LANCe DESIGN

ADX-2400D

AUDIO
DISTRIBUTION AND DELAY
SYSTEM

(AES Digital I/O)

Installation and Operation Manual

Software Version 1.3

October, 2007

CAUTION! HAZARDOUS VOLTAGES ARE EXPOSED WHEN THE TOP COVER OF THE RACK FRAME IS REMOVED.   DO NOT APPLY POWER WITH THE UNIT DISASSEMBLED.

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Front Panel View

Rear Panel View

QUICK OPERATION GUIDE

- **To Select Output Channel (or Channels) to Adjust**
  Press 'OUTPUT SELECT' button, and turn knob until desired channel is selected.
  The order of the channel selection is as follows:

  Local (AES) **Output 1 through 24** (Individual Outputs)
  Local Outputs 1-8 (Group)
  Local Outputs 9-16 (Group)
  Local Outputs 17-24 (Group)
  All Local Outputs (Group)
  Net (Transmitted to Ethernet) **Output 1 through 24** (Individual Outputs)
  Net Outputs 1-8 (Group)
  Net Outputs 9-16 (Group)
  Net Outputs 17-24 (Group)
  All Net Outputs (Group)

  The VU Meter and Headphone Jack will follow the output selection.

  Note that if a group of outputs is selected, any setup adjustments (source, level, delay) will be applied to all output channels within that group.

  Also if a group is selected, there will be no VU display or headphone output.

- **To Select Source** (for current output or group of outputs)
  Press 'SOURCE' button. It will light, and the currently-selected source for the selected output will be displayed.   The sources available for each output are as follows, and can be selected by turning the knob.

SILENCE	The output will be muted
LOCAL INPUT	The output will be fed by the corresponding local AES input
NET INPUT	The output will be fed by the corresponding network receiver
888HZ TONE	The output will be fed by the internal 888 Hz tone generator
560 HZ TONE	The output will be fed by the internal 560 Hz tone generator

  You may enable a 'stereo summing' mode by selecting any of the following choices, which follow the above sources in the menu list. In these modes, the selected source will be combined with the selected source for the other channel in the even/odd pair; e.g., channels 1 and 2, channels 3 and 4, etc. When a 'something + mix' source is selected, the mixed signal is reduced by 6 dB.

SILENCE + MIX	The output will silence mixed with the other channel of the pair
LOCAL + MIX	The local AES input mixed with the other channel of the pair
NET INPUT + MIX	The network receiver mixed with the other channel of the pair
888HZ TONE	888Hz tone mixed with the other channel of the pair
560 HZ TONE	560Hz tone mixed with the other channel of the pair

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- **To Adjust Level** (for current output or group of outputs)
  The output level can be adjusted in 0.25 dB increments. Maximum gain is +12 dB.
  To adjust, press the 'LEVEL' button, and turn the knob.

- **To Adjust Delay** (for current output or group of outputs)
  The delay of each output can be independently adjusted from zero delay through 680 milliseconds, which corresponds to more than 20 frames at 30 frames/sec. The delay is adjusted by first pressing the 'DELAY' button, then turning the knob to adjust. Note that the displayed units (milliseconds or frames) is selected in the menu.

- **To Adjust Headphone Volume**
  Press the 'HP VOLUME' button, and turn the knob. The bar graph display will show the knob 'position'.

- **To Configure Menu Items**
  The system has several configuration items which may be set by using the menu function. Press the 'MENU SELECT' button to enable the menu function. Turn the knob to select the desired menu item, then press the 'MENU SET' button. Turning the knob will now change the parameter for this item. When the desired selection is made, you can exit the MENU SET mode by pressing any other button. (See section on menu items below).

MENU ITEMS

Item 01 – RX 1-8 Bundle (000-999)

Packet assignment for network receiver 1, which corresponds to audio channels (net inputs) 1-8. This number should be set to match the bundle number of the transmitter in another unit which is sending audio to this receiver. Note that bundle 000 is inactive (off). Bundles 001-255 are broadcast bundles, and should only be used if one transmitter is sending to more than one receiver. Bundles 256-999 are unicast bundles, and should be used for normal point-to-point, one transmitter/one receiver operation.

Item 02 – RX 9-16 Bundle (000-999)

Packet assignment for network receiver 2, which corresponds to audio channels (net inputs) 9-16.

Item 03 – RX 17-24 Bundle (000-999)

Packet assignment for network receiver 3, which corresponds to audio channels (net inputs) 17-24.

Item 04 – TX 1-8 Bundle (000-999)

Packet assignment for network transmitter 1, which corresponds to audio outputs NET 01 – NET 08.

Item 05 – TX 9-16 Bundle (000-999)

Packet assignment for network transmitter 2, which corresponds to audio outputs NET 09-NET 16.

Item 06 – TX 17-24 Bundle (000-999)

Packet assignment for network transmitter 3, which corresponds to audio outputs NET 17 – NET 24.

Item 07 – Conductor Priority (Low – Normal – High)

This item determines the priority of this unit to operate as the 'sync generator' for the Ethernet audio network. It should normally be set to 'Normal' unless you specifically want this unit to be the conductor, in which case it could be set to high. If set to high, this unit will be the conductor unless another is also set high.   In the case where more than one unit has equal priority, the first unit active will assume the conductor role. This selection isn't too important, since the network will quickly re-negotiate a new conductor if the current conductor were to fail or be turned off.

Item 08 – Delay Units (Milliseconds – Frames (30) – Frames (25))

This item selects the units used to display the delay values. It only affects the display, and if set to Frames, saves the user having to do the arithmetic in his head. It assumes 33 milliseconds for 30 Frames/sec, and 40 milliseconds for 25 Frames/sec.

Item 09 – Configuration File (1, 2, or 3)

There are three user setup files, selected by this menu item. If desired, the users can store and recall configurations using these files.   Note that the current configuration is always stored in a 'default' file, different from these three. This is the file which is loaded on power-up. Configs stored in the three files selected by this menu item must be manually stored and recalled, using the next two menu items.

Item 10 - <Set> to Save Config

Pressing the 'MENU SET' button will store the current setup in the configuration file selected in menu item 09 above.

Item 11 - <Set> to Recall Config

Pressing the 'MENU SET' button will recall the configuration stored in the file selected in menu item 09 above.

The following items are STATUS items, and are only to display status information. They may not be changed by the user.

Status Item 01 – NET RX 1 Status (Active or Idle)

Displays ACTIVE status if data is being received by network receiver 1.   This receiver corresponds to net inputs 1-8.   Note that the data could be silence; an active receiver doesn't necessarily mean that there is audio present.

Status Item 02 – NET RX 2 Status (Active or Idle)

Same for receiver 2, which corresponds to net inputs 9-16.

Status Item 03 – NET RX 3 Status (Active or Idle)

Same for receiver 3, which corresponds to net inputs 17-24.

Status Item 04 – NET TX 1 Status (Idle or Number of Receivers)

If this transmitter is turned off (bundle = 000), or if it is set to a unicast bundle (bundle = 256-999) with no corresponding receiver present, this status item will indicate IDLE status.   The transmitter is not putting any data on the network.

Otherwise, it will indicate the number of receivers listening to this transmitter. The network only counts receivers up to four, so if there are more than three receivers present, the status item will report ">3 Rcvrs".

Note that unless the status is IDLE, the transmitter is putting data on the network. If assigned as a broadcast bundle (001-255), the status could be " 0 Rcvrs ", if no receivers were listening to this bundle number. The data is still present on the network.

Net TX 1 corresponds to net outputs 1-8.

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Status Item 05 – NET TX 2 Status (Idle or Number of Receivers)

Same as above for net outputs 9-16.

Status Item 06 – NET TX 3 Status (Idle or Number of Receivers)

Same as above for net outputs 17-24.

Status Item 07 – Conductor Status (Another Unit or This Unit)

Indicates if the network conductor ('sync generator') is this unit or not.

Status Item 08 – PCB Temperature (degrees Celsius)

Indicates temperature of sensors on main PCB.   Normal temperature is in the 35-45 degree range.   A high temperature indication might indicate a fan failure, and will cause a fault message to be displayed if the temperature exceeds 55 degrees.

Status Item 09 – Output Reference (Int or Ext)

This status item indicates the sync reference for the AES outputs. The ADX-2400 will lock the outputs to an external AES reference if that reference is present, and this status item will indicate EXT.   If there is no external AES reference signal connected, the ADX-2400 will lock the outputs to the network (Cobranet) clocks. This status item will indicate INT.

Status Item 10 – System ID (00-99)

Displays two-digit system (frame) ID, as determined by the rotary switches on the front edge of the pcb, behind the front panel. These two digits are used as the last octet of the network IP address (192.168.100.xx), and the last part of the Cobranet system name (Lance ADX2400D-xx).   This IP address and system name appear when using the Cobranet 'Discovery' application to report network node status.

Status Item 11 – Firmware Version

Displays the version and date of the installed firmware.

Saving and Recalling Configurations

The menu settings and the source, level, and delay settings are stored automatically after 20 seconds of panel inactivity in a 'default' flash memory. This is the memory which is restored automatically when the unit is first powered up.

You may also save configurations in three user memories. First select the desired memory using the menu (Config Item 09), then select '<Set> To Save Config' (Config Item 10), and press the MENU SET button.   When the settings are saved to the flash, the display will say 'Config Saved – File 1(or 2 or 3)'.

To recall one of these user memories, again first select the desired memory (Config Item 09), and then select Config Item 11, '<Set> to Recall Config', and press the MENU SET button. All config data saved in that user memory will be recalled and immediately applied to the audio hardware.

Factory default configuration may be recalled by setting the options dipswitch section 1 to the on position, the resetting the unit, either by powering it up, or by pressing the reset button on the PCB control panel.

The factory default sets all levels to unity, all delays to zero, local output sources to net inputs, and net outputs to local inputs. All bundle numbers are set to zero.

Locking Menu and Channel Setup [Dipswitch functions]

There is an Options Dipswitch located behind the front panel, accessible by removing the thumbscrews on either side of the front panel.

Section 1 of this switch cause the factory default setup to be loaded when the unit is powered on, or reset using the reset button, located to the right of the dipswitch.

Sections 2-6 are currently unused.

Turning on **Section 7** will prevent changes the channel setups (level, source, and delay).

Turning on **Section 8** will prevent changes to menu items (bundle numbers, etc.).

Options Dipsw ^   ^ System ID Switch   ^ Reset Button

General Operational Notes

The ADX-2400 is designed to provide delay, level control and distribution for effects or commentary audio. The system can be used for stand-alone delay of 24 AES audio channels (12 pairs), or can be used to transmit and receive audio signals via a standard Ethernet data network (24 transmit and 24 receive channels simultaneously), or the combination of both functions.

The system is 'output oriented'. It can be thought of as having 48 outputs: 24 'local' AES outputs on the rear panel, and 24 'network' outputs which are sent to the Ethernet network. Each of these 48 outputs can be set up as follows:

SELECT SOURCE:
SILENCE, LOCAL INPUT, NETWORK INPUT, TONE1 (888HZ), or TONE2 (560Hz)

ADJUST LEVEL:
OFF to +12DB in 0.25DB steps

ADJUST DELAY:
0 milliseconds to 680 milliseconds (20 frames in 30fps), in 1 millisecond steps

The configuration of each output is independent, although you can select groups or all to save setup time if you are setting them all to be the same.

The unit should also be thought of as having 48 inputs: 24 AES inputs on the back panel, and 24 inputs from the network receivers.

Application Examples:

For stand-alone delay, all outputs would be set to 'local input', and level and delay adjusted as desired. The network tx/rx would not be used.

For transmitting effects to another truck, and inserting delay in the path: The network outputs would be set to 'local inputs', routing the AES audio inputs to the network transmitters. Delay and level adjustment could be done as desired. The local outputs could also be set to 'local inputs', providing an independent local delay. Alternatively, the local outputs could be set to 'network inputs', and these used as network receivers for audio coming back from the other truck.

Distribution of effects or other audio to multiple trucks could be accomplished by transmitting the audio using broadcast bundles, and receiving at each point of use. Delay and levels could all be adjusted independently at the receivers, or globally at the network transmitters.

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The Ethernet Part

The Ethernet transmission uses the Cirrus Audio 'Cobranet' system, which is an industry standard. It is a professional, highly-reliable system which packs audio data into 'bundles' of 8 channels. The bundles are given numbers from 1 to 999. The first 255 are 'broadcast' bundles which can be received by any number of receivers, so long as the receiver is set to the same bundle number. The rest are 'unicast' bundles, which will only be received by one receiver at a time. More Cobranet info at: http://www.cobranet.info/en/support/cobranet/

There are two Audio Network ports on the rear panel of the ADX-2400. These are redundant network connections, and either may be used. If desired, a redundant network connection my be established by using the second port. If both are used, the left-hand connector will be the primary, and the right the backup. If both links are established, and one is lost, audio will continue uninterrupted.

The simplest network is simply connecting two ADX-2400 units together. This allows for transmission of 24 channels of audio in each direction. Note that this type of connection requires a Crossover Cable, as the ports are not auto-sensing.

Most networks are established by using a standard Ethernet switch. In this case, each ADX unit should be connected to the switch with a straight-through (not crossover) cable. Each ADX-2400 should be on its own switch port. If multiple switches are used, it is desirable for the switches to connect to each other using gigabit Ethernet. A gigabit Ethernet link allows 700 or more audio channels to be sent in each direction. A 100base/T full duplex link allows 72 channels to be sent in each direction.

It is recommended that simple hubs not be used, although they will work if total network traffic is limited to 48 channels (6 bundles total)

The **indicators** on the audio network ports provide an indication of port status, as described below:

Yellow Indicator: Steadily-lit if connector is active. (Does not indicate a link or audio transmission). Flashing indicates that this unit is the 'conductor' or sync generator for the entire audio network.

Green Indicator: Steadily-lit indicates an Ethernet link. Flashing indicates packet transmission/reception.

When audio is being transmitted, the normal condition is either:

Yellow On, Green Flashing (this unit not conductor)
or
Yellow Flashing, Green Flashing (this unit is conductor)

The other Ethernet port on the rear panel, the **remote control port** will be supported in later software revisions.

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Setting Bundle Numbers

The 24 transmit and 24 receive audio channels in the ADX are divided into 8-channel groups. These groups are assigned to network channels or 'bundles'. There are six bundles per ADX unit, three for receive and three for transmit. Each of these bundles can be assigned a three-digit number from 000 – 999. (Note that the Cobranet system allows numbers as high as 65000, but they are limited in the ADX-2400 to 999).

- A bundle assignment of 000 is defined as inactive, and will disable this network transmitter or receiver. Audio outputs from disabled receivers will be silence.

- A bundle assignment in the range 001-255 is a <u>Broadcast Bundle</u>. These numbers should be used when it is desired that one transmitter be received by multiple receivers. <u>Note that broadcast bundle data will appear on all network segments (all switch ports)</u> and can cause network congestion if used when not required. Use broadcast bundles only when required to avoid unnecessary traffic on the network.

- A bundle assignment in the range 256-999 is a <u>Unicast Bundle</u>. These numbers are used for normal transmission from one transmitter to one receiver (point to point). A switch will route this traffic only to the required port and reduce unnecessary traffic on the network.

The audio transmission will usually follow the bundle assignment almost instantly, however on occasion there will be a delay of a second or two as the Cobranet hardware negotiates the connection.

Designing the Network (Please read this section!)

The Cobranet technology is very powerful, and allows for very flexible system design. It is not without limits, however. It is important to have a full understanding of how the system operates to avoid network problems, and therefore to avoid audio problems.

Here are some important things to know:

- There are limits to the number of audio channels which may be present on any given network. The network connection on the rear panel of the ADX-2400 is a 100 Mbit/sec Ethernet connection. As transmitted by the ADX, each audio channel requires approximately 1 Mbit/sec of bandwidth, so each bundle (8 Channels) requires 8 Mbit/sec.

- Because of the additional control and timing data, each 100 Mbit/sec network segment can handle a <u>maximum of 10</u> bundles. This is an absolute maximum; restricting it to 9 provides a bit of safety margin, and is strongly recommended.

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- Exceeding this bandwidth limit will cause dropouts in the audio, and in severe cases may cause other problems such as sync and control problems.

- An Ethernet switch, which generally forms the hub of a network, can partition the traffic so that bundles only go the receivers which are listening to them. Since each ADX frame only has three receivers, this can eliminate network traffic problems if each bundle is a unicast bundle (one transmitter to one receiver). The switch will route the traffic only to the required receiver.

- Broadcast bundles (bundle numbers 001-255) can NOT be isolated by the Ethernet switch. They will appear on ALL network segments, regardless of receivers. You should use broadcast bundles only when required, and be aware that they add to the traffic on all segments of the network.

- The bottleneck for network will usually be the receive side of the network segments connecting the ADX frames. The network segment connecting to an ADX frame will see all unicast bundles being received by that frame, plus ALL broadcast bundles on the network. This total number of bundles can not exceed 10 (9 is better). (This number does not include bundles being transmitted by this frame, unless they are broadcast bundles).

The broadcast bundles are a very powerful feature, in that they allow very convenient and inexpensive distribution of lots of audio signals. Using broadcast bundles can really clog up the network, however, so be aware of the tradeoffs, and use them only when required.

If the network traffic becomes too heavy, and audio packets are being dropped, the ADX front panel buttons will flash, and a "NETWORK ERRORS" warning message will be displayed.
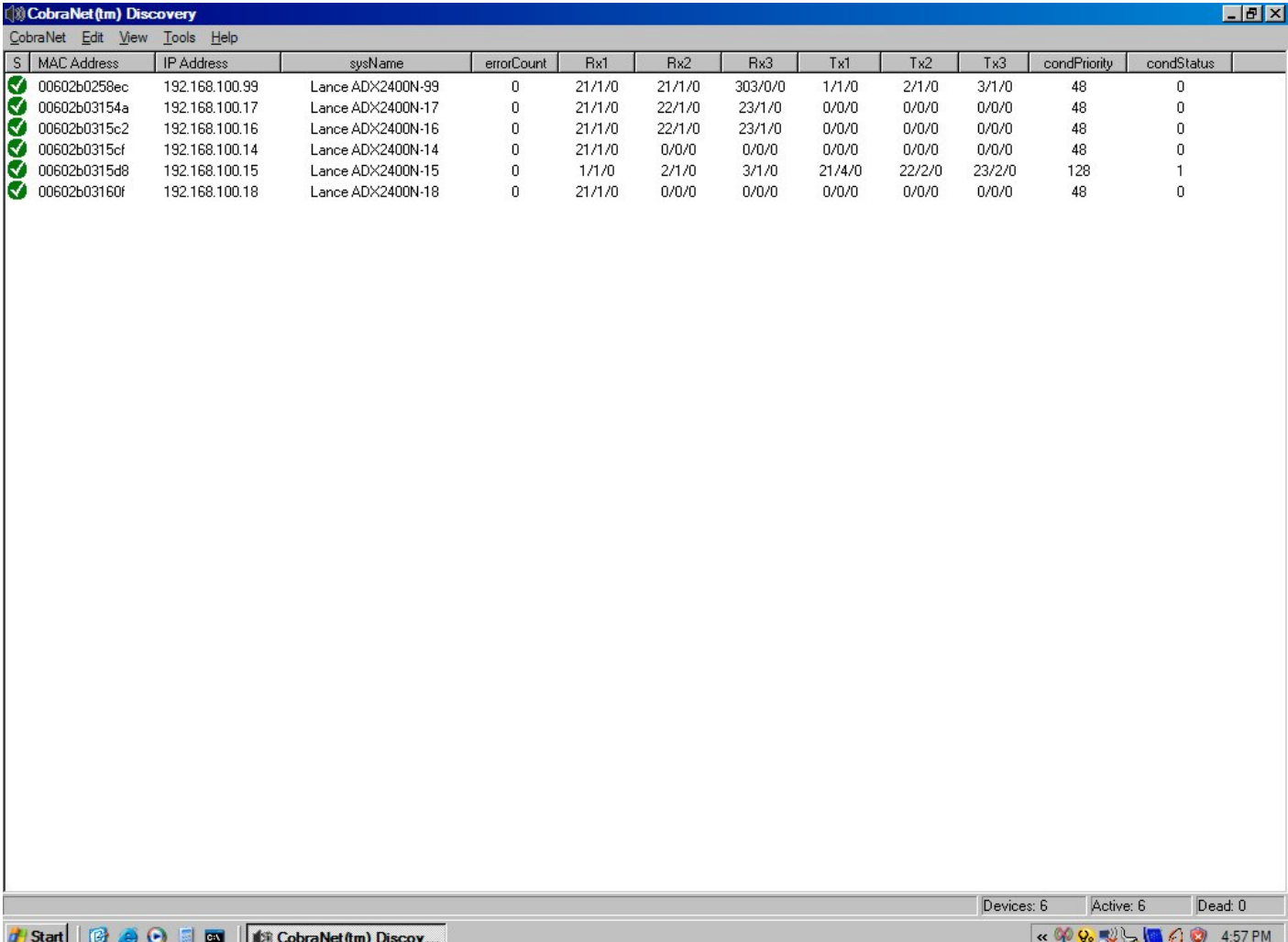
Some other things to know about the network operation:

- Because of the way Ethernet works, the ADX frames can not see their own transmissions. This means that if you dial a transmitter and receiver (in the same ADX unit) up to the same bundle number, the transmitted audio will NOT appear on the receiver outputs. Select 'local' as a source instead.

- Only one ADX receiver can listen to a given unicast bundle. If you assign two receivers to the same unicast bundle, only the first will output audio. Broadcast bundles can be repeated on multiple receivers, either in separate frames or in the same frame (for multiple copies of the same audio).

- All audio on the network is 20-bit uncompressed. It takes a fixed amount of bandwidth, regardless of the audio content.

Cobranet 'Discovery' PC Application

Cirrus Logic, the developers of Cobranet, make available on their website a nice PC application called 'Cobranet Discovery', or 'Disco'. It can be downloaded and installed on any PC running Windows XP. It allows the computer to be attached to the audio network and provides a variety of information about the attached network devices. Documentation is available on their website: www.cobranet.info, or at www.lancedesign.com.

The PC TCP/IP network properties must be set for a fixed IP address (not DHCP), and a subnet mask. The firmware in the ADX-2400s sets their IP addresses to 192.168.100.xx, where xx is the System ID, set by the rotary switches on the PCB behind the front panel. I recommend setting the PC to 192.168.0.1, although any other numbers are fine for the last two octets, provided they don't conflict with the addresses of any ADX-2400s on the network. The subnet mask should be set to 255.255.0.0.

S	MAC Address	IP Address	sysName	errorCount	Rx1	Rx2	Rx3	Tx1	Tx2	Tx3	condPriority	condStatus
✓	00602b0258ec	192.168.100.99	Lance ADX2400N-99	0	21/1/0	21/1/0	303/0/0	1/1/0	2/1/0	3/1/0	48	0
✓	00602b03154a	192.168.100.17	Lance ADX2400N-17	0	21/1/0	22/1/0	23/1/0	0/0/0	0/0/0	0/0/0	48	0
✓	00602b0315c2	192.168.100.16	Lance ADX2400N-16	0	21/1/0	22/1/0	23/1/0	0/0/0	0/0/0	0/0/0	48	0
✓	00602b0315cf	192.168.100.14	Lance ADX2400N-14	0	21/1/0	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	48	0
✓	00602b0315d8	192.168.100.15	Lance ADX2400N-15	0	1/1/0	2/1/0	3/1/0	21/4/0	22/2/0	23/2/0	128	1
✓	00602b03160f	192.168.100.18	Lance ADX2400N-18	0	21/1/0	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	48	0

Devices: 6 Active: 6 Dead: 0

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Installation

The ADX-2400D is designed to be installed in a standard 19" equipment rack. There is a cooling fan on the rear panel which draws air in through the sides of the cabinet and exhausts hot air through the rear panel. The unit should not be installed in such a way as to block the vents on the side panels, or air flow from the rear panel fan.

The unit is designed to operate on 95-250 volts AC, 50 or 60 Hz. The power supply is an wide-range switching supply, so no voltage selection needs to be made.

Power consumption is approximately 15 watts.

The AES audio input and output connections are made through BNC connectors on the rear panel. Each BNC connector corresponds to an AES pair, i.e. Input 1 is the connector for channels 1 and 2, Input 2 is the connector for channels 3 and 4, etc.

The input connectors are AC-terminated in 75 ohms (you won't see this termination with a DC meter), and require a nominal 1 volt p-p AES signal. The outputs provide a 1 volt p-p signal into 75 ohms. Inputs and outputs correspond to the AES specs for unbalanced (BNC) transmission.

The AES Reference Input is also a 75-ohm terminated input, requiring nominally 1 volt p-p. The applied signal should be AES Silence, Tone, or other AES signal. The input is not designed to accept 48-Khz word clock. The 12 outputs will be frequency and phased locked to this reference regardless of input or network timing.

There are no restrictions on the timing or locking of any of the 12 input signals. They will be syncronized in the unit to the network clock.

All AES audio into the ADX-2400D should have emphasis turned off, as emphasis is not supported internally. The output channel status bits will indicate NO EMPHASIS.

The coax cables should be supported in such a way as to prevent weight being applied to the rear of the ADX-2400. The rack mounting flanges are sufficient to support the unit itself, but not additional loading of the heavy I/O cables.

The Ethernet 'Audio Network' ports (one or both) should be connected to the network with standard CAT5 RJ-45 cables, following normal IT practice. The ports are 100/baseT Ethernet. The connectors on the ADX-2400 are wired with the same pinout as normal PC ports, and are not auto direction sensing. If connecting two units together without a switch, a crossover cable must be used.

It is not possible to 'daisy-chain' units together. The two ports do not function as 'loop-through'. Each unit should be connected to a separate switch port.

The maximum length for 100/baseT Ethernet on copper is 100 meters. For longer runs there must be a repeater (switch) or media converter (fiber) in the path. See the Cobranet website (www.cobranet.info) for more information.

ADX-2400D Specifications

Local Input Channels	24 AES on 12 unbalanced (BNC female) connectors, 1v p-p
Local Output Channels	24 AES on 12 unbalanced (BNC female) connectors, 1v p-p
AES Reference Input	AES Silence or other AES signal. BNC connector, 75-ohm, 1v p-p
Output Phase Lock Accuracy	+/- 1% of sample period (+/- 200 ns)
Input Phase Requirements	None. Inputs may be free-running
Sample Rate Converters	Highest-quality AD1895. Converters on both inputs and outputs.
Output Impedance	75 Ohms, transformer coupled
Input Impedance	75 Ohms AC termination, transformer coupled
Digital Processing and Delay	24-bit uncompressed
Cobranet Transmission	20-bit uncompressed
Sample Frequency	48 kHz
Adjustable Delay Range	0 milliseconds to 680 milliseconds (>20 frames at 30 fps)
Minimum Delay (AES in to AES out)	1.5 milliseconds
Minimum Delay (through Ethernet)	6.5 milliseconds
Headphone Jack	1/4" TRS (Stereo) follows Output selection, Low impedance
Menu	Selects Cobranet bundle numbers (address), config store/recall
Remote Control	Ethernet port (100baseT) separate from Audio Network.
VU Meter	Conventional VU ballistics (300ms), -20 to +3.5 dB scale, follows Output selection. Scale mark at 0 VU.
Display	2x24 VFD
Power Requirements	95 to 250 Volts AC, 50-60 Hz, 15 Watts

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