AVDS Interface Control Document

Document Information

Summary: Defines the general application interface model and the communication protocol.

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Revision History

REV	Date	Initials	Description
A	9/26/2007	RLD	Initial Release.
B	3/11/2008	RLD	ECO-00060
C	2/17/2011	RLD	ECO-00192
D	11/15/2011	RLD	ECO-00240
E	4/26/2012	RLD	ECO-00252

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1 Introduction

The AVDS (Audio Video Distribution System) is a highly configurable system capable of distributing high definition audio and video.

Figure 1 AVDS Logical Channels below depicts a way in which the system can be broken up into logical channels. Configuring an AVDS system involves defining the specific inputs that specify each input channel in the system and the specific outputs that define each output channel in the system. *Configuring* the system is the task of the System Designer.

Controlling an AVDS system involves requesting the system to route a given input channel to a given output channel and is the task of the CMS controls provider.

A key design feature of the AVDS is the straight forward manner that HD video, SD video, encoded audio, and analog audio signals can all be input from the same source. Hence, the system is able to provide the best match of available input signals to the capabilities of the rendering device. For example, one HD monitor can be displaying the HD video signal from a Blu-Ray DVD player, while an SD monitor is displaying the SD video signal from the same player. A surround sound receiver can process the player's encoded audio while the same player's down-mixed analog audio can be routed to a stereo-only device like headphones.

To simplify organization of the various input and output signals and make them easy to manage by the external control system, related signals are combined into logical channels. Selecting an input channel to be directed to an output channel is the fundamental task of the CMS controller.

The logical channels make it possible to associate the video signal from one source with the audio signal from another source as is the case of Input Channel 3. However, if one didn't want them to be grouped together, another input channel could be defined just for the CD player.

Note that although audio and video signals are combined logically within a given input channel, the system affords the flexibility of routing the audio from one input channel and video from another input channel to the same output channel. This allows the user to watch the video from one channel while listening to the audio from another channel.

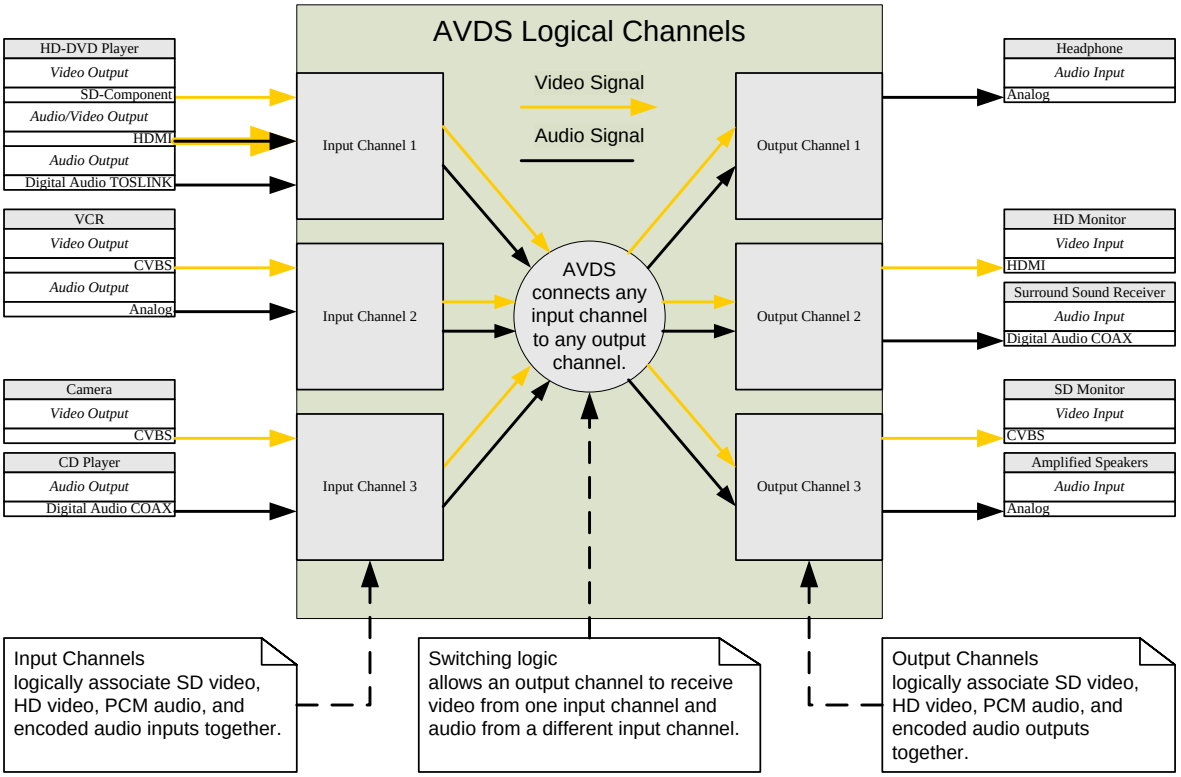

Figure 1 AVDS Logical Channels

1.1 Channels

Each channel has a channel number (1 and above).

Input channels are typically assigned to a particular *source*, e.g. an HD-DVD, BluRay, CD Player, VCR, Camera, etc.

Output channels are typically assigned to a particular *seat location,* e.g. a personal monitor and a pair of headphones might be assigned to RHS-1.

A CMS supplier that is responsible for controlling the AVDS must be given a map by the System Designer to associate equipment with logical channels. Using the simple example from Figure 1 above, the map would look as follows:

Input Channels	
Channel	**Description**
1	HD-DVD
2	VCR
3	Camera/CD Player
Output Channels	
1	RHS-1 Headphones
2	FWD Area Monitor/Surround Speakers
3	AFT Area Monitor/Speakers

1.2 Zones

A zone is a group of output channels. These are used for control of an area, and are most often used for page/brief or video announcement overrides. Zones can also be used to set all sinks in an area of the aircraft to a channel using a single command. Output channels are not required to be placed in a zone, they are provided to simplify the control system interface. Once again, it is the responsibility of the System Designer to specify to the CMS equipment provider which logical output channels are associated with which zones.

1.3 Override Control

Override control allows a channel to be set temporarily, and then reverted. Override control for audio channel, video channel, and volume are provided. When a channel override is set, a new override will overwrite the previous. When the override is released, the channel will revert to the original value. The AVDS system allows normal channel changes to occur during an active override, but these changes are not seen until the override is released. It is the responsibility of the control system to prevent channel changes during an active override if desired.

2 Run Time Control

Control of the AVDS is accomplished using either an Ethernet interface or an RS-232/RS-485 interface. Both interfaces use a synchronous protocol, with each response applying to the previous message.

There are 4 possible data types for command data. All are sent MSB first, and are listed below:

Byte	8 bit unsigned value
Word	16 bit unsigned value
Dword	32 bit unsigned value
SFDP.1	Signed Fixed Decimal Point. A 16 bit signed value (multiplied by 10, so 30.3 becomes 303)
String	A NULL terminated string, ASCII encoded.

Table 1 Command Data Types

Each response starts with the command byte followed by a Dword result value. Any result with the MSB set is a failed result and no further data will be sent. The Result value MUST be successful for the remaining data to be valid.

2.1 Ethernet Interface

The AVDS Ethernet protocol uses a TCP socket for command and control. The subnet for the AVDS is always 10.0.0.0 with a subnet mask of 255.0.0.0.

AVDS operates with a primary node, but allows any node to take over this responsibility. This means that the IP address that connects to the AVDS may change from time to time. To allow the control system to select the correct IP address, a UDP socket is used to periodically transmit the correct IP address and Port number.

To make a connection, follow these steps:

1. Insure that Ethernet port is running at address 10.100.100.100, the reserved control system IP address.
2. Open a UDP socket on this port, listening to port 2010.
3. Wait for a Connection Info message (See Section 2.1.1)
4. Process the Connection Info message to get the IP address and port number of the manager.
5. Open a TCP socket to the IP address and Port number given.

2.1.1 Connection Info Message

The Connection Info Message is sent periodically by the AVDS Manager to inform the control system of the IP address and port of the manager and some system status information. Any node can assume the role of manager in the AVDS, so this message must be processed when making a new connection over Ethernet.

Length	Description
4 Bytes	IP Address of AVDS Manager
2 Bytes	Port Number of Manager
1 Byte	System Status Byte (Reserved For Future Use)
1Byte	Number of PA State Entries
4 x *n* Bytes	The PA State information, 4 bytes per entry.

Table 2 Connection Info Message

2.1.1.1 IP Address of Manager

The IP Address is sent as 4 bytes where each byte reflects one octet of the address. The byte is sent with large endian, so the address of 10.2.3.5 would be sent as:

0x0A, 0x02, 0x03, 0x05

2.1.1.2 Port Number of Manager

The Manager port number is sent as two bytes in large endian format, so a port number of 2001 would be sent as:

0x07, 0xD1

2.1.1.3 System Status Byte

The system status byte has not yet been implemented and is not currently defined. It is reserved for future use.

2.1.1.4 PA State

The PA state returns the status of any PA events. This includes both software PA events (those initiated by the control system) and hardware PA events (those triggered by keyline input from third party devices).

The PA state is sent using one byte as the number of entries followed by 4 bytes for every entry. The 4 bytes are allocated as follows:

zzzzzzzz zzzzzzzz pppppppp pppppppp

where z refelects the zone (in large endian format) and p represents a bitmap of the PA state.

2.1.1.4.1 Zone

The zone number is a 16 bit number that will match the number for a configured zone or will reflect one of the reserved zone values of 0xFFFF (all channels) or 0x0000 (unassigned channels). The zone is sent in large endian format, so zone 1 would be sent as:

0x00, 0x01

2.1.1.4.2 PA State Bitmap

The PA State is a bitmapped value reflecting the active PA events in the zone. The PA bits are defined as follows:

Bit Number	PA State
0 (LSB)	Software Chime
1	Software Briefer
2	Aux 2 PTT
3	Aux 1 PTT
4	Mic 3 PTT
5	Mic 2 PTT
6	Mic 1 PTT
7	Ordinance 6
8	Ordinance 5
9	Ordinance 4
10	Ordinance 3
11	Ordinance 2
12 (MSB)	Ordinance 1

Table 3 PA State Bitmap

While there may be multiple PA events set, only the one with the highest priority is active at any given time. The bits are ordered by priority, so the highest bit is the highest priority.

2.2 Serial Interface

The serial interface uses 115200 Baud, 8 Bits, no parity, 1 stop bit RS-485 or RS-232.

For pin out information and electrical characteristics, please refer to section 3 AVDS Node Connectors.

2.2.1 Serial Command Structure

Most AVDS commands are the same regardless of the transport mechanism, but the serial packets must be wrapped with control information to insure that the packet was delivered correctly.

Command Wrapper:

Type	Description
Byte	Preamble 1 (0xAA)
Byte	Preamble 2 (0x55)
Word	Packet Length
	Command Data 0
	Command Data 1
	…
	Command Data *n*
Word	CRC

Table 4 Serial Command Wrapper

The Length and CRC are calculated on the Command Data only and do not include the preamble, length or CRC data.

2.2.1.1 Packet CRC Calculation

CRC calculations use the Direct CCITT-16 algorithm to create a 16 bit CRC with an initial value of 0xFFFF. Sample code for generating the 16 bit CRC is available from Innovative Advantage upon request.

2.2.2 Serial Interface Commands

These commands are used only for the serial interface.

2.2.2.1 Initialize Communication

This should be the first command written to the AVDS after a reset or offline event. The AVDS will not respond to any command until it has received the Initialize Communication command. This guarantees that the control system will detect any offline event that occurs.

Command:

Type	Description
Byte	Command (0x22)

Table 5 Initialize Communication Command

Response:

Type	Description

Byte	Command (0x22)
Dword	Result

Table 6 Initialize Communication Response

2.2.2.2 Ping

This command is used to verify that the AVDS is still online and has not reset since the last command was sent.

Command:

Type	Description
Byte	Command (0x23)

Table 7 Ping Command

Response:

Type	Description
Byte	Command (0x23)
Dword	Result

Table 8 Ping Response

2.3 Commands

The commands in this section are used to control the AVDS for both Ethernet and Serial connections.

2.3.1 Set Channel

This command is used to make a channel change.
Send an input channel of 0 to turn off the audio or video.
Send an input channel of 0xFFFF to leave the channel unchanged.

Command:

Type	Description
Byte	Command (0x10)
Word	Output Channel
Word	Audio Input Channel
Word	Video Input Channel

Table 9 Set Channel Command

Response:

Type	Description
Byte	Command (0x10)
Dword	Result

Table 10 Set Channel Response

2.3.2 Get Channel

This command is used to request the current audio and video channel assigned to an input channel.

A returned input channel of 0 indicates that the audio or video is turned off.

Command:

Type	Description
Byte	Command (0x11)
Word	Output Channel

Table 11 Get Channel Command

Response:

Type	Description
Byte	Command (0x11)
Dword	Result
Word	Audio Input Channel
Word	Video Input Channel

Table 12 Get Channel Response

2.3.3 Set Zone

This command is called to set a zone to an input channel. This performs a normal channel change; it does not activate an override.

A zone of 0 activates all channels that are not assigned to a zone.
A zone of 0xFFFF assigns all channels regardless of zone.
An input channel of 0 turns off the audio or video.
An input channel of 0xFFFF leaves the channel unchanged.

Command:

Type	Description
Byte	Command (0x12)
Word	Zone
Word	Audio Input Channel
Word	Video Input Channel

Table 13 Set Zone Command

Response:

Type	Description
Byte	Command (0x12)
Dword	Result

Table 14 Set Zone Response

2.3.4 Set Override

This command sets an override to a single channel. See section 1.3, Override Control for more information.

An input channel of 0 turns off the audio or video.
An input channel of 0xFFFF leaves the channel unchanged.

Command:

Type	Description
Byte	Command (0x13)
Word	Output Channel
Word	Audio Input Channel
Word	Video Input Channel
SFDP.1	Volume (-80.0 to +20)

Table 15 Set Override Command

Response:

Type	Description
Byte	Command (0x13)
Dword	Result

Table 16 Set Override Response

2.3.5 Restore Override

This command restores an override to a single channel.

Command:

Type	Description
Byte	Command (0x14)
Word	Output Channel

Table 17 Restore Override Command

Response:

Type	Description
Byte	Command (0x14)
Dword	Result

Table 18 Restore Override Response

2.3.6 Set Zone Override

This command sets an override to an entire zone. See section 1.3, Override Control for more information.

A zone of 0 activates all channels that are not assigned to a zone.
A zone of 0xFFFF assigns all channels regardless of zone.

An input channel of 0 turns off the audio or video.
An input channel of 0xFFFF leaves the channel unchanged.

The Chime Tone can be 0 (no chime) or a chime index value of 1-6. The chime must be provided by a third party device connected to the AVDS.

Command:

Type	Description
Byte	Command (0x15)
Word	Zone
Word	Audio Input Channel
Word	Video Input Channel
SFDP.1	Volume (-80.0 to +20)
Byte	Chime Tone

Table 19 Set Zone Override Command

Response:

Type	Description
Byte	Command (0x15)
Dword	Result

Table 20 Set Zone Override Response

2.3.7 Restore Zone Override

This command releases the override for all channels within the given zone.
A zone of 0 restores all channels that are not assigned to a zone.
A zone of 0xFFFF restores all channels regardless of zone.

Channels that were not participating in an override are unaffected by this command.

Command:

Type	Description
Byte	Command (0x16)
Word	Zone

Table 21 Restore Zone Override Command

Response:

Type	Description
Byte	Command (0x16)
Dword	Result

Table 22 Restore Zone Override Response

2.3.8 Control Properties

Control properties include volume and mute. The control properties commands allow access to these properties by sending a property ID and a Dword containing the value.

The valid properties are listed in Table 23.

Property	Range	Description
Volume (0x04)	-80.0 to +20	Treat like a SFDP.1 value, but cast to Dword
Mute (0x05)	0, 1	1 is mute enabled. Cast to Dword
Treble (0x06)	-6.0 to +6.0	Treat like a SFDP.1 value, but cast to Dword
Bass (0x07)	-6.0 to +6.0	Treat like a SFDP.1 value, but cast to Dword
Compression(0x17)	0,1	1 is compression enabled, Cast to Dword

Table 23 Control Properties

2.3.8.1 Set Control Property

This command is used to set any of the property values listed in Table 23.

Command:

Type	Description
Byte	Command (0x19)
Word	Output Channel
Byte	Property (See Table 23)
Dword	Value

Table 24 Set Control Property Command

Response:

Type	Description
Byte	Command (0x19)
Dword	Result

Table 25 Set Control Property Response

2.3.8.2 Get Control Property

This command requests the current value of a control property.

Command:

Type	Description
Byte	Command (0x1A)
Word	Output Channel
Byte	Property (See Table 23)

Table 26 Get Control Property Command

Response:

Type	Description
Byte	Command (0x1A)
Dword	Result
Dword	Value

Table 27 Get Control Property Response

2.3.8.3 Set Zone Control Property

This command sets the value of a control property for an entire zone.

A zone of 0 activates all channels that are not assigned to a zone.
A zone of 0xFFFF assigns all channels regardless of zone.

Command:

Type	Description
Byte	Command (0x1B)
Word	Zone
Byte	Property (See Table 23)
Dword	Value

Table 28 Set Zone Control Property Command

Response:

Type	Description
Byte	Command (0x1B)
Dword	Result

Table 29 Set Zone Control Property Response

2.3.9 Channel Properties

Channel properties allow settings set in the configuration file to be temporarily overridden. The valid properties are listed in Table 30.

Property	Range	Description
Priority (0x01)	Low (0), Normal (1), High (2), Highest (3)	Allows the channel priority to be modified during runtime. This may be useful if the VIP changes seats, etc.

Table 30 Valid Channel Properties

These properties will remain valid until overwritten or until a system reset occurs.

2.3.9.1 Set Channel Property

This command sets a channel property.

Command:

Type	Description
Byte	Command (0x17)
Byte	Output Channel Flag (1 if output channel)
Word	Channel
Byte	Property (See Table 30)
Dword	Value

Table 31 Set Channel Property Command

Response:

Type	Description
Byte	Command (0x17)
Dword	Result

Table 32 Set Channel Property Response

2.3.9.2 Get Channel Property

This command requests a channel property.

Command:

Type	Description
Byte	Command (0x18)
Byte	Output Channel Flag (1 if output channel)
Word	Channel
Byte	Property (See Table 30)

Table 33 Get Channel Property Command

Response:

Type	Description
Byte	Command (0x18)
Dword	Result
Dword	Value

Table 34 Get Channel Property Response

2.3.10 Get Channel Information

This command retrieves the status of the requested output channel.

Command:

Type	Description
Byte	Command (0x20)
Word	Output Channel Number

Table 35 Get Channel Information Command

Response:

Type	Description
Byte	Command (0x20)
Dword	Result
Word	Output Channel
Word	Audio Input Channel
Word	Video Input Channel
SFDP.1	Volume
SFDP.1	Treble
SFDP.1	Bass
Byte	Mute Active
Byte	Audio Compression Active
Word	Override Audio Channel
Word	Override Video Channel
SFDP.1	Override Volume

Table 36 Get Channel Information Response

2.3.11 Set Channel Information

This command allows the control system to set all properties associated with an output channel.

Any channel value of 0 indicates off. This includes override, which can be set by placing a non 0 value in the override channel property.

Command:

Type	Description
Byte	Command (0x21)
Word	Output Channel
Word	Audio Input Channel
Word	Video Input Channel
SFDP.1	Volume (-80.0 to +20)
SFDP.1	Treble
SFDP.1	Bass
Byte	Mute Active
Byte	Audio Compression Active
Word	Override Audio Channel
Word	Override Video Channel
SFDP.1	Override Volume (-80.0 to +20)

Table 37 Set Channel Information Command

Response:

Type	Description
Byte	Command (0x21)
Dword	Result

Table 38 Set Channel Information Response

2.3.12 Get System Status

This command is used to retrieve the status of the AVDS. The command returns status values for the entire system and status for individual nodes.

Command:

Type	Description
Byte	Command (0x24)

Table 39 Get System Status Command

Response:

Type	Description
Byte	Command (0x24)
Dword	Result
String	Application File
Dword	Application Version
Word	Application CRC
String	Configuration File
Dword	Configuration Version
Word	Configuration CRC
Byte	Loop Completed
Byte	Number of connected clients
Dword	Client IP Address 0
Dword	Client IP Address 1
Dword	Client IP Address *n*
Word	Number of nodes
Word	Node 0 Address
Byte	Node 0 Online
Word	Node 1 Address
Byte	Node 1 Online
Word	Node *n* Address
Byte	Node *n* Online

Table 40 Get System Status Response

2.3.13 Get Node Status

This command can be called to retrieve more detailed status information on a particular node.

Command:

Type	Description
Byte	Command (0x25)
Word	Node Address

Table 41 Get Node Status Command

Response:

Type	Description
Byte	Command (0x25)
Dword	Result
Word	Node Address
Byte	Online
Byte	RAM Test Result (0=Failed)
Byte	Flash Test Result (0=Failed)
Word	Temperature
Byte	Fiber Link Status A
Byte	Fiber Link Status B
Byte	External Ethernet Status 1
Byte	External Ethernet Status 2
DWORD	Hops to Manager

Table 42 Get Node Status Response

2.3.14 Get Temperature

This command retrieves the temperature status from all online nodes in the system. The response contains a command and the result. If the result indicates success, the number of nodes returned will come next then the address and temperature for each node.

Command:

Type	Description
Byte	Command (0x26)

Table 43 Get Temperature Command

Response:

Type	Description
Byte	Command (0x26)
Dword	Result
	Remaining bytes are included if status indicates success.
Dword	Number of Nodes
Word	Node 0 Address
Word	Node 0 Temperature
	…
	…
Word	Node *n* Address
Word	Node *n* Temperature

Table 44 Get Temperature Response

2.3.15 Get Short System Status

This command retrieves a bitmapped Dword value with flags that indicate the general health of the system.

Command:

Type	Description
Byte	Command (0x27)

Table 45 Get Short System Status Command

Response:

Type	Description
Byte	Command (0x27)
Dword	Result
	Remaining bytes are included if status indicates success.
Dword	System Status Bitmap

Table 46 Get Short System Status Response

The bitmap is defined as follows:

xxxx xxxx xxxx xxxx xxxx xxxx xxxx DUES

MSB LSB

Bit	Description
x	Unused
D	Download Active: This can refer to a download from outside the system or to internal loading of firmware.
U	Unacknowledged Error: There is an error in the flash error log that has not been read. This is cleared by retrieving the error log using the AVDS Client.
E	Error Status: Set when an error has been logged to flash during the current system power cycle. This is cleared by retrieving the error log using the AVDS Client or by reading all errors using the Get Next Error Msg (0x28) command.
S	System Ready: If this is 1, the system is ready. This is not set until all cards are initialized and the topology of the system has been verified.

Table 47 Short System Status Bit Definitions

2.3.16 Get Next Error Msg

This command retrieves a single error message from the error log. To read all messages, this message should be continually sent until no messages are returned. This command only returns the error messages that were logged during the current power sequence, so it can be used to get detailed information on the current state of the system.

Command:

Type	Description
Byte	Command (0x28)

Table 48 Get Next Error Msg Command

Response:

Type	Description
Byte	Command (0x28)
Dword	Result
Byte	Length
Byte 0..*n*	Ascii formatted string containing the error message, *Length* bytes long.

Table 49 Get Next Error Msg Response

3 AVDS Node Connectors

3.1 Power/Serial Communication Port (P1)

Connector P1 is used for input power and serial communications. The unit requires 28VDC and can draw up to 3 amps when fully loaded.

The serial port can be used for communication with a cabin control system. The port can be configured for RS232 or RS485 (pin 12 is strapped to DC Return for RS485, leave unconnected for RS232). Software updates typically occur over the Ethernet port, but the serial port can also be used to update software and even restore the boot-loader itself in the event that program storage has been entirely corrupted.

The AVDS node's power/serial connector is D-Subminiature 15 Male (Pins) with jack-posts

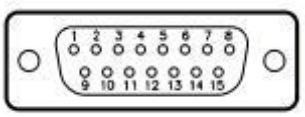

Figure 2 AVDS Node Power/Serial Port D-Sub 15

Mating connectors are to be secured with jack-screws.

Connector Pinout:

Pin	Function
1	+28VDC
2	+28VDC
3	DC Return
4	DC Return
5	Serial bootloader enable
6	RS232 RX
7	RS232 TX/RS485_B
8	Signal Ground
9	+28VDC
10	Chassis
11	DC Return
12	RS232/RS485_N
13	Watchdog disable used for debug/bootloader
14	Reset used for serial bootloader
15	RS485_A

Pins 5, 13, and14 are used for serial bootloading and debugging. These pins should be left unconnected when not in use.

3.1.1 RS-232 Physical Layer

The pins used are TD, RD and SGND. Signal levels comply with EIA RS-232 standard.

3.1.2 RS-485 Physical Layer

Connection is over one twisted shielded pair cable.

- cable characteristic impedance: 100Ω ±10Ω
- maximum cable length shall be less than 300 ft.

Electrical characteristic conforms to the ANSI RS-485 industry standard.

- typical output high: +5 VDC
- typical output low: 0 VDC
- maximum input range: -7 VDC to +12 VDC

Point to point from the AVDS to Control System.
Non Return to Zero (NRZ) signaling.
Half duplex operation.

The shield shall be tied to chassis ground at both ends of the bus. The 485 signal shall be externally terminated at both ends of the bus with a 100Ω resistor. AVDS RS-485 is electrically isolated from AVDS return.

3.2 Ethernet Ports (RJ1,RJ2)

The Ethernet ports can be used for connection to a cabin control system or any other equipment that needs access to the Ethernet backbone. The ports are capable of 10Mbps, 100Mbps, or 1 Gbps, full duplex.

Connector Type: **10/100/1000 Base-T RJ45**

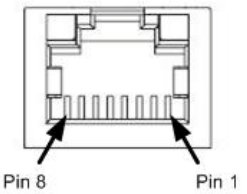

Figure 3 Ethernet Port RJ45 Receptacle

Connector Pinout:

Pin	10/100 Base-T Function	1000 Base-T Function
1	Transmit+	BI-DA+
2	Transmit-	BI-DA-
3	Receive+	BI-DB+
4	Unused	BI-DC+
5	Unused	BI-DC-
6	Receive-	BI-DB-
7	Unused	BI-DD+
8	Unused	BI-DD-

Note: Gigabit connections should use CAT5e or CAT6 cables.

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