplifier is becoming too hot for safe operation. Allow amplifier to cool. Check for loads less than 2 ohms, and for excessive input levels. Check for proper ventilation.

**CONDITION:** Fault indicator is flashing.

**POSSIBLE REASON:**
- The amplifier channel has stopped operating. Refer the unit to an authorized Crown Service Center.

**CONDITION:** Power indicator is off and power switch is not illuminated.

**POSSIBLE REASON:**
- Load is wired incorrectly or Output Mode switch in LCD-screen menu is set incorrectly. Check both.
- Input is overloaded by a signal level that is too high. Turn down your amplifier level controls (Encoders), or turn down the input signal, until the clip light goes out.

**Note:** If the signal sounds distorted even though the Clip LED is off, the input signal may be distorted before it reaches the amplifier input. Check gain staging and output levels of the mixer or preamp.

**CONDITION:** No sound, even though the amp has power.

**POSSIBLE REASON:**
- Speakers not connected.
- Open circuit due to speaker failure.
- Ready LED is off. Channel has been set to standby mode via the software.
- Amplifier is in blackout mode. Press or turn an Encoder to reactivate the LCD display.

**CONDITION:** No input signal.

**POSSIBLE REASON:**
- Input signal level is very low.
- Another source is selected or routed.

**CONDITION:** Data indicator not flashing, even though host computer software is active.

**POSSIBLE REASON:**
- Cable between computer and amplifier is broken or not connected.

**Note:** Data indicator flashes only when the amplifier is polled for data, or is polled to see whether it is online.

**CONDITION:** Yellow LINK ACTIVITY indicator in Ethernet connector does not illuminate or flash.

**POSSIBLE REASON:**
- Ethernet link is broken.

**CONDITION:** Computer does not communicate with the network devices.

**POSSIBLE REASON:**
- There is only one conductor allowed per network system. This conductor is the one where the amplifier is connected.
- Amplifier is in blackout mode. Press or turn an Encoder to reactivate the LCD display.

- There is a short on the amplifier output. First disconnect your speakers from the affected channel(s) by one row to determine if one of the loads is shorted.
- Connect your speakers to the affected channel(s) and then turn on the amplifier to check for faulty connections.

- There is a short on the amplifier output. First disconnect your speakers from the affected channel(s) by one row to determine if one of the loads is shorted.
- Amplifier is in blackout mode. Press or turn an Encoder to reactivate the LCD display.

- There is a problem with the amplifier's power supply. Check for loose connections or damaged cables.
- Amplifier is in blackout mode. Press or turn an Encoder to reactivate the LCD display.

**CONDITION:** COND indicator is off.

**POSSIBLE REASON:**
- There is only one conductor allowed per network system. This indicator is lit only when the amplifier is the conductor.
- Amplifier is in blackout mode. Press or turn an Encoder to reactivate the LCD display.
### Minimum Guaranteed Power

<table>
<thead>
<tr>
<th>Resistance</th>
<th>20 Hz - 20 kHz</th>
<th>2-ohm</th>
<th>2.7-ohm</th>
<th>4-ohm</th>
<th>6-ohm</th>
<th>8-ohm</th>
<th>4-ohm Bridge</th>
<th>8-ohm Bridge</th>
<th>70Vrms Direct</th>
<th>100Vrms Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Power</td>
<td>2,100W</td>
<td>2,200W</td>
<td>2,400W</td>
<td>1,900W</td>
<td>4,200W</td>
<td>4,800W</td>
<td>2,100W</td>
<td>2,700W</td>
<td>70Vrms Direct</td>
<td>100Vrms Direct</td>
</tr>
</tbody>
</table>

#### Performance

**Input Sensitivity (rms RMS)** for rated output
- Adjustable in 0.1V steps from 1.28V to 8V

**Voltage Gain for full rated power at 8 ohms**
- 37.1 dB to 22.2 dB

**Frequency Response (20 Hz to 20 kHz)**
- ± 0.25 dB

**Signal to Noise Ratio below rated full-bandwidth power, A-weighted**
- > -108 dB

**Total Harmonic Distortion (THD) at full rated power at 1 kHz**
- < 0.35%

**Intermodulation Distortion (IMD)**
- 60 Hz and 7 kHz at 4:1, from full rated output to –35 dB
- < 0.06%

**Maximum Input Level**
- +15 dBu or +21 dBu, depending on setting of maximum input level

**Latency**
- 1.16 ms at 48 kHz, 1.13 ms at 96 kHz

**A/D, D/A Converters**
- 24-bit, 96 kHz, Cirrus Logic

**Network**
- Ethernet, CAN, USB, RS-232, RS-485, IP

**Dimensions**
- 3.5-inch (8.9-cm) height, 16.95-inch (43.1-cm) depth behind front mounting surface

**Weight**
- Net: 29 pounds (13.1 kg)  
- Shipping: 37 pounds (16.8 kg)
9 Specifications

Charts

Figure 9.1 Typical Frequency Response (1W)

Figure 9.2 Typical Crosstalk vs. Frequency

Figure 9.3 Typical Damping Factor vs. Frequency
10 AC Power Draw and Thermal Dissipation

I-Tech 4x3500HD AC Current Draw and Thermal Dissipation:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Idle (awake)</th>
<th>1/8th Power Pink Noise 8 Ohms/Ch.</th>
<th>1/3rd Power Pink Noise 8 Ohms/Ch.</th>
</tr>
</thead>
<tbody>
<tr>
<td>120VAC</td>
<td>36.8</td>
<td>1309</td>
<td>19.9</td>
</tr>
<tr>
<td>208VAC</td>
<td>33.9</td>
<td>1044</td>
<td>17.5</td>
</tr>
<tr>
<td>230VAC</td>
<td>36.8</td>
<td>1211</td>
<td>19.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load</th>
<th>Watt Output</th>
<th>Per 1A</th>
<th>Watts Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>120VAC</td>
<td>118.0</td>
<td>116.8</td>
<td>120.5</td>
</tr>
<tr>
<td>208VAC</td>
<td>128.6</td>
<td>128.6</td>
<td>130.9</td>
</tr>
<tr>
<td>230VAC</td>
<td>128.3</td>
<td>128.3</td>
<td>130.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load</th>
<th>Power Dissipated as Heat</th>
<th>Watts BTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>120VAC</td>
<td>118.0</td>
<td>120.5</td>
</tr>
<tr>
<td>208VAC</td>
<td>128.6</td>
<td>130.9</td>
</tr>
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</tr>
<tr>
<td>230VAC</td>
<td>128.3</td>
<td>130.9</td>
</tr>
</tbody>
</table>

11 Advanced Features

11.1 Protection Systems

You Crown amplifier provides extensive protection and diagnostic capabilities, including thermal level control, fault indicators, high-impedance AC fused protection, over-voltage protection, over-line protection, and over-temperature protection. These features ensure the safety and reliability of your amplifier.

11.1.1 Thermal Level Control (TLC)

Thermal Level Control is a technology that monitors the temperature of your amplifier’s power supplies. It automatically adjusts the output power to prevent overheating. If the amplifier becomes too hot for safe operation, the TLC will engage to reduce the output power and cool the amplifier down. The degree of compression is proportional to the amount of overheating. This feature allows the amplifier to shut down and only occur when necessary.

11.1.2 Circuit Breaker

If the amplifier becomes overloaded, the circuit breaker will automatically disconnect the power supply from the AC mains. This feature allows the show to go on, rather than shutting down the amplifier. The circuit breaker is designed to trip at a specific amount of current, providing a safety margin.

11.2 Global Switching Power Supply with PFC

The I-Tech amplifier incorporates the latest global switching power supply technology with Power Factor Correction (PFC). This advanced technology ensures that your amplifier works anywhere in the world. Thanks to its global power supply, the I-Tech amplifier provides energy conservation.

11.3-9th Generation Class I Circuitry

Class I (BCA, Balanced Current Amplifier) eliminates all the high levels of power draw that would otherwise dominate your amplifier’s weight. Instead of drawing high-magnitude current from the AC mains, the I-Tech amplifier draws a smooth and quiet current waveform that is in phase with the mains voltage spikes that reduce the capacity of your power distribution system. This leads to a much smaller and lighter amplifier. The I-Tech amplifier’s power supply is designed to reduce current draw down to AC mains waste.

11.4 Color-Coded Rear Overlay

The I-Tech amplifier has a color-coded rear overlay that is easy to read and helps you identify the functions of each component. The overlay color-codes each component similar functions under common colors.
12 Appendix A: Network and CobraNet Basics

12.1 HiQnet Networks

Background: A Local Area Network (LAN) is a group of computers in a sense that can communicate directly with each other. CobraNet is a popular HiQnet communication protocol for PCs. As audio networks are Local Area Networks made of audio devices and one or more components, CobraNet is a small network within a larger network. For example, an audio network might have two subnets: one for entertainment audio, and one for paging.

One use of audio networks is to control and monitor power amplifiers on stage from a computer in a venue. You can set amplifier levels, adjust crossovers, measure system performance, and even update firmware. CobraNet is a Local Area Network (LAN) communication protocol for PCs. An audio network is a Local Area Network made of audio devices and one or more components. CobraNet is a small network within a larger network. For example, an audio network might have two subnets: one for entertainment audio, and one for paging.

HiQnet control offers many advantages:

• Use of “off-the-shelf” network hardware. HiQnet uses routers that do not require a new model of equipment, making it both cost-saving and readily available.
• Better Performance. Many display better in real-time because the network is wide bandwidth.
• A centralized control: One controller can affect all audio devices.
• Networked devices can be configured to an Ethernet switch for better performance.
• Standard hardware can be used to build larger networks.

HiQnet Address:

When you set up a network with System Architect software, you assign an audio network component its own address, numbered from 1 to 65535.

Internet Protocol (IP) Address: Every HiQnet device has a unique IP address. It is a group of computers in a sense that can communicate with each other through cables. Each HiQnet device is limited to two-byte octets such as: 192.168.0.100.

To identify which part of the IP address is the network ID, you assign a different subnet to the network. A Subnet Mask is a string of “1” bytes separated by periods. For example, 255.255.255.0 is a subnet mask with a “1” byte for the network ID. A valid IP address is a string of four numbers (0-255) separated by periods. For example: 192.168.0.100 is a valid IP address. To communicate between different networks, you need an IP router. Any control data or monitoring data that is sent to the other network must go through the IP router.

The IP router allows control and data on multiple connected networks to communicate with other IP routers. Figure 12.2 shows a typical network layout with an IP router.

HiQnet Discovery:

Crown) on an Ethernet network. Figure 12.1 shows a typical HiQnet network.

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12.2 A Closer Look at CobraNet

12.2.1 Fast Ethernet

Fast Ethernet (IEEE 802.3u) runs at 100Mbit per second. It uses a hub or network switch to interconnect all network nodes (components). This forms a star network, as shown in Figure 12.1. At any network, all PCs are connected to dedicated hubs. The hubs are connected to one another with twisted-pair high-speed Ethernet cable. In practice, one hub acts as the network switch, to which the other hubs are connected in a daisy chain, as shown in the diagram. The bandwidth of this network is the total bandwidth of all components, which is limited by the bandwidth of the slowest component. The message either to the whole network or, if a switched hub (network switch) is used, to the destination device only.

CobraNet networks can be built using Ethernet and Fast Ethernet devices. CAT-5 copper cable, 2 kilometers over multimode fiber. Proprietary “Fast Ethernet via Single Mode Fiber” networks can reach even further. The maximum length of cable for CobraNet is the same as for Ethernet: 100 meters over CAT-5 copper cable, 2 kilometers over multimode fiber. Proprietary “Fast Ethernet via Single Mode Fiber” networks can reach even further.

12.2.2 Audio Spec

Sample Rate: CobraNet can handle sample rates of 48 kHz or 96 kHz. I-Tech HD is set to 256 samples as a default. This gives a network transmission latency of 5.333 ms for 96 kHz sampling rates. The transmitter and receiver buffers required for reliable transmission are 255 ms of the network cycle time (1/48 kHz). The latency is determined by the assigned bundle priority. Higher priority schemes allow higher latency schemes. The faster the network slot is determined by the assigned bundle priority. Higher priority schemes allow higher latency schemes.

Bit depth: Set each channel to transmit 16-, 20- or 24-bit audio data as desired.

Latency: The number of usable time frames per second is determined by the signal’s bit depth and sampling rate. Only 4 bundles are available when 96 kHz sampling rate is in use.

12.2.3 Bundles and Audio Channels

CobraNet uses channels to group bundles of audio channels together on the CobraNet network. Switches were formerly called Network Channels. A bundle can carry up to 8 audio channels. Up to 8 bundles can be used in a 100 MHz link, depending on the size of the bundles and the receiver buffer size. Only 4 channels are available.

The maximum number of usable time frames per second is determined by the signal’s bit depth and sampling rate. Only 4 bundles are available when 96 kHz sampling rates are in use.

Maximum size bundles are suggested for the most efficient use of network bandwidth. If 24-bit data is desired, then only 7 audio channels can be loaded into a single Bundled audio channel.

12.2.4 The Conductor

A CobraNet system is coordinated by one audio device in the network called the Conductor. It regulates the CobraNet digital audio traffic on the CobraNet network. The Conductor is the master clock. The Conductor handles time-division multiplexing and clock recovery on the network. The Conductor periodically (every 15 ms) sends a well-defined “beat” packet to all components to recover synchronous timing information. The “beat” also specifies which addresses can transmit on the network. The Conductor periodically (every 15 ms) sends a well-defined “beat” packet to all components to recover synchronous timing information.

In effect, each network port in an audio system component, 100Mbit of bandwidth. The network can handle 100 Mbit times the number of ports as the network.

12.2.5 Switched Networks

A complex CobraNet network can be built using Ethernet switches. Gateways do not simply break broad and each packets to all nodes. Instead, they each to only the devices that are on the same network. CobraNet is a switched network. The faster the network slot is determined by the assigned bundle priority. Higher priority bundles may receive less network bandwidth and be transmitted first.

In a switched network, a single device can send audio data to a single device or to multiple devices. This allows devices to be distributed across network nodes.
13 LevelMAX™ Limiter Suite

The i-Tech HD LevelMAX ™ Limiter Suite is available in three types of limiting:
- Peak
- RMS
- Transducer Thermal
and three modes of operation:
- Auto
- Advanced
- Manual

The electrical specification for the LevelMAX limiter panel (Advanced/Manual) is shown below:

14 LevelMAX Limiters

14.1 LevelMAX Peak Limiter

LevelMAX Peak limiting begins only upon the output voltage exceeding the defined peak threshold voltage. In Auto mode, the peak limiter threshold value is automatically determined from the actual RMS threshold value and the low pass frequency defined in the XOVER block. For Advanced and Manual modes, the peak limiter threshold can be set by the user.

14.2 Peak Limiter Threshold (V)

In Auto mode, the peak limiter threshold value is automatically determined from the actual RMS threshold value and the low pass frequency defined in the XOVER block. For Advanced and Manual modes, the peak limiter threshold can be set by the user.

14.3 Peak Limiter Attack (sec)

The peak limiter attack time is instantaneous and cannot be modified. The output voltage is limited to the value defined by the peak limiter threshold value.

14.4 Peak Limiter Release (sec)

For Advanced and Manual modes, the peak limiter release time can be set by the user. For Auto mode, the peak limiter release time is determined by the high pass frequency defined in the XOVER block.

14.5 Peak Limiter Look-Ahead

In Auto mode, the peak limiter look-ahead is determined by the high pass frequency defined in the XOVER block. For Advanced and Manual modes, the peak limiter look-ahead can be set by the user.

14.6 LevelMAX RMS Limiter

LevelMAX RMS limiting acts once the output signal reaches the RMS threshold. On the main limiter panel, the thermal protection LED is enabled and when the thermal voltage threshold is lower than the RMS threshold, it will be turned on. The RMS limiter functions only when the RMS limiter threshold is enabled. The RMS threshold should be set to correspond to the long term RMS threshold voltage.

14.7 RMS Threshold (VRMS)

The RMS threshold should be set to correspond to the long term RMS threshold voltage.

14.8 LevelMAX Transducer Thermal Limiter

LevelMAX Transducer Thermal limiting is designed to protect transducers from long term thermal damage by gradually adjusting the RMS threshold voltage as the long term thermal threshold voltage has been reached. The thermal limiter functions only when the RMS limiter is enabled. The thermal limiter threshold voltage is lower than the RMS threshold. To protect transducers from thermal overload, the thermal protection LED is turned on or off on the thermal limiter panel at 0.8 x 2 hour limit.

14.9 Thermal Voltage (VRMS)

The thermal voltage threshold should be set to correspond to the long term (100 hour) power handling of the transducer or system.

14.10 Thermal Response Time (s)

The thermal response time is the amount of time it takes to reach the target voltage after the thermal limiter has been enabled.

14.11 LevelMAX Summary

LevelMAX has been designed to limit accurately to the specified voltage thresholds. The addition of a thermal limiter allows feedback to the feedback block and peak limiter to be set to higher values, providing more output headroom and dynamic range before the onset of limiting, while protecting the transducers from long term thermal damage by gradually adjusting the RMS threshold voltage.

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### 15 Appendix B: Table of Parameters Modified by Each Mode with LevelMAX Limiter Suite Enabled

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Auto</th>
<th>Advanced</th>
<th>Visible in Main Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Enable</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Peak Threshold</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Peak Attack</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Peak Release</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>RMS Enable</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>RMS Threshold</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>RMS Attack</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>RMS Release</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>RMS Detector Time</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Thermal Enable</td>
<td>✓</td>
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<tr>
<td>Thermal Threshold</td>
<td>✓</td>
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<td>✓</td>
</tr>
<tr>
<td>Thermal Attack</td>
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<td></td>
<td>✓</td>
</tr>
<tr>
<td>Thermal Slope (Kp &amp; Ki)</td>
<td>✓</td>
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<td>✓</td>
</tr>
<tr>
<td>Look-Ahead</td>
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### SV Value Range

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Auto</th>
<th>Increment</th>
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<tbody>
<tr>
<td>Peak Threshold</td>
<td>1-400V</td>
<td>1V</td>
</tr>
<tr>
<td>Peak Release</td>
<td>0.1ms-10s</td>
<td>1ms</td>
</tr>
<tr>
<td>RMS Threshold</td>
<td>1-200V</td>
<td>1V</td>
</tr>
<tr>
<td>RMS Attack</td>
<td>0-10s</td>
<td>/n</td>
</tr>
<tr>
<td>RMS Release</td>
<td>0-10s</td>
<td>1ms</td>
</tr>
<tr>
<td>RMS Detector Time</td>
<td>1ms-1s</td>
<td>/n</td>
</tr>
<tr>
<td>Thermal Threshold</td>
<td>1-200V</td>
<td>1.1V</td>
</tr>
<tr>
<td>Thermal Attack</td>
<td>1-600V</td>
<td>1</td>
</tr>
<tr>
<td>Thermal Slope (Kp &amp; Ki)</td>
<td>1-10</td>
<td>/n</td>
</tr>
<tr>
<td>Look-Ahead</td>
<td>0-10ms</td>
<td>/n</td>
</tr>
</tbody>
</table>

### Auto Peak max for each model (online)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Auto</th>
<th>Incremen</th>
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</thead>
<tbody>
<tr>
<td>I-Tech HD 5000</td>
<td>201.2</td>
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</tr>
<tr>
<td>I-Tech HD 9000</td>
<td>217.6</td>
<td></td>
</tr>
<tr>
<td>I-Tech HD 12000</td>
<td>233.4</td>
<td></td>
</tr>
<tr>
<td>I-Tech 4x3500 HD</td>
<td>217.6</td>
<td></td>
</tr>
<tr>
<td>SV Value Range</td>
<td>Auto Peak max for each model (online)</td>
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</tr>
</tbody>
</table>
16 Application of FIR Filters to Loudspeaker Crossovers

16.1 FIR Overview
The power of DSP processing is in the latest Crown I-Tech HD DriveCore Series amplifiers with optimized DSP Impulse Response Filters as well. FIR filters offer a number of advantages when used in comparison to the conventional analog crossover.

Although high-order IIR filters, which are based on conventional analog circuits, can filter designed high-order low-pass or high-pass filters, the realized filter phase response is very difficult to implement. This significantly complicates crossover design and implementation.

As compared to FIR filters, IIR filters can be designed to follow extremely steep crossover slopes while changing drivers and the crossover slope is very easily designed. Minimizing number of taps enables sections to be very flexible and easy to modify different responses through the crossover region.

The white paper entitled “Characteristics and Crossovers of IIR and FIR Filters,” discusses the desirable and undesirable properties of IIR and FIR filters. In addition, audio-related references are available on Crown’s web site and the documentation files found in this document (see Appendix A at the end of this report).

16.2 What are IIR Filters and FIR Filters?
A filter describes certain characteristics in the input and output signals and can be characterized as being: causal or non-causal, stable or unstable, linear or nonlinear, time invariant or time variant. Many of these characteristics describe the behavior of a system that filters signals. This section is purely an analogy with a real piece of hardware such as a computer-based filtering is also often realized as digital filters using digital signal processing technology. These algorithms can be implemented in hardware as well as software. The term “digital filter” refers to the specific hardware or software routine that performs the filtering algorithm.

Digital filters may be characterized into two main types (i.e. Infinite Impulse Response (IIR) and Finite Impulse Response (FIR)). Informally, IIR filters include feedback because they are implemented as active filters. The feedback in an IIR filter means that the impulse response of the third and higher-order sections. In other words, “infinite” in the name. The impulse response of an IIR filter, on the other hand, is finite. In theory it has no length. Simplified structures for both types of filters are shown in Fig. 16.1.

A filter modifies certain characteristics of a signal such as amplitude, phase, and linear-phase crossovers can easily be designed. Minimizing number of taps enables sections to be very flexible and easy to modify different responses through the crossover region.

As compared to IIR filters, FIR filters can be designed to follow extremely steep crossover slopes while changing drivers and the crossover slope is very easily designed. Minimizing number of taps enables sections to be very flexible and easy to modify different responses through the crossover region.

Fig. 16.1: FIR filter structure and an IIR filter (inverted filter) structure

The FIR filter is the right side block weighted delayed versions of the input signal. Each block represents one or more complex nonlinear operations on the input signal to produce the output signal. The filter coefficient values or parameters are both real and complex. For a single-value input, the operation is a linear system. For a complex input, the operation is a nonlinear system.

The left side block is the input signal which is filtered or processed by the filter. The output signal is the input signal to which the filter has been applied. The output signal is a function of the input signal and the filter coefficients. The filter coefficients are determined by the filter design process.

For a single-value input, the operation is a linear system. For a complex input, the operation is a nonlinear system. The output signal is the input signal to which the filter has been applied. The output signal is a function of the input signal and the filter coefficients. The filter coefficients are determined by the filter design process.

Digital filters can be designed to follow extremely steep crossover slopes while changing drivers and the crossover slope is very easily designed. Minimizing number of taps enables sections to be very flexible and easy to modify different responses through the crossover region.

As compared to IIR filters, FIR filters can be straightforwardly designed as compared to IIR filters, which are based on conventional analog circuits, can filter designed high-order low-pass or high-pass filters, the realized filter phase response is very difficult to implement. This significantly complicates crossover design and implementation.

36x29 I-Tech HD DriveCore Series Power Amplifiers
Operation Manual

16.3 Filter and Crossover IR and FIR Filters
The following table lists several characteristics of the two types of filters and their applications:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>IIR Filter</th>
<th>FIR Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Rolloff Rates</td>
<td>Yes</td>
<td>Possible</td>
</tr>
<tr>
<td>Response</td>
<td>Linear</td>
<td>Linear</td>
</tr>
<tr>
<td>Computational</td>
<td>Simple</td>
<td>Massive</td>
</tr>
<tr>
<td>Stability</td>
<td>Conditionally</td>
<td>Naturally Stable</td>
</tr>
<tr>
<td>Complexity</td>
<td>Few CPU cycles</td>
<td>Massive CPU cycles</td>
</tr>
<tr>
<td>Implement Complexity</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Impulse Response</td>
<td>Non-causal</td>
<td>causal</td>
</tr>
</tbody>
</table>

The table above lists several characteristics of the two types of filters and their applications.

In theory tells us that multiplication in the frequency domain is equivalent to convolution in the time domain. However, in practice, the FFT is a very efficient and fast way of moving between the time and frequency domains. The resource requirements of a high-performance FIR filter in terms of computational power can be enormous. For example, an FIR filter with a sample rate of 44.1 kHz and a filter length of 10000 coefficients (e.g. a low-pass filter) would require approximately 200 MIPS (Million instructions per second) of processing power to implement.

The resource requirements of a high-performance FIR filter in terms of computational power can be enormous. For example, an FIR filter with a sample rate of 44.1 kHz and a filter length of 10000 coefficients (e.g. a low-pass filter) would require approximately 200 MIPS (Million instructions per second) of processing power to implement.

16.4 Convolution of FIR Filters
Fig. 16.2 shows two blocks of the I-Tech HD Power amplifiers. The input signal is convolved with the impulse response of the FIR filter, which is implemented as a convolution of the input signal with the impulse response of the FIR filter. The convolution is equivalent to the product of the input signal and the impulse response of the FIR filter. The output signal is the convolution of the input signal and the impulse response of the FIR filter.

The resource requirements of a high-performance FIR filter in terms of computational power can be enormous. For example, an FIR filter with a sample rate of 44.1 kHz and a filter length of 10000 coefficients (e.g. a low-pass filter) would require approximately 200 MIPS (Million instructions per second) of processing power to implement.

16.8 Crown’s Implementation of FIR Filters
Crown’s implementation of FIR filters uses an extremely advanced and powerful digital signal processing architecture which allows the flexibility of the I-Tech HD Power amplifiers. The output signal is the convolution of the input signal and the impulse response of the FIR filter. The output signal is the convolution of the input signal and the impulse response of the FIR filter. The output signal is the convolution of the input signal and the impulse response of the FIR filter. The output signal is the convolution of the input signal and the impulse response of the FIR filter.
16 Application of FIR Filters to Loudspeaker Crossovers

16.10 Filter Design

FIR filters are designed using an analog circuit. Because of this, the FIR design process is straightforward. The design involves converting an analog filter frequency response into the digital domain and then using that information to generate the coefficients needed for the digital filter. In contrast, IIR filters are designed using a proprietary iterative algorithm that can approximate the response of the ideal, though physically unrealizable filter. The I-Tech HD FIR filters are designed using a proprietary iterative algorithm based on the state-space equation and are optimized for low latency and high-quality audio applications.

16.11 Low Latency 36 kHz Studio Quality Filters

Because of the extremely short delay imposed by these particular FIR filter crossovers, system DSP and high-pass applications like the HPF crossover algorithm are essentially noiseless and do not affect the outcome of I-Tech HD's platform-optimized FIR crossover algorithms. The I-Tech HD FIR crossover algorithm is designed for low latency and high-quality audio applications.

Real World Benefits

16.12 Measurements of Two-way Loudspeaker System

The practical advantage of using a FIR-based crossover is that it can be implemented computationally (i.e., in real-time) using an embedded processor or DSP. By converting an analog filter frequency response into digital form, it is possible to realize a digital filter that closely approximates the response of the ideal, though physically unrealizable filter. The I-Tech HD FIR filters are designed using a proprietary iterative algorithm based on the state-space equation and are optimized for low latency and high-quality audio applications.

The following two sets of measurements illustrate the results of using a conventional FIR filter set up as a three-way crossover. Each set of measurements is then followed by the appropriate Linear-Phase crossover filter response and crossover effects. The following section discusses the results of using a series of crossover filters to illustrate the differences between FIR and IIR filter designs.

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16.13 FIR Measurements

The Crown® TEC HD amplifier was used to create a linear-phase FIR crossover with a 2.5 kHz corner frequency. This allows the crossover to be positioned in line with the source, so at frequencies above the corner frequency can be down by 12dB using HI-Res. Selection of a higher crossover allows an equal loudness to be achieved with correspondingly lower crossover frequencies. FIR filters, with coefficients from 250 to 25,000 can be created with the amplifier’s software in a similar manner. The crossover is shown to be a relatively sharp cut-off filter with minimally short latency.

Figure 17.9 shows two graphs illustrating the measured crossover responses of a 3 kHz crossover. The right graph shows the measured phase of the crossover with phase rotation due to the latency and speaker-to-microphone transit time subtracted out. It shows a linear zero-phase characteristic over most the measured range.

Figure 17.6 Measured individual driver responses (left) and overall summed on-axis response (right) of the two-way system of Fig. 5 driven with 3.67 ms latency 3 kHz FIR crossover filter generated by a Crown® TEC HD amplifier.

Figure 3 shows two graphs illustrating the measured crossover responses of a 3 kHz crossover. The right graph shows the measured phase of the crossover with phase rotation due to the latency and speaker-to-microphone transit time subtracted out. It shows a linear zero-phase characteristic over most the measured range.

Note the extremely sharp filter roll-offs in the left graphs which approach ±60° slopes and the exceptionally narrow one-third octave crossover span.

16.14 Conclusions

For those who want a more in-depth treatment of the topics in this white paper, here are three good references.


Crown® TEC HD Series power amplifiers allow sophisticated crossovers to be implemented using Finite Impulse Response (FIR) filters that can achieve a wide variety of crossover responses, including very high Q dips, crossover filters with correspondingly lower corner frequencies. FIR filters, with coefficients from 250 to 25,000 can be created with the amplifier’s software in a similar manner. The crossover is shown to be a relatively sharp cut-off filter with minimally short latency.

The final two graphs, shown in Fig. 7, illustrate the measured crossover responses of the two-way system of Fig. 5 driven with 3.67 ms latency 3 kHz FIR crossover filter generated by a Crown® TEC HD amplifier.

The final two graphs, shown in Fig. 7, illustrate the measured crossover responses of the two-way system of Fig. 5 driven with 3.67 ms latency 3 kHz FIR crossover filter generated by a Crown® TEC HD amplifier.
17.2.1 Service at a US Service Center

Service may be obtained in one of two ways: from an authorized service center or at our factory. If you contact your local distributor.

*Warranty is only valid within the United States of America. For information on Warranty outside of U.S.A. please contact your local distributor.

17.2.2 Factory Service

For more information, please contact us direct.

17.2.3 Factory Service Shipping Instructions:

**Crown Factory Service**

1718 W. Mishawaka Rd., South Bend, IN 46614

Telephone: 574.294.8124 (Factory Service) 574.294.8301 (Technical Support)

17.2.4 Packaging Instructions:

These instructions must be followed. If they are not followed, Crown Audio, Inc. assumes no responsibility for damaged goods or accessories that are sent with your unit.

1. Open carton and lift center cushion leaving both end-cushions in place. Or, if you prefer, you may prepay the cost of shipping the product to the factory for service. Please ship by Crown Factory Service only.

Crown International, 1718 West Mishawaka Road, South Bend, IN 46614, USA

Payment on out-of-warranty repairs must be received before repairs are made. If repairs are not completed within 30 days of the estimate and the repair is still under warranty, the rest of the warranty will become the property of Crown Audio Inc.

Warranty work for some products can only be performed by Crown authorized service centers or at the factory. All expenses in connection with the return of such a defect. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This Crown Warranty is in effect only for failure of the parts created by poor packaging will not be covered under warranty.

Claims for product loss in transit will not be considered under warranty. This includes any damage to another product or products resulting from a defect in the new Crown product.
Service Return Authorization Request

Shipping Address: HARMAN Factory Service, 1718 W. Mishawaka Rd., Elkhart, IN 46517
You may also request a service return authorization at www.crown audio.com/support/rma

PLEASE PRINT CLEARLY

SRA #: _________________________________________________________________________________ (If sending product to Crown factory service)

Model: __________________________Serial Number: ______________________________ Purchase Date: ______________________________________________________

PRODUCT RETURN INFORMATION

Individual or Business Name:  __________________________________________________________________________________________________________________________________

Phone #: _________________________________ Fax #:_______________________________________ E-Mail:_______________________________________________________________

Street Address (please, no P.O. Boxes):  _____________________________________________________________________________________________________________________________

City: _________________________________ State/Prov:__________________ Postal Code: ___________________ Country:______________________________________________________

Nature of problem:  ___________________________________________________________________________________________________________________________________________

_________________________________________________________________________________________________________________________________________________________

_________________________________________________________________________________________________________________________________________________________

_________________________________________________________________________________________________________________________________________________________

_________________________________________________________________________________________________________________________________________________________

Other equipment in your system:  __________________________________________________________________________________________________________________________________

If warranty is expired, please provide method of payment. Proof of purchase may be required to validate warranty.

PAYMENT OPTIONS

I have open account payment terms. Purchase order required. PO#: _______________________________________

COD

Credit Card (Information below is required; however if you do not want to provide this information at this time, we will contact you when your bill is required for the information.)

Credit card information:

Type of credit card:  

Type of credit card account:  

Card # ____________________________________________ Exp. date: ___________________ *Card ID #: _____________________________________________

*Card ID # is located on the back of the card following the credit card #, in the signature area. On American Express, it may be located on the front of the card. This number is required to process the charge to your account. If you do not want to provide it at this time, we will call you to obtain this number when the repair of your unit is complete.

Name on credit card:  _________________________________________________________________________________________________

Billing address of credit card:  ________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________