Ayre DX-5 Universal A/V Engine

RS-232 Control Protocol – May 2010

Note: The Ayre DX-5 Universal A/V Engine comes with AyreLink connectors for system communications. The advantage of AyreLink is that it utilizes opto-isolators to ensure that no ground loops are formed, and that any RFI generated by the CPU in the system controller is completely isolated from the audio and video systems.

To use an RS-232C controller link for wired system control, an external Ayre RS-232C-to-AyreLink adapter unit is required. The RS-232C port is configured as a DCE device using a female 9-pin D-Sub type connector.

RS-232 Pin Configuration:

The pin out of the DX-5 RS-232C-to-AyreLink adapter unit port is as follows:

Pin	2	3	5
Signal	TXD	RXD	GND

This pin configuration allows a PC running a serial terminal program (such as HyperTerminal) to communicate with the player using a straight-through DB9 9-pin RS-232 serial cable. Do NOT use a “Null-Modem” type cable for PC connection. For connection to a system controller (eg, Crestron, AMX), please refer to the documentation that comes with the controller.

Communication Settings:

Baud Rate	Data Bits	Parity	Stop Bit	Flow Control
9600	8	None	1	None

Command Structure:

Each command starts with a # sign (ASCII 0x23), followed by a 3-character command code. If there are any parameters for the command, the parameters are given in text format, separated by a space (ASCII 0x20) from the command code. The # character (ASCII 0x23) must never appear in the parameters. A carriage return (ASCII 0x0D) indicates the end of the command. Each command must not exceed 25 bytes including the start of command and end of command bytes.

The illustration of the command structure is as the followings:

<Command> = <Start of Command><Command Code>[<sp><Parameters>]
<End of Command>

where:
<Start of Command> = # (ASCII 0x23)
<Command Code> = <byte><byte><byte> (three ASCII characters)
<sp> = space (ASCII 0x20)
<Parameters> = command-specific (ASCII characters)
<End of Command> = CR (ASCII 0x0D)

Response Structure:

Upon receiving a command, the player shall try to execute the command and send back a response. Two response formats are supported: the short response and the verbose response. The short response is used by default. If the verbose mode (See command reference for SVM) is set, the verbose response will be used instead.

The response starts with an “@” sign (ASCII 0x23), (followed by the original command code and a space (ASCII 0x20) if the verbose response is in use), and a result code, either “OK” or “ER”. If there are any parameters or additional messages, these are given in text format, separated by a space (ASCII 0x20) from the result code. The @ character (ASCII 0x40) must never appear in the parameters or message. A carriage return (ASCII 0x0D) indicates the end of response. Each response must not exceed 25 bytes, including the start of response and the end of response bytes.

The illustration of the response structure is as the followings:

<Short Response> = <Start of Response><Result Code>[<sp><Parameters>]
<End of Response>

<Verbose Response> = <Start of Response><Command Code><sp><Result Code>
[<sp><Parameters>]<End of Response>

where:
<Start of Response> = @ (ASCII 0x40)
<Command Code> = <byte><byte><byte> (three ASCII characters)
<Result Code> = OK / ER (OK / Error)
<sp> = space (ASCII 0x20)
<Parameters> = command-specific (ASCII characters)
<End of Response> = CR (ASCII 0x0D)

Status Update Messages Structure:

If the verbose mode is set to “2“ or “3“, the player will send status update messages automatically. These messages are not a response to any particular command. Any status change caused by commands from RS-232, front panel buttons, IR remote control, or playback progress may trigger status update messages.

The status update messages have the following structure:

<Update> = <Start of Update><Status Code>[<sp><Parameters>]<End of Update>

where:
<Start of Update> = @ (ASCII 0x40)
<Status Code> = <byte><byte><byte> (three ASCII characters)
<sp> = space (ASCII 0x20)
<Parameters> = status-specific (ASCII characters)
<End of Response> = CR (ASCII 0x0D)

Command Sequence:

Commands are executed in the order received. The host should wait for a response from the player before sending the next command. If the player receives a new command before executing the previous command, the player may discard the previous command. If the host does not receive a response from the player 10 seconds after the command is issued, the host may consider the command lost during transmission, and can retransmit the command.

Command List:

A. Command that maps to a remote control button

These commands map directly to the infrared remote control buttons and are handled in the same way. No parameters are needed for these commands. For actions that require a multiple-key sequence, such as go to a certain chapter (GoTo command, numeric key commands, Enter command), the player responds to each command individually. When the last command is received the player shall respond with either OK or ER depending on the result of the action.

Command Code	Remote Key	Function	Response Example
POW	Power	Toggle “Standby” and “On”	OK ON OK OFF
SRC	Source	Go to Home Menu	OK
EJT	Open	Open/close the disc tray	OK OPEN OK CLOSE
PON	On	Discrete on	OK ON
POF	Off	Discrete off	OK OFF
SYS	P/N	Switch output TV system	OK NTSC OK PAL OK AUTO
DIM	Dimmer	Dim front panel display	OK ON OK DIM OK OFF
PUR	Pure Audio	Pure audio mode (no video)	OK ON OK OFF
MUT	Mute	Mute audio	OK MUTE OK UNMUTE
NU1	1	Numeric key 1	OK
NU2	2	Numeric key 2	OK
NU3	3	Numeric key 3	OK
NU4	4	Numeric key 4	OK
NU5	5	Numeric key 5	OK
NU6	6	Numeric key 6	OK
NU7	7	Numeric key 7	OK
NU8	8	Numeric key 8	OK
NU9	9	Numeric key 9	OK
NU0	0	Numeric key 0	OK
CLR	Clear	Clear numeric input	OK

GOT	Go To	Play from a specified location	OK
HOM	Home	Go to Home Menu	OK
PUP	Page Up	Show previous page	OK
PDN	Page Down	Show next page	OK
OSD	Display	Show/hide on-screen display	OK
TTL	Top Menu	Show BD top or DVD title menu	OK
MNU	PopUp Menu	Show BD pop-up or DVD menu	OK
NUP	Up Arrow	Navigation	OK
NLT	Left Arrow	Navigation	OK
NRT	Right Arrow	Navigation	OK
NDN	Down Arrow	Navigation	OK
SEL	Enter	Navigation	OK
SET	Setup	Enter the player setup menu	OK
RET	Return	Return to previous menu/mode	OK
RED	Red	Function varies by content	OK
GRN	Green	Function varies by content	OK
BLU	Blue	Function varies by content	OK
YLW	Yellow	Function varies by content	OK
STP	Stop	Stop playback	OK
PLA	Play	Start playback	OK
PAU	Pause	Pause playback	OK
PRE	Prev	Skip to previous	OK
REV	Rev	Fast reverse play	OK 1X
FWD	Fwd	Fast forward play	OK 1X
NXT	Next	Skip to next	OK
AUD	Audio	Change audio soundtrack	OK
SUB	Subtitle	Change subtitle language	OK
ANG	Angle	Change camera angle	OK a/b (current angle/total angles)
ZOM	Zoom	Adjust zoom and aspect ratio	OK (zoom ratio)
SAP	SAP	Secondary Audio Program	OK (audio track information) OK OFF
ATB	AB Replay	Repeat the selected section	OK A- OK A-B OK OFF
RPT	Repeat	Repeat play	OK Repeat Chapter OK Repeat Title OK OFF
PIP	PIP	Show/hide Picture-in-Picture	OK (PIP program info) OK OFF
HDM	Resolution	Switch output resolution	OK
SUH	Subtitle (hold)	Activate subtitle shift feature	OK
NOP		No operation	OK

B. Query Commands

This group of commands issues queries to the player. The player shall respond according to its current status.

Command Code	Function	Response Example
QVM	Query verbose mode	OK 0 OK 1 OK 2 OK 3
QPW	Query power status	OK ON OK OFF
QVR	Query firmware version	OK AYDX5-50-0424
QVL	Query volume	OK 100 OK MUTE
QHD	Query HDMI resolution	OK 480P OK 720P50 OK 1080P60 OK AUTO
QPL	Query playback status	OK NO DISC OK LOADING OK OPEN OK CLOSE OK PLAY OK PAUSE OK STOP OK STEP OK FREV OK FFWD OK SFWD OK SREV OK SETUP OK HOME MENU OK MEDIA CENTER
QTK	Query track/title	OK 2/10
QCH	Query chapter	OK 3/3
QTE	Query track/title elapsed time	OK 0:1:34
QTR	Query track/title remaining time	OK 1:20:23
QCE	Query chapter elapsed time	OK 0:1:34
QCR	Query chapter remaining time	OK 0:12:22
QEL	Query total elapsed time	OK 0:5:12
QRE	Query total remaining time	OK 1:34:44
QAT	Query audio type	OK DD 1/1 OK DD 1/5 English OK DTS 2/5 English OK LPCM OK DTS-HD 1/4 English

QDT	Query disc type	OK BD-MV OK DVD-VIDEO OK DVD-AUDIO OK SACD OK CDDA OK HDCD OK DATA-DISC
QST	Query subtitle type	OK OFF OK 1/1 English
QSH	Query subtitle shift	OK -5 (valid returns are -5 .. 00 .. 05)
QOP	Query OSD position	OK 0 (valid returns are 0 .. 5)
QRP	Query repeat mode	OK 00 OFF OK 01 REPEAT ONE OK 02 REPEAT CHAPTER OK 03 REPEAT ALL OK 04 REPEAT TITLE OK 05 SHUFFLE OK 06 RANDOM
QZM	Query zoom mode	OK 00 OFF OK 01 STRETCH OK 02 FULL OK 03 UNDERSCAN OK 04 1.2 OK 05 1.3 OK 06 1.5 OK 07 2 OK 08 3 OK 09 4 OK 10 1/2 OK 11 1/3 OK 12 1/4

C. Advanced Commands

This group of commands instructs the player to perform an advanced operation in a single step.

Command Code	**Parameters**	**Function**	**Response Example**
SVM	0 1 2 3	0 – Set Verbose Mode to off 1 – Commands are echoed back in the response 2 – Enable unsolicited status update Only major status changes are reported 3 – Enable detailed status update When content is playing, the player sends out playback time update every second	OK 0 OK 1 OK 2 OK 3

SHD	SDI SDP 720P 1080I 1080P SRC AUTO	Set HDMI output resolution SDI – Standard definition interlaced (480i/576i) SDP – Standard definition progressive (480p/576p) SRC – Source Direct	OK 480P (OK followed by the original parameter)
SPN	NTSC PAL AUTO	Set output TV system	OK NTSC OK PAL OK AUTO
SZM	1 AR FS US 1.2 1.3 1.5 2 1/2	Set zoom ratio. AR – Aspect ratio (Stretch, Letterbox or Pillarbox) FS – Full Screen US – Underscan	OK 1 (OK followed by the zoom ratio) ER INVALID
SRP	CH TT ALL OFF SHF RND	Repeat chapter Repeat title or CD track Repeat all Repeat off Shuffle Random	OK CH (OK followed by the repeat mode) ER INVALID
SRH	T3 C10 C 0:00:34 T 0:12:13 0:12:13	Search to Title 3 Search to Chapter 10 Search to 0:00:34 of the current chapter or track Search to 0:12:13 of the current title or disc Search to 0:12:13 of the current title or disc	OK ER INVALID
DPL		Direct play	OK
RST		Reset RS-232 Command – Clean all command buffers, do not wait for any pending/executing commands. Start over again.	OK
SSH	-5 .. 5	Set subtitle shift	OK -5 (OK followed by the shift level) ER INVALID
SOP	0 .. 5	Set OSD position	OK 5 (OK followed by the position value) ER INVALID

Status Update Messages:

The following status update messages are sent by the player automatically when the verbose mode is set to 2 or 3.

Verbose Mode 2:

UPW - Power Status Update:
Sent when there is a change of power on/off status.
Possible parameters: 1 digit
1 – Player is turned on
0 – Player is going off
Example: @UPW 1

UPL - Playback Status Update:
Sent when there is a change of playback status.
Possible Parameters: 4 chars
DISC – No disc
LOAD – Loading disc
OPEN – Tray is open
CLOS – Tray is closing
PLAY – Playback is starting
PAUS – Playback is paused
STOP – Playback is stopped
STPF – Forward frame-by-frame step mode
STPR – Reverse frame-by-frame step mode
FFWn – Fast forward mode. Where n is a number of 1..5 to indicate the speed level
FRVn – Fast reverse mode. Where n is a number of 1..5 to indicate the speed level
SFWn – Slow forward mode. Where n is a number of 1..5 to indicate the speed level (1 = ½, 2 = ¼, 3 = 1/8, 4 = 1/16, 5 = 1/32)
SRVn – Slow reverse mode. Where n is a number of 1..5 to indicate the speed level (1 = ½, 2 = ¼, 3 = 1/8, 4 = 1/16, 5 = 1/32)
HOME – in home menu
MCTR – in media center
Example: @UPL PLAY

UVL - Volume Level Update:
Sent when there is a change in volume level or mute status.
Possible Parameters: 3 chars
MUT – Mute is engaged
100 – Current volume level. Sent when mute is canceled.
Example: @UVL 100

UDT - Disc Type Update:

Sent when a new disc type is detected.

Possible Parameters: 4 chars

BDMV - Blu-ray Disc
DVDV – DVD-Video
DVDA – DVD-Audio
SACD
CDDA
HDCD
DATA – Data disc
VCD2 – VCD 2.0
SVCD - SVCD

Example: @UDT DVDV

UAT - Audio Type Update:

Sent when a new audio track is encountered.

Parameters: Type (2 chars), space, number (01/99, 5 chars), space, language (3 chars), space, channels (2 chars)

Type code:

DD – Dolby Digital
DP – Dolby Digital Plus
DT – Dolby TrueHD
TS – DTS
TH – DTS-HD High Resolution
TM – DTS-HD Master Audio
PC – LPCM
MP – MPEG Audio
CD – CD Audio
UN – Unknown

Number: current audio track / available audio tracks in 2-digit number format. For example, 01/99 means the first of 99 available tracks; 02/05 means the second of 5 available tracks. If only one track is available, it is 01/01.

Language: Three-character language code: ENG for English, FRA for French, and so on (ISO3166). UNK for unknown.

Channels: 1.0 for mono, 2.0 for stereo, 5.1 or 7.1 for 5.1-channel or 7.1-ch surround, 0.0 for unknown.

Example: @UAT DD 01/05 ENG 5.1

UST - Subtitle Type Update:

Sent when a new subtitle is selected.

Parameters: number (01/99, 5 chars), space, language (3 chars)

Number: current subtitle track / available subtitle tracks in 2-digit number format. For example, 01/99 means the first of 99 available tracks; 02/05 means the second of 5 available tracks. If subtitle is set to off, use 00/xx where xx is the number of available subtitle tracks. If no subtitle is available, use 00/00.

Language: Three-character language code: ENG for English, FRA for French, and so on (ISO3166). UNK for unknown.

Example: @UST 02/05 ENG

Verbose Mode 3:

UTC - Time Code Update:

Sent every second when the playback time advances. The time information is the same as the front panel display. To switch to a different type of time information, please refer to the STC command.

Parameters: Title (3 digits), space, Chapter (3 digits), space, Type (1 chars), space, time (8 chars HH:MM:SS)

Title: Current title number. For example, 001. For discs without title numbers (CD), 001 is always used.

Chapter: Current chapter or track number. For example, 003.

Type Code:

- E – Total Elapsed time
- R – Total Remaining time
- T – Title Elapsed time
- X – Title Remaining time
- C – Chapter/track Elapsed time
- K – Chapter/track Remaining time

Example: @UTC 001 001 C 00:01:23

UVO - Video Resolution Update:

Sent when the source content resolution or the output resolution is changed.

Parameters: Source resolution (7 chars), space, Output resolution (7 chars)

Resolution Names:

- _480I60 – 480i 60/59.94Hz
- _480P60 – 480p 60/59.94Hz
- _576I50 – 576i 50Hz
- _576P50 – 576p 50Hz
- _720P60 – 720p 60/59.94Hz
- _720P50 – 720p 50Hz
- 1080I60 – 1080i 60/59.94Hz
- 1080I50 – 1080i 50Hz
- 1080P60 – 1080p 60/59.94Hz
- 1080P50 – 1080p 50Hz
- 1080P24 – 1080p 24Hz
- 1080P23 – 1080p 23.97Hz

Examples:

The following are examples of playing a Blu-ray movie using the RS-232 control protocol. The comments are placed after the semicolon.

Example 1 – No verbose mode in use. Backwards compatible to the original version of the RS232 control protocol.

```
#PON                    ; Turn on power
@OK ON                  ; Player is turned on
#QPW                    ; Check power status
@OK OFF                 ; Player is still doing power-on initialization
(Wait for a while)
#QPW                    ; Check power status
@OK ON                  ; Player is powered on and ready
#EJT                    ; Eject the tray
@OK OPEN                ; Tray opens
(Place a disc on the tray)
#PLA                    ; Start playback
@OK PLAY                ; You may get "ER OVERTIME" message due to the
                        ; mechanical delay. This is normal
#QDT                    ; Check disc type
@OK LOADING             ; Player is still loading
(Wait for a while)
#QDT                    ; Check disc type again
@OK BD-MV               : Disc is a Blu-ray disc.
#QPL                    ; Check playback status
@OK PLAY                : Playback is in progress
(Watch the movie)
#STP                    ; Stop playback
@OK STOP                : Playback has stopped
#EJT                    ; Eject the tray
@OK OPEN                ; Tray opens
(Take out the disc)
#POF                    ; Turn off power
@OK OFF                 ; The player turns off
```

Example 2 – Verbose mode 2. The player provides important status updates.

```
#SVM 2                  ; Set verbose mode to level 2
@SVM OK 2               ; Response to confirm the verbose mode. Notice the
                        ; SVM command code is now included in the response.
#PON                    ; Turn on power
@PON OK ON              ; Player is turned on
@UPW 1                  ; Player provides a status update to indicate the new power status
@SVM OK 2               ; This is a repeat of the SVM response because the main
                        ; processor comes on line.
@UPL DISC               ; Player indicates that there is no disc
#EJT                    ; Eject the tray
@EJT OK OPEN            ; Tray opens
@UPL OPEN               ; Player indicates that the tray is open
(Place a disc on the tray)
```

```
#PLA                    ; Start playback
@PLA OK PLAY            ; Player confirms playback action
@UPL CLOS               ; Player indicates that the tray is closing
@UPL LOAD               ; Player indicates that the disc is loading
@UDT BDMV               ; Player indicates that the disc type is Blu-ray
@UAT DT 01/01 ENG 5.1   ; Current audio is Dolby TrueHD English 5.1ch
@UST 00/00 UNK          ; Current subtitle is none
@UPL PLAY               ; Current status is playing
(Watch the movie)
#STP                    ; Stop playback
@STP OK STOP            ; Player confirms stop action
@UPL STOP               ; Player indicates that playback has stopped
@UPL STOP               ; It is normal to see repeated status update
#EJT                    ; Eject the tray
@UPL STOP               ; It is normal to see repeated status update
@EJT OK OPEN            ; Tray opens
@UPL OPEN               ; Status update to show that the tray is open
(Take out the disc)
#POF                    ; Turn off power
@POF OK OFF             ; Player confirms the action
@UPL CLOS               ; The tray is closing
@UPL LOAD               ; Player is trying to read the disc
@UPW 0                  ; Player reports that the power is turned off
```

Example 3 – Verbose mode 3. The player provides more detailed status updates.

```
#SVM 3                  ; Set verbose mode to level 3
@SVM OK 3               ; Response to confirm the verbose mode. Notice the
                        ; SVM command code is now included in the response.
#PON                    ; Turn on power
@PON OK ON              ; Player is turned on
@UPW 1                  ; Player provides a status update to indicate the new power status
@SVM OK 3               ; This is a repeat of the SVM response because the main
                        ; processor comes on line.
@UPL DISC               ; Player indicates that there is no disc
#EJT                    ; Eject the tray
@EJT OK OPEN            ; Tray opens
@UPL OPEN               ; Player indicates that the tray is open
(Place a disc on the tray)
#PLA                    ; Start playback
@PLA OK PLAY            ; Player confirms playback action
@UPL CLOS               ; Player indicates that the tray is closing
@UPL LOAD               ; Player indicates that the disc is loading
@UDT BDMV               ; Player indicates that the disc type is Blu-ray
@UTC 000 000 T 00:00:00 ; Player indicates that the current counter is all 0 and
                        ; play back is about to begin
@UVO 1080P23 1080P60    ; Player indicates that the source program resolution is
                        ; 1080p 23.976Hz, and the output resolution is 1080p60
```

```
@UAT DT 01/01 ENG 0.0     ; Current audio is Dolby TrueHD English with unknown
                          ; number of channels
@UST 00/00 UNK            ; Current subtitle is none
@UTC 126 002 T 00:01:27   ; Playback resumes at Title 126, Chapter 2, title elapsed
                          ; time 00:01:27
@UPL PLAY                 ; Current status is playing
@UAT DT 01/01 ENG 5.1     ; Current audio is Dolby TrueHD English 5.1ch
@UTC 126 002 T 00:01:28   ; Player provides continuous counter updates
@UTC 126 002 T 00:01:29
@UTC 126 002 T 00:01:30
@UTC 126 002 T 00:01:31
@UTC 126 002 T 00:01:32
@UTC 126 002 T 00:01:33
@UTC 126 002 T 00:01:34
@UTC 126 002 T 00:01:35
@UTC 126 002 T 00:01:36
@UTC 126 002 T 00:01:37
@UTC 126 002 T 00:01:38
@UTC 126 002 T 00:01:39
#PAU ; Pause
@PAU OK PAUSE             ; Confirm pause operation
@UPL PAUS                 ; Current status is paused
#PLA                      ; Play again
@PLA OK PLAY              ; Confirm play operation
@UPL PLAY                 ; Current status is playing
@UTC 126 002 T 00:01:40   ; Counter updates continue
@UTC 126 002 T 00:01:41
@UTC 126 002 T 00:01:42
(Watch the movie)
#STP ; Stop playback
@STP OK STOP              ; Player confirms stop action
@UPL STOP                 ; Player indicates that playback has stopped
@UPL STOP                 ; It is normal to see repeated status update
#EJT ; Eject the tray
@UPL STOP                 ; It is normal to see repeated status update
@EJT OK OPEN              ; Tray opens
@UPL OPEN                 ; Status update to show that the tray is open
@UVO 1080P60 1080P60      ; Resolution change – the background screen is 1080p60
                          ; and the output is also 1080p60
(Take out the disc)
#POF                      ; Turn off power
@POF OK OFF               ; Player confirms the action
@UPL CLOS                 ; The tray is closing
@UPL LOAD                 ; Player is trying to read the disc
@UPW 0                    ; Player reports that the power is turned off
```

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