



## ***VauxProtocol Version 6.0***

RS-232 System Control

August 2002

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## ***VauxProtocol Commands & Messages (RS-232 Control)***

Connection of a control system or computer to the Vaux switcher's Control (RS-232) serial port allows you to fully control the system using a selection of "Commands," and to obtain immediate or polled feedback on system status by listening to "Messages." This Command/Message language is called VauxProtocol.

Using VauxProtocol, and/or infrared remote control commands, you may control Vaux systems to distribute audio/video signals throughout a house or building. Vaux switchers are available in sizes up to 16-by-16, and switchers may be combined, for up to 255 audio and/or video zones, driven by up to 16 a/v sources -- and controlled via a single serial port. Using an RC-16 remote control gives access to 90 zones and 16 sources.

### ***Zones, Groups, and Clusters.***

Each room that needs a/v, will be driven from a Zone on the Vaux switcher. Each zone can independently select from multiple sources, each zone can have the same, or different, source for audio and video, and each zone has full volume/bass/treble/mute capability.

Single-command control of multiple zones at a time is provided with zone Groups. The group commands allow selection of up to eight consecutive zones, starting at any zone. There is no limit to the number of groups, since the definition is embedded in the command.

Groups can be used with adjoining areas that would normally have the same source selection, such as the Master-Bedroom/Master-Bath, or Foyer/Great-Room/Dining-Room/Lavatory. Separate zones drive each room, with zone commands providing individual room volume control. Group commands allow master control of source-selection, and simultaneous volume adjustment of all zones in the group.

Groups can also be used within a room, such as when a powered subwoofer augments the main audio system. Both the subwoofer and the main audio amps are driven from separate zones, and hence have individual volume control with zone commands. Group commands provide master source-selection, volume-absolute/relative/ramping control, and muting.

A Vaux remote control can access eight Clusters, which are pre-programmed zone group definitions. Clusters have the same constraints as zone groups (ie: up to eight consecutive zones, starting at any zone). Clusters are part of the switcher configuration -- the factory setting provides a few ready-to-use clusters, or they may be changed using programming commands. To access clusters 1 to 8 from an RC-16, the remote control is set to Zone-91 through 98, respectively. Only source-selection, volume, and muting commands may be used when the remote is set to a cluster, and cluster volume from the remote control does not allow press-and-hold operation as it does for zones (clusters are 2-dB up/down per press). Note that RS-232 VauxProtocol commands do provide group ramping operation. Clusters can be accessed via VauxProtocol commands, but this is intended primarily for testing, since the group commands are more flexible and do not require system programming, as do clusters.

## **Send Commands, and Receive Messages**

You will likely only need to implement a handful of Commands/Messages in a typical application. In fact, the simplest application merely sends basic routing and volume Commands, and ignores any received Messages. The next level of complexity involves interpreting the Messages that are returned in response to control operations – these Messages are returned for both RS-232 Commands and button-press actions on handheld remote-controls. You may watch for an expected message immediately after sending a Command (single-threaded program), or you may have a separate section of code that parses the messages independently of the command processing code, and then updates internal variables and displays (multi-threaded program). This allows you to close-the-loop on the whole system (232 and IR control). You may send commands from the control section of your 232 code, and/or use IR control from remotes or keypads -- your message-handler will update variables/displays in the background. If you wish to ensure that your 232 command resulted in an action, you may monitor internal variables after sending your command (instead of waiting for a specific message), and implement timeout/retry/alert handling as desired for your application.

VauxProtocol Commands begin with an asterisk (\*) character, followed by two letters (uppercase or lowercase) defining the type of command, one or more comma-delimited decimal-number parameters, and finally a carriage-return and/or line-feed character (CR/LF). The CR/LF characters are the only non-printable ascii characters used in VauxProtocol, and are identified in Vaux documentation as <cr>.

The first number parameter is a "command-id" number, defining the specific action for this type of command, and which parameters follow to complete the command. If a Command (optionally) includes an extra parameter, the last parameter is presumed to be a checksum. An example command:

```
*CW,40,3,5,4 <cr>
```

Similarly, VauxProtocol Messages begin with an exclamation (!) character, followed by one letter defining the type of message, one or more comma-delimited decimal number parameters, and a terminating CR/LF. Optionally, you can force leading zeroes in Messages, for fixed three-digit parameters (eg: 003,012). Many Commands return the same status Message – simplifying parsing code. An example message:

```
!S,40,3,5,4 <cr>
```

<b>The serial port requires 38400 baud, 8 data bits, no parity, 1 stop bit, with Xon/Xoff flow control enabled.</b>
---

## **Command Flexibility**

Letters in the Command header may be upper or lowercase, and spaces can appear in the commands, as desired.

The decimal number parameters in Commands are ascii-encoded-decimal number strings that normally range from 0 to 255. There may be any number of digits in a parameter (eg: 5, 21, 114), and a parameter may optionally include any number of leading zeroes (ie: 002, 02, and 2 are all equivalent).

Parameters normally should not exceed 255, although larger numbers are allowed. Numbers greater than 255 are truncated to 1-byte internally (this is actually handy for the optional checksum parameter, discussed later).

A null parameter (nothing between the commas) will evaluate to 0. An 'X' character may be placed in a parameter position, and will evaluate to 255, which, in some commands, is used to IGNORE the parameter.

A comma ',' is used to delimit parameter fields. An underscore character '\_' may optionally be substituted for the comma delimiter.

Commands are terminated with a carriage-return (CR) and/or line-feed (LF) character (CR = 0x0d = 13; LF = 0x0a = 10), to work with string terminations found in various programming environments:

- linux/unix systems use LF (\n aka newline)
- macintosh systems use CR (\r aka return)
- windows/dos systems use CR/LF (\r\n)

Vaux documentation uses the symbol <cr> to indicate termination of Commands (CR and/or LF accepted), and termination of Messages (CR and LF are sent).

A Command will be discarded if 1) it is truncated with a premature CR, LF, or \*, 2) if the delimit character is anything other than comma or underscore, or 3) if non-digit chars are embedded in the numerical parameters (except 'X' may be used in place of a parameter, evaluating to 255 -- this is used to ignore the parameter, for commands that allow it).

Four VauxProtocol Command formats are defined:

Control-Write:	*CW,id,num1(,num2)...<cr>	or	*CW_id_num1(_num2)...<cr>
Control-Read (poll):	*CR,id,num1(,num2)...<cr>	or	*CR_id_num1(_num2)...<cr>
Program-Write:	*PW,id,num1(,num2)...<cr>	or	*PW_id_num1(_num2)...<cr>
Program-Read:	*PR,id,num1(,num2)...<cr>	or	*PR_id_num1(_num2)...<cr>

**User applications use the Control-Write (\*CW) Commands, and parse the resulting Status-Messages. User applications may also use the Control-Read (\*CR) Commands, if it is desired to handle Message parsing on a periodically-pollled basis. The Program-Write (\*PW) and Program-Read (\*PR) Commands are for programming the system configuration, and are not to be employed in a user application, except as part of a setup function. Do not use \*PW commands in power-up boot code, since power-fluctuations at boot time (eg: power restoring after an outage), could result in corrupted parameters.**

## **Optional Command Checksums**

If a Command includes an extra parameter, the last parameter is presumed to be a checksum of all preceding parameters. The checksum can be truncated to 1-byte before being sent (overflow discarded) or it can simply be the total sum (which, if over 255, gets truncated to 1-byte internally).

Example command to set Zone-7 volume to 0-dB:

<b>*CW,23,7,32,0</b>	this is normal command with no checksum
<b>*CW,23,7,32,0,62</b>	this is command with checksum (23+7+32+0=62)

Example command to set Zone-241 volume to 0-dB:

<b>*CW,23,241,32,0</b>	this is normal command with no checksum
<b>*CW,23,241,32,0,296</b>	this is command with total checksum (23+241+32+0=296)
<b>*CW,23,241,32,0,40</b>	this is command with truncated (1-byte) checksum (296-256=40)

## Routing Commands & Messages:

- For zone 0 (all zones), no messages are returned (multiple zones/switchers would be responding together).
- A muted zone will be unmuted if route commands are received (except route-muted cmds).
- Group commands apply to a group of up to eight consecutive zones, as defined in the command.

<i>Control-Write Cmd</i>	<i>Description</i>	<i>Command</i>	<i>Status-Message</i>
Route-Audio/Video	(note 3, 4, 5)	*CW,10,zon,ssa,ssv <cr>	IS,3,zon,sta,stv,ssa,ssv,vvl,vvr,bas,trb <cr>
Route-Audio	(note 1, 5)	*CW,11,zon,ssa <cr>	IS,1,zon,sta,ssa,vvl,vvr,bas,trb <cr>
Route-Video	(note 2)	*CW,12,zon,ssv <cr>	IS,2,zon,stv,ssv <cr>
Route-AV	(note 3, 5)	*CW,13,zon,src <cr>	IS,3,zon,sta,stv,ssa,ssv,vvl,vvr,bas,trb <cr>
Route-Muted	(note 3, 4, 6)	*CW,14,zon,ssa,ssv <cr>	IS,1/2/3 (as appropriate)
Route-at-Volume	(note 3, 4, 7)	*CW,15,zon,ssa,ssv,vra <cr>	IS,1/2/3 (as appropriate)
Route-at-Volume-Muted	(note 3, 4, 8)	*CW,16,zon,ssa,ssv,vra <cr>	IS,1/2/3 (as appropriate)
Group-Route-Audio/Video	(note 3, 4, 9)	*CW,60,gbz,gzd,ssa,ssv <cr>	IS,1/2/3 (for each zone in group)
Group-Route-Muted	(note 3, 4, 6, 9)	*CW,61,gbz,gzd,ssa,ssv <cr>	IS,1/2/3 (for each zone in group)

zon is zone	0 to 255 (when permitted, 0=all-zones, with no messages returned)
ssa is audio source	0 to 8 (0=off) (or 0 to 16, for 16-source switchers) (see note 4)
ssv is video source	0 to 8 (0=off) (or 0 to 16, for 16-source switchers) (see note 4)
src is audio and video source	0 to 8 (0=off) (or 0 to 16, for 16-source switchers)
vra is route-at volume (left and right)	1 to 35 (2-dB/increment) (see note 10)
vvl is left volume level	0 to 35 (2-dB/increment) (see note 10)
vvr is right volume level	0 to 35 (2-dB/increment) (see note 10)
bas is bass level	0 to 8 (3-dB/increment) (see note 11)
trb is treble level	0 to 8 (3-dB/increment) (see note 11)
sta is audio-state code	0=off, 1=on, 2=on/muted-audio
stv is video-state code	0=off, 1=on
gbz is group-base-zone	1 to 249; on 8-zone increments (eg: 1, 9, 17...) (see note 9)
gzd is group-zone-definition	0 to 255 (each bit specifies 1 of 8 zones, starting at gbz) (see note 9)

## **Routing Notes:**

### **Note 1 -- Audio-only route commands (may use Zone-0) (\*CW,11):**

- to audio-only switcher: route audio, update audio state, send audio mssg
- to video-only switcher: ignore
- to a/v switcher: route audio, update audio state, send audio mssg

### **Note 2 -- Video-only route commands (may use Zone-0) (\*CW,12):**

- to audio-only switcher: ignore
- to video-only switcher: route video, update video state, send video mssg
- to a/v switcher: route video, update video state, send video mssg

### **Note 3 -- Audio/Video route commands (may use Zone-0, as appropriate) (\*CW,10/13/14/15/16/60/61):**

(the audio unit tracks and reports video state, and video unit is silent – eg: LE-1600A and LE-1600V together)

- to audio-only switcher: route audio, update audio AND VIDEO state, send a/v mssg
- to video-only switcher: route video, update video state -- NO MSSG
- to a/v switcher: route a/v, update a/v state, send a/v mssg

### **Note 4 -- Audio and/or Video route commands (may use Zone-0, as appropriate) (\*CW,10/14/15/16/60/61):**

- Source parameters ssa and ssv may both be defined, or either may be IGNORE (to only set one source)  
For IGNORE, set the parameter to 255, or, optionally, insert the 'X' character.

### **Note 5 -- Routing audio using standard route commands (\*CW,10/11/13/60):**

- 1) Routing a source when zone is currently off:
  - Routes and sets zone volume to:
    - a) Normal (factory setting) route volume uses programmed "Zone-Initial-Volume."
    - b) Optionally, may configure route volume to be "Previous" volume.  
(this was level when zone was last turned off)  
(the implementation actually updates Zone-Initial-Volume at every zone turn-off).
- 2) Routing a source when zone is currently on (skipped if source is the same):
  - Routes at current zone volume.
- 3) Routing a source when zone is currently muted:
  - Routes and unmutes to previous volume (level when zone was muted).

### **Note 6 -- Routing audio using Route-Muted commands (\*CW,14/61):**

- 1) Routing a source when zone is currently off:
  - Routes and places zone in muted state, and sets unmute volume to:
    - a) Normal (factory setting) unmute level uses programmed "Zone-Initial-Volume."
    - b) Optionally, may configure unmute level to be "Previous" volume.  
(this was level when zone was last turned off)  
(the implementation actually updates Zone-Initial-Volume at every zone turn-off,  
then this route-muted command loads unmute levels from initial).
- 2) Routing a source when zone is currently on (skipped if source is the same):
  - Routes at current zone volume.  
NOTE: DOES NOT MUTE IF ZONE IS ON
- 3) Routing a source when zone is currently muted:
  - Routes and leaves zone in muted state.
  - Unmute level will be previous volume (level when zone was muted).

### **Note 7 -- Routing audio using Route-At-Volume commands (\*CW,15):**

- 1) Routing a source when zone is currently off:
  - Routes and sets zone volume to specified volume level.
- 2) Routing a source when zone is currently on:
  - Routes at specified volume level (if source is the same, just updates volume).
- 3) Routing a source when zone is currently muted:
  - Routes and unmutes to specified volume level.

**Note 8 -- Routing audio using Route-At-Volume-Muted commands (\*CW,16):**

- 1) Routing a source when zone is currently off:
  - Routes and places zone in muted state, and unmute level will be specified volume level.
- 2) Routing a source when zone is currently on (NOTE: DOES NOT MUTE IF ZONE IS ON):
  - Routes at specified volume level (if source is the same, just updates volume).
- 3) Routing a source when zone is currently muted:
  - Routes and leaves zone in muted state, and unmute level will be specified volume level.

**Note 9 -- Routing using Group commands (\*CW,60/61):**

Routes are reported for each zone defined in the group. Group commands apply to a group of eight consecutive zones, as defined in the command by gbz and gzd. Parameter gbz is group-base-zone, and gzd is group-zone-definition, which define a group of up to eight zones. If the group is defined such that the zones are on different switchers, the returned messages will collide and be garbled – therefore, gbz should be restricted to 8-zone increments (1, 9, 17...).

Each bit in gzd corresponds to one of eight zones, with bit-0 (LSB) being the lowest zone, and the bit-7 (MSB) being the highest zone. If the bit is 1, the zone is included in the group, and if the bit is 0, it is excluded.

The first zone (selected by bit-0) is defined as group-base-zone gbz. The next seven bits in gzd correspond to the next seven zones above gbz. For example, if gbz = 9 and gzd = 155, the group includes zones 9, 10, 12, 13, and 16. First, choose gbz, then to select the appropriate gzd, you need to set the gzd bits corresponding to the desired zones.

Zone	gzd-bit	bit-value	1=included	add bit-values
9 = gbz	bit-0	1	1 (lsb)	1
10	bit-1	2	1	2
11	bit-2	4	0	0
12	bit-3	8	1	8
13	bit-4	16	1	16
14	bit-5	32	0	0
15	bit-6	64	0	0
16	bit-7	128	1 (msb)	128
				<hr/>
				= 10011011 = 155 = gzd

Therefore, when we choose gbz = 9, and set the appropriate bits in gzd to include zones 9, 10, 12, 13, and 16 in the group, we need gzd = 155. You can get this gzd either by converting the binary value 10011011 to decimal, or by adding the bit-values that correspond to the included zones (128+16+8+2+1 = 155).

For testing clusters, use the group commands but set gbz to cluster 1 to 8, and gzd to 0.

**Note 10 – Volume Levels (vvl, vvr, vra) are 2-dB/increment (except for 0 = -80dB):**

35	+6 dB	26	-12 dB	17	-30 dB	8	-48 dB
34	+4 dB	25	-14 dB	16	-32 dB	7	-50 dB
33	+2 dB	24	-16 dB	15	-34 dB	6	-52 dB
32	0 dB (pass)	23	-18 dB	14	-36 dB	5	-54 dB
31	-2 dB	22	-20 dB	13	-38 dB	4	-56 dB
30	-4 dB	21	-22 dB	12	-40 dB	3	-58 dB
29	-6 dB	20	-24 dB	11	-42 dB	2	-60 dB
28	-8 dB	19	-26 dB	10	-44 dB	1	-62 dB
27	-10 dB	18	-28 dB	9	-46 dB	0	-80 dB

**Note 11 – Bass/Treble Levels (bas, trb) are 3-dB/increment:**

8	+12 dB
7	+9 dB
6	+6 dB
5	+3 dB
4	0 dB (flat)
3	-3 dB
2	-6 dB
1	-9 dB
0	-12 dB

## Volume/Bass/Treble/Mute Commands & Messages:

- Volume/bass/treble/mute commands will only affect zones that are not off (ie: zones that are on or muted).
- A muted zone will be unmuted if volume adjustment commands are received.
- Group commands apply to a group of up to eight consecutive zones, as defined in the command.

<i>Control-Write Cmd</i>	<i>Description</i>	<i>Command</i>	<i>Status-Message</i>
Absolute-L/R-Volume	(note 1, 2, 4, 7)	*CW,20,zon,vvl,vvr,tpr <cr>	!S,20,zon,sta,vvl,vvr <cr>
Absolute-Volume	(note 2)	*CW,23,zon,vol,tpr <cr>	!S,20,zon,sta,vvl,vvr <cr>
Volume-Up (2-dB)		*CW,24,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Volume-Down (2-dB)		*CW,25,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Left-Volume-Up	(note 4)	*CW,26,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Left-Volume-Down	(note 4)	*CW,27,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Right-Volume-Up	(note 4)	*CW,28,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Right-Volume-Down	(note 4)	*CW,29,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Balance-to-Left	(note 5)	*CW,30,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Balance-to-Right	(note 5)	*CW,31,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Ramp-Volume-Up		*CW,35,zon <cr>	(none)
Ramp-Volume-Down		*CW,36,zon <cr>	(none)
Ramp-Volume-Stop	(note 3)	*CW,37,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
NOTE: volume ramps at 2-dB/100-msec until stopped, or Min/Max-Vol reached!			
Absolute-Bass/Treble	(note 1)	*CW,40,zon,bas,trb <cr>	!S,40,zon,bas,trb <cr>
Flat-Bass/Treble (0-dB)		*CW,41,zon <cr>	!S,40,zon,bas,trb <cr>
Bass-Up (3-dB/step)		*CW,42,zon <cr>	!S,40,zon,bas,trb <cr>
Bass-Down (3-dB/step)		*CW,43,zon <cr>	!S,40,zon,bas,trb <cr>
Treble-Up (3-dB/step)		*CW,44,zon <cr>	!S,40,zon,bas,trb <cr>
Treble-Down (3-dB/step)		*CW,45,zon <cr>	!S,40,zon,bas,trb <cr>
Audio-Mute-Toggle		*CW,50,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Audio-Mute-On		*CW,51,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Audio-Mute-Off		*CW,52,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Group-Volume-Up (2-dB)	(note 6)	*CW,62,gbz,gzd <cr>	!S,20,zon,sta,vvl,vvr <cr> (for each zon in group)
Group-Volume-Down (2-dB)	(note 6)	*CW,63,gbz,gzd <cr>	!S,20,zon,sta,vvl,vvr <cr> (for each zon in group)
Group-Ramp-Volume-Up	(note 6)	*CW,64,gbz,gzd <cr>	(none)
Group-Ramp-Volume-Down	(note 6)	*CW,65,gbz,gzd <cr>	(none)
Group-Ramp-Volume-Stop	(note 3, 6)	*CW,66,gbz,gzd <cr>	!S,20,zon,sta,vvl,vvr <cr>> (for each zon in group)
Group-Mute-Toggle	(note 6)	*CW,67,gbz,gzd <cr>	!S,20,zon,sta,vvl,vvr <cr> (for each zon in group)
Group-Mute-On	(note 6)	*CW,68,gbz,gzd <cr>	!S,20,zon,sta,vvl,vvr <cr> (for each zon in group)
Group-Mute-Off	(note 6)	*CW,69,gbz,gzd <cr>	!S,20,zon,sta,vvl,vvr <cr> (for each zon in group)

zon is zone	1 to 255 (zone-0 not permitted)
vvl is left volume level	0 to 35 (2-dB/increment) (see note 1, 7)
vvr is right volume level	0 to 35 (2-dB/increment) (see note 1, 7)
vol is volume (left and right)	0 to 35 (2-dB/increment) (see note 7)
bas is bass level	0 to 8 (3-dB/increment) (see note 8)
trb is treble level	0 to 8 (3-dB/increment) (see note 8)
tpr is taper-enable	0=no-taper, 1=taper-volume
sta is audio-state code	0=off, 1=on, 2=on/muted-audio
gbz is group-base-zone	1 to 249; on 8-zone increments (eg: 1, 9, 17... ) (see note 6)
gzd is group-zone-definition	0 to 255 (each bit specifies 1 of 8 zones, starting at gbz) (see note 6)

### **Volume/Bass/Treble/Mute Notes:**

#### **Note 1 – Absolute Left and/or Right Volume (\*CW,20), and Absolute Bass and/or Treble (\*CW,40) commands:**

Volume level parameters vvl and vvr may both be defined, or either may be IGNORE (to only set the one channel)  
For IGNORE, set the parameter to 255, or, optionally, insert the ‘X’ character. Either bas or trb may be set to IGNORE.

#### **Note 2 – Tapering with Absolute Volume commands (\*CW,20/23):**

If parameter tpr is set to 0, the absolute volume is set immediately. If tpr is set to 1, the level tapers-up or down using the zone’s tud/tdd taper configuration.

#### **Note 3 –Volume-Ramping commands (\*CW,35/36/37/64/65/66):**

Volume levels are reported only when ramping is stopped (not at each increment).

#### **Note 4 – Mono zone with Left and/or Right Volume commands (\*CW,20/26/27/28/29):**

If a zone is programmed for mono operation, the same source must be routed to both the L&R channels, but these volume commands allow you to provide independent volume control for two mono areas. You may also apply relative-up/down control to both L&R as a “master” control of this 2-channel area, while retaining independent “sub-zone” control over each channel with the individual (L or R) volume commands. This is handy in patios etc.

#### **Note 5 – Zone Balance commands (\*CW,30/31):**

The Balance-to-Left command increases the left channel by 2-dB, and decreases the right channel by 2-dB. The Balance-to-Right command is the opposite. For finer control you can adjust only one channel with the \*CW,24/25 commands. The left and right volumes may remain at different levels -- the volume up/down and ramping commands operate on both channels, relative to the volume of each. Balance is maintained when muting/unmuting, and running volume to the rails and back. After balancing a zone, adjust the volume to the desired level for zone turn-on, and save the current levels as the Initial-Volume-Levels (balance will be maintained, since left and right initial levels are saved).



## Polling Commands & Messages:

As defined above, Status-Message are sent automatically in response to Control-Write Commands, but system status may also be determined at any time by polling, using these optional Control-Read Commands. Applications that parse and process Status-Messages in real-time will not need these Commands, but applications can ignore Messages until periodic polling intervals, and then issue Polling Commands to update variables and displays.

<i>Control-Read Cmd Description</i>	<i>Command</i>	<i>Status-Message</i>
Read-Zone-Audio-Status	*CR,1,zon <cr>	!S,1,zon,sta,ssa,vvl,vvr,bas,trb <cr>
Read-Zone-Video-Status	*CR,2,zon <cr>	!S,2,zon,stv,ssv <cr>
Read-Zone-Audio/Video-Status	*CR,3,zon <cr>	!S,3,zon,sta,stv,ssa,ssv,vvl,vvr,bas,trb <cr>
Read-Zone-Audio/Video-Sources	*CR,10,zon <cr>	!S,10,zon,ssa,ssv <cr>
Read-Zone-Audio-Source	*CR,11,zon <cr>	!S,11,zon,ssa <cr>
Read-Zone-Video-Source	*CR,12,zon <cr>	!S,12,zon,ssv <cr>
Read-Zone-Volumes	*CR,20,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Read-Zone-Bass/Treble	*CR,40,zon <cr>	!S,40,zon,bas,trb <cr>
Read-Group-All-Current (note 1)	*CR,80,gbz <cr>	!S,81... through !S,88...
Read-Group-Audio-States (note 1)	*CR,81,gbz <cr>	!S,81,bzn,sta1,sta2...sta8 <cr>
Read-Group-Video-States (note 1)	*CR,82,gbz <cr>	!S,82,bzn,stv1,stv2...stv8 <cr>
Read-Group-Audio-Sources (note 1)	*CR,83,gbz <cr>	!S,83,bzn,ssa1,ssa2...ssa8 <cr>
Read-Group-Video-Sources (note 1)	*CR,84,gbz <cr>	!S,84,bzn,ssv1,ssv2...ssv8 <cr>
Read-Group-Left-Volumes (note 1)	*CR,85,gbz <cr>	!S,85,bzn,vvl1,vvl2...vvl8 <cr>
Read-Group-Right-Volumes (note 1)	*CR,86,gbz <cr>	!S,86,bzn,vvr1,vvr2...vvr8 <cr>
Read-Group-Bass-Levels (note 1)	*CR,87,gbz <cr>	!S,87,bzn,bas1,bas2...bas8 <cr>
Read-Group-Treble-Levels (note 1)	*CR,88,gbz <cr>	!S,88,bzn,trb1,trb2...trb8 <cr>
Read-System-Information (note 2, 3)	*CR,100,bzn <cr>	!S,100,bzn,fam,fid,0,0,svh,svl <cr>
Read-Acknowledge (note 2, 4)	*CR,101,bzn <cr>	!S,101,bzn <cr>

zon is zone	1 to 255
bzn is Base-Zone for switcher	1 to 249 for 8-zone, or 1 to 241 for 16-zone switcher (eg: 1, 9, 17...)
gbz is group-base-zone	1 to 249; on 8-zone increments (eg: 1, 9, 17...) (see note 1)
sta is audio-state code	0=off, 1=on, 2=on/muted-audio
stv is video-state code	0=off, 1=on
ssa is audio source	0 to 8 (0=off) (or 0 to 16, for 16-source switchers)
ssv is video source	0 to 8 (0=off) (or 0 to 16, for 16-source switchers)
vvl is left volume level	0 to 35 (2-dB/increment)
vvr is right volume level	0 to 35 (2-dB/increment)
bas is bass level	0 to 8 (3-dB/increment)
trb is treble level	0 to 8 (3-dB/increment)
fam,fid is Family,Family-ID	10,5 = LE800A; 10,6 = LE800AV; 10,7 = LE1600A; 10,8 = LE1600V
svh,svl is Software-Version-High,Low	(0 to 99 each, eg: 6,0 is version 6.0)

## **Polling Notes:**

### **Note 1 – Read-Group Commands:**

The Read-Group commands will only return a message if the specified gbz parameter matches the programmed Base-Zone in the switcher configuration. Unlike the other group commands, these include all eight zones starting at gbz.

The Read-Group Commands return 8 parameters, starting at Base-Zone (params for bzn, bzn+1...bzn+7). For a 16-zone switcher, two messages are returned: the first message starts at Base-Zone (params for bzn, bzn+1...bzn+7), and the second message starts at Base-Zone+8 (params for bzn+8, bzn+9...bzn+15),

### **Note 2 – Base-Zone Commands:**

The Base-Zone-related commands will only return a message if the specified bzn parameter matches the programmed Base-Zone in the switcher configuration.

### **Note 3 – System-Information Message (!S,100):**

The SysInfo message is sent in response to a \*CR,100,bzn Polling Command, and is also sent at system boot.

When both video-only and audio-only switchers have the same base-zone (eg: LE-1600A and LE-1600V), the video switcher sends the message 16-ms after the audio switcher (the worst-case SysInfo message is under 10-ms).

At boot time of an installation with multiple daisy-chained switchers, the messages are delayed 32-ms for every 8 zones in the base-zone, so there is no overlap in the messages. Any video-only switchers are delayed an additional 16-ms, as described above. You may process the messages to extract the bzn and fam/fid parameters, to determine exactly how many zones are available, and which zones are audio and/or video.

<u>Boot-time Delay</u>	<u>Switcher Type</u>	<u>Switcher Base-Zone</u>	<u>Message</u>
0 ms	audio or a/v	1	!S,100,1...
16 ms	video-only	1	!S,100,1...
32 ms	audio or a/v	9	!S,100,9...
48 ms	video-only	9	!S,100,9...
64 ms	audio or a/v	16	!S,100,16...
80 ms	video-only	16	!S,100,16...
(etc)			

You could also poll for the full configuration of a multi-switcher installation, by polling with incremental base-zones (eg: 1, 9, 17, 25, 33...), and processing the messages that are returned.

### **Note 4 – Read-Acknowledge Command:**

The Read-Acknowledge command may be used to poll for existence of a switcher (with less complexity than polling with the SysInfo command). When both video-only and audio-only switchers have the same base-zone (eg: LE-1600A and LE-1600V), the video switcher sends the message 16-ms after the audio switcher.

This command is also useful in programs where you issue multiple commands (eg: multiple routes), and wish to wait for completion – you may issue a Read-Acknowledge command, and wait for the response before continuing in your program.

## Miscellaneous Status Messages:

These miscellaneous Status Messages are returned for various system actions:

<b>Sensor-State-Change messages</b> VI input on I/O jack	!S,180,sen,sst,0,0 <cr> !S,180,1,sst,0,0 <cr>	sen is sensor-id; sst is new state sst=0: VI=low, sst=1: VI=high
<b>Diagnostic messages (normally disabled)</b> Watchdog-Reset occurred Cmd-Error: Invalid Base-Zone cmd Cmd-Error: Invalid Cmd-Type Cmd-Error: Invalid Cmd-Parameter	!S,190,dgc,opt,0,0 <cr> !S,190,0,0,0,0 <cr> !S,190,3,0,0,0 <cr> !S,190,3,1,0,0 <cr> !S,190,3,2,0,0 <cr>	dgc is diagnostic-id; opt is option  (not *CW, *CR, *PW, or *PR) (invalid cmd-id, wrong number of parameters bad param value, or checksum error)
IR command request	!S,197,zon,irs,irf,0 <cr>	(factory-use)
Unknown RC command	!S,198,rb1,rb2,rb3,rb4 <cr>	(factory-use)
Internal diagnostic	!S,199,p1,p2,p3,p4 <cr>	(factory-use)

## Configuration (Programming) Commands & Messages:

In many applications, the factory settings are just right, but you may want to tweak some parameters, such as the Zone-Initial-Volume (zone-turn-on) levels. You can adjust zone settings using the \*PW commands below – some of the zone configuration settings may also be adjusted using an RC-16 remote control.

**The Program-Read (\*PR) and Program-Write (\*PW) Commands are for programming the system configuration, and are not to be employed in a user application, except as part of a setup function. Do not use \*PW commands in power-up boot code, since power-fluctuations at boot time (eg: power restoring after an outage), could result in corrupted parameters.**

<i>Program-Read-Cmd Description</i>	<i>Command</i>	<i>Config-Message</i>
Read-All-Config-Tables	*PR,8,bzn <cr>	!C,9... for all zones on switcher
Read-Zone-Config-Table	*PR,9,zon <cr>	!C,9,zon,vll,vhh,vil,vir,vmm,mod,bas,trb,tud,tdd <cr>
Read-Min/Max-Volume-Levels (note 1, 11)	*PR,10,zon <cr>	!C,10,zon,vll,vhh <cr>
Read-Initial-Volume-Levels (note 2, 11)	*PR,12,zon <cr>	!C,12,zon,vil,vir <cr>
Read-Mute-Level/Audio-Mode (note 3, 11)	*PR,14,zon <cr>	!C,14,zon,vmm,mod <cr>
Read-Bass/Treble-Levels (note 4, 12)	*PR,16,zon <cr>	!C,16,zon,bas,trb <cr>
Read-Taper-Delays (note 5)	*PR,18,zon <cr>	!C,18,zon,tud,tdd <cr>
Read-Source-Trim-Level (note 6)	*PR,22,1,ssa <cr>	!C,22,1,ssa,ast <cr>
Read-All-Source-Trim-Levels (note 6)	*PR,23,1 <cr>	!C,22 for all sources on switcher
Read-Cluster-Definition (note 7)	*PR,70,1,clu <cr>	!C,70,1,clu,gbz,gzd <cr>
Read-All-Cluster-Definitions (note 7)	*PR,71,1 <cr>	!C,70 for clusters 1 to 8
Read-Base-Zone (note 8)	*PR,100,0,0 <cr>	!C,100,0,0,0,bzn <cr>
Read-Tmp-Config-Flags (note 9)	*PR,240,1,flg <cr>	!C,240,1,flg,fst <cr>
<i>Program-Write-Cmd Description</i>	<i>Command</i>	<i>Config-Message</i>
Write-Zone-Parameter-Config-Table	*PW,9,zon,vll,vhh,vil,vir,vmm,mod,bas,trb,tud,tdd <cr> !C,9,zon,vll,vhh,vil,vir,vmm,mod,bas,trb,tud,tdd <cr>	
Write-Min/Max-Volume-Levels (note 1, 11)	*PW,10,zon,vll,vhh <cr>	!C,10,zon,vll,vhh <cr>
Write-Initial-Volume-Levels (note 2, 11)	*PW,12,zon,vil,vir <cr>	!C,12,zon,vil,vir <cr>
Write-Mute-Level/Audio-Mode (note 3, 11)	*PW,14,zon,vmm,mod <cr>	!C,14,zon,vmm,mod <cr>
Write-Bass/Treble-Levels (note 4, 12)	*PW,16,zon,bas,trb <cr>	!C,16,zon,bas,trb <cr>
Write-Taper-Delays (note 5)	*PW,18,zon,tud,tdd <cr>	!C,18,zon,tud,tdd <cr>
Write-Source-Trim-Level (note 6)	*PW,22,1,ssa,ast <cr>	!C,22,1,ssa,ast <cr>
Write-Cluster-Definition (note 7)	*PW,70,1,clu,gbz,gzd <cr>	!C,70,1,clu,gbz,gzd <cr>
Write-Base-Zone (note 8)	*PW,100,0,0,0,bzn <cr>	!C,100,0,0,0,bzn <cr>
Write-Tmp-Config-Flag (note 9)	*PW,240,1,flg,fst <cr>	!C,240,1,flg,fst <cr>

The following are miscellaneous Program Commands:

<b>Program-Cmd Description</b>	<b>Command</b>	<b>Message</b>
<b>Zone-Setup</b> (note 10)	*PW,40,zon,sid <cr>	!C,9,zon,vll,vhh,vil,vir,vmm,mod,bas,trb,tud,tdd <cr>
<b>Restore-All-Factory-Settings</b>	*PW,254,0,0,1 <cr>	!C,254,0,0 <cr> (Factory-Settings-Restored), and the front-panel light-bar will flash.
<b>Force-System-Reset</b>	*PW,255,0,0,1 <cr>	(factory-use)
<b>Get-SX-Slave-Revision</b>	*PR,255,0 <cr>	!C,255,sxh,sxl <cr> (factory-use)

<b>zon is zone</b>	<b>1 to 255</b>
<b>vll is Minimum-Volume-Level</b>	<b>0 to 35 (2-dB/increment) (see note 1, 11) Factory-Setting = 0 (-80 dB)</b>
<b>vhh is Maximum-Volume-Level</b>	<b>0 to 35 (2-dB/increment) (see note 1, 11) Factory-Setting = 35 (+6 dB)</b>
<b>vil is Initial-Left-Volume-Level</b>	<b>0 to 35 (2-dB/increment) (see note 2, 11) Factory-Setting = 22 (-20 dB)</b>
<b>vir is Initial-Right-Volume-Level</b>	<b>0 to 35 (2-dB/increment) (see note 2, 11) Factory-Setting = 22 (-20 dB)</b>
<b>vmm is Mute-Volume-Level</b>	<b>0 to 35 (2-dB/increment) (see note 3, 11) Factory-Setting = 0 (-80 dB)</b>
<b>mod is Zone-Mode</b>	<b>0 to 3 (see note 3) Factory-Setting = 1 (stereo/use-initial-vol)</b>
<b>bas is bass level</b>	<b>0 to 8 (3-dB/increment) (see note 4, 12) Factory-Setting = 4 (0 dB)</b>
<b>trb is treble level</b>	<b>0 to 8 (3-dB/increment) (see note 4, 12) Factory-Setting = 4 (0 dB)</b>
<b>tud is Taper-Up-Delay</b>	<b>1 to 30 (ms/2-dB-step) (see note 5) Factory-Setting = 20</b>
<b>tdd is Taper-Down-Delay</b>	<b>1 to 30 (ms/2-dB-step) (see note 5) Factory-Setting = 5</b>
<b>ssa is audio source</b>	<b>1 to 8 (or 1 to 16, for 16-source switchers)</b>
<b>ast is source-trim-attenuation</b>	<b>0 to 10 (see note 6) Factory-Setting = 0 (0-dB)</b>
<b>clu is cluster number</b>	<b>1 to 8 (see Note 7)</b>
<b>gbz is group-base-zone</b>	<b>1 to 249; on 8-zone increments (eg: 1, 9, 17...) (see note 7)</b>
<b>gzd is group-zone-definition</b>	<b>1 to 255 (each bit specifies 1 of 8 zones, starting at gbz) (see note 7)</b>
<b>bzn is Base-Zone for switcher</b>	<b>1 to 249 for 8-zone, or 1 to 241 for 16-zone switcher (see note 8) (eg: 1, 9, 17...) Factory-Setting = 1</b>
<b>flg is flag</b>	<b>1 to 3 (see note 9)</b>
<b>fst is flag state</b>	<b>1 (on) or 0 (off) (see note 9) Factory-Setting = 0</b>
<b>sid is Zone-Setup id</b>	<b>1 to 9 (see note 10)</b>

## **Configuration Notes:**

### **Note 1 – Zone Min/Max-Volume Levels**

Min-vol has priority over mute-vol and initial-vol, and is the absolute min volume zone will reach. If min-vol incorrectly set above max-vol, then min-vol will be presumed to be zero. Max-vol has priority over all other settings, and is the absolute max volume zone will reach.

### **Note 2 – Zone Initial-Volume Levels**

Min-Vol and Max-Vol should be set before setting Initial-Volumes. If initial-vol incorrectly set above max-vol, then initial-vol will be presumed to be max-vol. If initial-vol incorrectly set below min-vol, then initial-vol will be presumed to be min-vol. Initial-vol levels include both left and right levels, and should be set after performing a balance adjustment on a zone.

### **Note 3 – Zone Mute-Volume Level and Audio Mode**

Min-Vol and Max-Vol should be set before setting Mute-Volume. Mute always acts upon both L&R channels, even though L&R volume levels may differ; balance is preserved when zone is unmuted. Mute-vol is a ceiling, not an absolute level. If mute-vol set above min-vol, zone volume levels may go below mute-vol level. When muting, volumes above mute-vol will lower to mute-vol level, but volumes below mute-vol will not change. If mute-vol incorrectly set above max-vol, then mute-vol will be presumed to be max-vol. If mute-vol incorrectly set below min-vol, then mute-vol will be presumed to be min-vol.

Audio-Mode byte mod is a collection of bits, of which only bits 0 and 1 are currently defined:

Bit 0 (lsb) is MODE\_STEREO\_BIT: 1 = stereo (normal) or 0 = mono.

Bit 1 is MODE\_PREVIOUS\_VOL\_BIT: 1 = turn-on-at-prev-vol, 0 = turn-on-at-initial-vol (normal).

The factory setting for mod is 1, which is stereo and turn-on-at-initial-vol.

To choose the appropriate mod, you need to set the bits appropriately:

Definition	mod-bit	bit-value	1=on	add bit-values
MODE_STEREO_BIT	bit-0	1	1 (lsb)	1
MODE_PREVIOUS_VOL_BIT	bit-1	2	1	2
(unused)	bit-2	4	0	0
(unused)	bit-3	8	0	0
(unused)	bit-4	16	0	0
(unused)	bit-5	32	0	0
(unused)	bit-6	64	0	0
(unused)	bit-7	128	0 (msb)	0
			<u>          </u>	<u>          </u>
			= 10011011	= 3 = mod

Therefore, when mod = 3, the zone will be stereo, and will turn on at previous volume.

### **Note 4 – Zone Bass/Treble Levels**

Bass and Treble levels are technically part of the zone configuration (\*PW cmds), but also have analogous control (\*CW) commands, for normal adjustment. The \*CW commands are to be used in the user program, and also update an active zone with the new bass/treble levels. The \*PW commands are used for simply changing the switcher configuration, and changes will not be noticed until the zone is turned off and then back on.

### **Note 5 – Zone Taper Delays**

Taper delays are inserted between each 2-dB volume step to provide a pleasant transition when muting/unmuting, routing sources, or when using the taper option with absolute volume commands. It generally sounds better to have a longer taper-up delay than taper-down delay.

### Note 6 – Source Trim Levels

A source may be attenuated up to 20-dB, if needed, so all sources sound similar in loudness when switching.

ast	attenuation	ast	attenuation
0	0 dB	7	-14 dB
1	-2 dB	8	-16 dB
2	-4 dB	9	-18 dB
3	-6 dB	10	-20 dB
4	-8 dB		
5	-10 dB	240	vol-down = ast+1
6	-12 dB	241	vol-up = ast-1

### Note 7 – Cluster Definition:

Clusters are saved groups, accessed only via remote controls – for RS-232 control, use the group commands directly.

A Vaux remote control can access eight Clusters, which are pre-programmed zone group definitions. Clusters have the same constraints as zone groups (ie: up to eight consecutive zones, starting at any zone). Clusters are part of the switcher configuration -- the factory setting provides a few ready-to-use clusters, or they may be changed using programming commands. To access clusters 1 to 8 from an RC-16, the remote control is set to Zone-91 through 98, respectively. Only source-selection and volume commands may be used when the remote is set to a cluster. The factory-settings are:

- cluster 1 includes zones 1 and 2 (gbz = 1, gzd = 3)
- cluster 2 includes zones 1, 2, and 3 (gbz = 1, gzd = 7)
- cluster 3 includes zones 1, 2, 3, and 4 (gbz = 1, gzd = 15)
- clusters 4 to 8 include no zones (gbz = 1, gzd = 0)

Cluster commands apply to a group of eight consecutive zones, as defined in the cluster by gbz and gzd. Parameter gbz is group-base-zone, and gzd is group-zone-definition, which define a group of up to eight zones. If the group is defined such that the zones are on different switchers, the returned messages will collide and be garbled – therefore, gbz should be restricted to 8-zone increments (1, 9, 17...).

Each bit in gzd corresponds to one of eight zones, with bit-0 (LSB) being the lowest zone, and the bit-7 (MSB) being the highest zone. If the bit is 1, the zone is included in the group, and if the bit is 0, it is excluded.

The first zone (selected by bit-0) is defined as group-base-zone gbz. The next seven bits in gzd correspond to the next seven zones above gbz. For example, if gbz = 9 and gzd = 155, the group includes zones 9, 10, 12, 13, and 16. First, choose gbz, then to select the appropriate gzd, you need to set the gzd bits corresponding to the desired zones.

Zone	gzd-bit	bit-value	1=included	add bit-values
9 = gbz	bit-0	1	1 (lsb)	1
10	bit-1	2	1	2
11	bit-2	4	0	0
12	bit-3	8	1	8
13	bit-4	16	1	16
14	bit-5	32	0	0
15	bit-6	64	0	0
16	bit-7	128	1 (msb)	128
			<u>10011011</u>	<u>155 = gzd</u>

Therefore, when we choose gbz = 9, and set the appropriate bits in gzd to include zones 9, 10, 12, 13, and 16 in the group, we need gzd = 155. You can get this gzd either by converting the binary value 10011011 to decimal, or by adding the bit-values that correspond to the included zones (128+16+8+2+1 = 155).

### Note 8 – Switcher Base-Zone:

The Base-Zone parameter specifies where a switcher's zone range will start. The Factory-Setting is 1: for a 16-zone switcher, this means it will listen for commands directed to zones 1 to 16, and ignore other zones. If a second 16-zone switcher is added to the system, it will need its Base-Zone set to 17, so it can handle zones 17 to 32. The RS-232 and/or infrared control cables will connect to the first switcher, and a 6P6C modular cable will connect from the first switcher's Ctrl-Out port to the Ctrl-In port on the second switcher. Switcher control can daisy-chain in this fashion to a maximum of 255 zones in the system. The bzn parameter for an 8-zone switcher will get set to 1, 9, 17, 24..., while 16-zone switchers will use 1, 17, 33.... The Factory-Setting for bzn is 1.

**Note 9 – Temporary Configuration Flags:**

There are some flags that may be turned on to change aspects of the system – the power-up state for all flags is 0 (off).

flg = 1 = Echo-Chars	When on, RS-232 characters are echoed (for testing only)
flg = 2 = Show-Diagnostic-Mssgs	When on, diagnostic messages (!S,190 to !S,199) are enabled
flg = 3 = Leading-Zeroes-in-Mssgs	When on, message parameters use fixed 3-char format.

**Note 10 – Zone-Setup Command:**

These Setup commands are handy for configuring zones, and are identical to the setup commands available using the RC-16 remote control (shift-pause-#, where # is the sid digit). The zone must be on and not muted to use these commands

sid = 1	Set Zone-Initial-Volumes to current left/right levels
sid = 2	Set Zone-Mute-Volume to current (left) level
sid = 3	Set Zone-Min-Volume to current (left) level
sid = 4	Set Zone-Max-Volume to current (left) level
sid = 5	Set Previous-Volume-Flag Off (zone turns on with programmed Initial-Volume level) (normal)
sid = 6	Set Previous-Volume-Flag On (zone turns on at previous level, saved when last turned off)
sid = 7	Set Audio-Mode to Mono
sid = 8	Set Audio-Mode to Stereo (normal)
sid = 9	Restore Zone-Factory-Settings (restored on this one zone only)

**Note 11 – Volume Levels (vvl, vvr, vra) are 2-dB/increment (except for 0 = -80dB):**

35	+6 dB	26	-12 dB	17	-30 dB	8	-48 dB
34	+4 dB	25	-14 dB	16	-32 dB	7	-50 dB
33	+2 dB	24	-16 dB	15	-34 dB	6	-52 dB
32	0 dB (pass)	23	-18 dB	14	-36 dB	5	-54 dB
31	-2 dB	22	-20 dB	13	-38 dB	4	-56 dB
30	-4 dB	21	-22 dB	12	-40 dB	3	-58 dB
29	-6 dB	20	-24 dB	11	-42 dB	2	-60 dB
28	-8 dB	19	-26 dB	10	-44 dB	1	-62 dB
27	-10 dB	18	-28 dB	9	-46 dB	0	-80 dB

**Note 12 – Bass/Treble Levels (bas, trb) are 3-dB/increment:**

8	+12 dB
7	+9 dB
6	+6 dB
5	+3 dB
4	0 dB (flat)
3	-3 dB
2	-6 dB
1	-9 dB
0	-12 dB

## Remote-Control Equivalent Commands and Messages:

Pressing buttons on Vaux remote controls or keypads initiates actions equivalent to the following VauxProtocol Commands. Since these actions result in the same Messages being sent (as they would for the equivalent Command), the control system must only parse one set of Messages. This means that the control system is always up-to-date on zone-routes, volume-levels, and other system parameters, regardless of whether they were initiated by a VauxProtocol command, or by a remote-control button press.

<b>Remote-Control Button-Press</b>	<b>Equivalent Command</b>	<b>Status-Message</b>
Source-Select (tuner...) or Zone-Off	*CW,13,zon,src <cr>	!S,3,zon,sta,stv,ssa,ssv,vvl,vvr,bas,trb <cr>
Volume-Up/Down/Release (note 1)	*CW,35/36/37,zon <cr>	!S,20,zon,sta,vvl,vvr <cr> (when button released)
Bass-Up/Down (shift-chan-up/dn)	*CW,42/43,zon <cr>	!S,40,zon,bas,trb <cr>
Treble-Up/Down (shift-vol-up/dn)	*CW,44/45,zon <cr>	!S,40,zon,bas,trb <cr>
Flat (shift-rewind)	*CW,41,zon <cr>	!S,40,zon,bas,trb <cr>
Mute-Toggle (mute)	*CW,50,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Mute-On (shift-mute)	*CW,51,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Mute-Off (shift-a/b)	*CW,52,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
<b>Clusters (note 2) – messages are sent for each zone in cluster-group:</b>		
Cluster-Source-Select (tuner...) or Off	*CW,60,gbz,gzd,src,src <cr>	!S,3,zon,sta,stv,ssa,ssv,vvl,vvr,bas,trb <cr>
Cluster-Vol-Up/Down	*CW,62/63,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Cluster-Mute-Toggle/On/Off	*CW,50/51/52,zon <cr>	!S,20,zon,sta,vvl,vvr <cr>
Source-Trim-Down (shift-down)	*PW,22,src,240 <cr>	!C,22,src,ast <cr>
Source-Trim-Up (shift-up)	*PW,22,src,241 <cr>	!C,22,src,ast <cr>
Zone-Setup (shift-pause-#)	*PW,40,zon,# <cr>	!C,9,zon,vll,vhh,vil,vir,vmm,mod,bas,trb,tud,tdd <cr>
Initial-Vol-to-Current (shift-ffwd)	*PW,40,zon,1 <cr>	!C,9,zon,vll,vhh,vil,vir,vmm,mod,bas,trb,tud,tdd <cr>
Set-Base-Zone (prog/hold-#-#) (## = bzn: 01 to 98)	*PW,100,0,0,0,bzn <cr>	!C,100,0,0,0,bzn <cr>
Restore-All-Factory-Settings (prog/hold-9-9)	*PW,254,0,0,1 <cr>	!C,254,0,0 <cr>

### Note 1 – Volume adjustment:

Volume ramps at 2-dB/100-msec until button released, or Min/Max-Vol reached!

### Note 2 – Clusters:

Clusters 1 to 8 accessed by setting remote to zones 91 to 98, respectively.

Clusters must be programmed to define gbz and gzd for each cluster.

### Note 3 – Zone-Setup Command:

These Setup commands are handy for configuring zones, and are identical to the setup commands described in the previous section. The zone must be on and not muted to use these commands

- sid = 1 Set Zone-Initial-Volumes to current left/right levels
- sid = 2 Set Zone-Mute-Volume to current (left) level
- sid = 3 Set Zone-Min-Volume to current (left) level
- sid = 4 Set Zone-Max-Volume to current (left) level
- sid = 5 Set Previous-Volume-Flag Off (zone turns on with programmed Initial-Volume level) (normal)
- sid = 6 Set Previous-Volume-Flag On (zone turns on at previous level, saved when last turned off)
- sid = 7 Set Audio-Mode to Mono
- sid = 8 Set Audio-Mode to Stereo (normal)
- sid = 9 Restore Zone-Factory-Settings (restored on this one zone only)

## Control Serial Port (EIA/RS-232)

The Control Port is designed to connect directly to any control system or computer that has a standard RS-232 serial port.

A cable (not supplied) is needed to connect the Control Port to the control system or computer serial port. The Control Port has a DB-9-F (female) connector – the connector pinout is defined below. Typically, only three wires are needed: TX, RX, and Ground. If your serial port expects handshake inputs (on CTS, DSR, and/or DCD), you may be able to either change your port configuration to ignore these signals, or you may provide either the 5V or 12V signals from the Vaux Control connector to drive them active.

**The serial port requires 38400 baud, 8 data bits, no parity, 1 stop bit, with Xon/Xoff flow control enabled.**

The serial port on the controlling system must be configured according to its manufacturer's instructions. Information transfer between the controlling computer and the Vaux system is in the VauxProtocol format — a Vaux-defined command language comprised of various commands and messages.

### Control Port (RS-232 Interface) (DB-9 F Connector):

<u>Pin</u>	<u>Vaux Control Port</u>	<u>Signal Direction</u>	<u>Standard Computer Port</u>
1	5V *	→	DCD (Data Carrier Detect)
2	Data Out	→	RXD (Receive Data)
3	Data In	←	TXD (Transmit Data)
4	[do not use]	←	DTR (Data Terminal Ready)
5	Signal Ground	—	Signal Ground
6	12V *	→	DSR (Data Set Ready)
7	[do not use]	←	RTS (Request To Send)
8	[do not use]	→	CTS (Clear To Send)
9	[do not use]	→	RI (Ring Indicator)

- Typical Connections: Data-In (TXD), Data-Out (RXD), and Signal Ground.
- Minimal Connections: Data-In (TXD), and Signal Ground (for commands only)
- \* If CTS, DSR, or DCD is needed by your serial port, connect to the 5V or 12V signal (1-mA max load).
- The DB-9 shield rim (the “D”) is connected to signal ground.

## Highlights of new VauxProtocol version 6.0 features:

- System now uses flash-memory-based controller (system software can no longer be erased)
- New switchers identified by green PROG light (was red)
- Baud rate now 38400 (was 9600)
- New Group commands for multi-zone routing, volume-absolute/relative/ramping control, and muting
- Audio/Video route commands now work with 1600A/V combo, without any configuration changes
- New Group Polling commands return status for eight zones at a time
- Routing same source to same zone again, now returns status message (was silent)
- Polling commands for System-Information and Acknowledge include Base-Zone for specific inquiry
- Configuration commands streamlined, and new Read-All-Config includes Base-Zone for specific inquiry
- Checksum parameter may be added to the end of any command
- Underscore character '\_' may be substituted for comma ',' delimiter in commands
- Program-Write commands (\*PW) send message (!C) after changing params (previously, had to use \*PR)
- New test mode for echoing 232 characters
- New features using RC-16 remote control:
  - Clusters are now programmed groups
  - Cluster volume and muting now available
  - Set Base-Zone (was only available via 232)
  - Source-Trim (was only available via 232)
  - Mute-On and Mute-Off (in addition to Mute-Toggle)
  - Setup cmds for Stereo or Mono zone

## Changes to Routing Commands:

<b>Routing Command</b>	<b>Old Command (5.22)</b>	<b>New Command (6.0)</b>
Route-Audio/Video	*CW,10,zon,ssa,ssv	(same)
Route-Audio	*CW,11,zon,ssa	(same)
Route-Video	*CW,12,zon,ssv	(same)
Route-A/V	*CW,13,zon,src	(same)
Route-Muted	*CW,14,zon,ssa	*CW,14,zon,ssa,ssv (adds ssv)
Route-At-Volume	*CW,15,zon,ssa,vvl,vvr	*CW,15,zon,ssa,ssv,vra (adds ssv; use vra not vvl/vvr)
Route-At-Vol-Muted	*CW,16,zon,ssa,vvl,vvr	*CW,16,zon,ssa,ssv,vra (adds ssv; use vra not vvl/vvr)
Route-Cluster	*CW,17,clu,ssa,ssv	*CW,60,gbz,gzd,ssa,ssv (use new group command)
Route-Cluster-Muted	*CW,18,clu,ssa,ssv	*CW,61,gbz,gzd,ssa,ssv (use new group command)
Route-Cluster-Src	*CW,19,clu,src	*CW,60,gbz,gzd,src,src (use new group command)

## Changes to Routing Messages:

<b>Routing Command</b>	<b>Old Message (5.22)</b>	<b>New Message (6.0)</b>
*CW,10/13/17/18/19	!S,10,zon,ssa,ssv then !S,50,zon,sta,vvl,vvr	!S,3,zon,sta,stv,ssa,ssv,vvl,vvr,bas,trb
*CW,11/14/15/16	!S,11,zon,ssa then !S,50,zon,sta,vvl,vvr	!S,1,zon,sta,ssa,vvl,vvr,bas,trb
*CW,12	!S,12,zon,ssv then !S,50,zon,sta,vvl,vvr	!S,2,zon,stv,ssv

## Changes to Volume/Bass/Treble/Mute Commands (zone-0 no longer allowed):

<i>VBTM Command</i>	<i>Old Command (5.22)</i>	<i>New Command (6.0)</i>
Absolute-L/R-Vols	*CW,20,zon,vvl,vvr	*CW,20,zon,vvl,vvr,tpr (adds taper param)
Absolute-Left-Volume	*CW,21,zon,vvl	*CW,20,zon,vvl,255,tpr (IGNORE param for vvr)
Absolute-Right-Volume	*CW,22,zon,vvr	*CW,20,zon,255,vvr,tpr (IGNORE param for vvr)
Absolute-Volume	*CW,23,zon,vol	*CW,23,zon,vol,tpr (adds taper param)
Volume-Up (2-dB/step)	*CW,24,zon	(same)
Volume-Dn (2-dB/step)	*CW,25,zon	(same)
Left-Volume-Up	*CW,26,zon	(same)
Left-Volume-Dn	*CW,27,zon	(same)
Right-Volume-Up	*CW,28,zon	(same)
Right-Volume-Dn	*CW,29,zon	(same)
Balance-to-Left	*CW,30,zon	(same)
Balance-to-Right	*CW,31,zon	(same)
Start-Ramping-Volume-Up	*CW,35,zon	(same, ramps at 2-dB/100-msec; was 2-dB/120-msec)
Start-Ramping-Volume-Down	*CW,36,zon	(same, ramps at 2-dB/100-msec; was 2-dB/120-msec)
Stop-Ramping-Volume	*CW,37,zon	(same)
Absolute-Bass/Treble levels	*CW,40,zon,bas,trb	(same; may IGNORE either bas or trb now)
Flat-Bass/Treble (0-dB)	*CW,41,zon	(same)
Bass-Up (3-dB/step)	*CW,42,zon	(same)
Bass-Down (3-dB/step)	*CW,43,zon	(same)
Treble-Up (3-dB/step)	*CW,44,zon	(same)
Treble-Down (3-dB/step)	*CW,45,zon	(same)
Audio-Mute-Toggle	*CW,50,zon	(same)
Audio-Mute-On	*CW,51,zon	(same)
Audio-Mute-Off	*CW,52,zon	(same)

## Changes to Volume/Bass/Treble/Muting Messages:

<i>VBTM Command</i>	<i>Old Message (5.22)</i>	<i>New Message (6.0)</i>
*CW,20/23/24/25/50/51/52	IS,50,zon,sta,vvl,vvr	IS,20,zon,sta,vvl,vvr
*CW,21/26/27	IS,21,zon,vvl	IS,20,zon,sta,vvl,vvr
*CW,22/28/29	IS,22,zon,vvl	IS,20,zon,sta,vvl,vvr
*CW,30/31	IS,20,zon,vvl,vvr	IS,20,zon,sta,vvl,vvr
*CW,35/36/37	IS,50,zon,sta,vvl,vvr (per step)	IS,20,zon,sta,vvl,vvr (at end of ramp only)
*CW,40/41/42/43/44/45	IS,40,zon,bas,trb	(same)

## Changes to Polling Commands (also see new Read-Group cmds):

<i>Polling Command</i>	<i>Old Command (5.22)</i>	<i>New Command (6.0)</i>
Get-System-Information	*CR,0,0	*CR,100,bzn
Get-Zone-Status	*CR,1,zon	*CR,3,zon (also see new *CR,1/2 cmds)
Get-Audio/Video-Sources	*CR,10,zon	(same)
Get-Audio-Source	*CR,11,zon	(same)
Get-Video-Source	*CR,12,zon	(same)
Get-Left/Right-Volumes	*CR,20,zon	(same)
Get-Left-Volume	*CR,21,zon	use *CR,20,zon
Get-Right-Volume	*CR,22,zon	use *CR,20,zon
Get-Bass/Treble	*CR,40,zon	(same)
Get-Audio-Mute-State	*CR,50,zon	use *CR,20,zon
Get-Acknowledge	*CR,199,0	*CR,101,bzn

## Changes to Polling Messages:

<i>Polling Command</i>	<i>Old Message (5.22)</i>	<i>New Message (6.0)</i>
*CR,0,0	IS,0,bzn,ccf,ccm,swc,0,svh,svl	IS,100,bzn,fam,fid,0,,0,svh,svl
*CR,1,zon	IS,1,zon,sta,stv,ssa,ssv,vvl,vvr,bas,trb	IS,3,zon,sta,stv,ssa,ssv,vvl,vvr,bas,trb
*CR,10,zon	IS,10,zon,ssa,ssv	(same)
*CR,11,zon	IS,11,zon,ssa	(same)
*CR,12,zon	IS,12,zon,ssv	(same)
*CR,20,zon	IS,20,zon,vvl,vvr	IS,20,zon,sta,vvl,vvr (adds sta)
*CR,21,zon	IS,21,zon,vvl	IS,20,zon,sta,vvl,vvr
*CR,22,zon	IS,22,zon,vvr	IS,20,zon,sta,vvl,vvr
*CR,40,zon	IS,40,zon,bas,trb	(same)
*CR,50,zon	IS,50,zon,sta,vvl,vvr	IS,20,zon,sta,vvl,vvr
*CR,199,0	IS,199,1	IS,101,bzn

## Changes to Configuration Commands (also see new Read-All cmds):

<b>Config Command</b>	<b>Old Command (5.22)</b>	<b>New Command (6.0)</b>
Write- Base-Zone	*PW,1,swc,0,0,bzn	*PW,100,0,0,0,bzn
Write-Zone-Min-Volume-Level	*PW,10,zon,vll	*PW,10,zon,vll,vhh
Write-Zone-Max-Volume-Level	*PW,11,zon,vhh	(use *PW,10)
Write-Zone-Initial-L-Vol-Level	*PW,12,zon,vil	*PW,12,zon,vil,vir
Write-Zone-Initial-R-Vol-Level	*PW,13,zon,vir	(use *PW,12)
Write-Zone-Mute-Vol-Level	*PW,14,zon,vmm	*PW,14,zon,vmm,mod
Write-Zone-Bass-Level	*PW,15,zon,bas	(use *PW,16)
Write-Zone-Treble-Level	*PW,16,zon,trb	*PW,16,zon,bas,trb
Write-Zone-Audio-Mode	*PW,17,zon,mod	(use *PW,14)
Write-Zone-Taper-Up-Delay	*PW,18,zon,tud	*PW,18,zon,tud,tdd
Write-Zone-Taper-Down-Delay	*PW,19,zon,tdd	(use *PW,18)
Write-Zone-Param-Config-Table	*PW,30,zon,vll,vhh,vil,vir,vmm,bas,trb,mod,tud,tdd	*PW,9,zon,vll,vhh,vil,vir,vmm,mod,bas,trb,tud,tdd (mod moved)
Write-Zone-Prev-Vol-Flag	*PW,20,zon,1,fst	(Prev-Vol now part of mod)
Write-Cluster-Table	*PW,21,clu,z01,z02...	*PW,70,1,clu,gbz,gzd
Write-Source-Trim-Level	*PW,22,ssa,ast	(same)
Zone-Restore-Factory-Settings	*PW,31,zon	*PW,40,zon,9
Write-Zone-Volume-Settings	*PW,40,zon,cvs	*PW,40,zon,sid (same, but new setup params added)
Restore-Factory-Settings	*PW,254,0,0,1	(same)

## ***Downloading system-software updates (version 6.0 and up) to new switchers:***

- System now uses flash-memory-based controller (system software can no longer be erased)
- New switchers identified by green PROG light (was red)
- Obtain appropriate system software file and download utility from Vaux
- Start Vaux-Downloader on pc
- Press Search/F2 button, select file to download
- Press Write/F4 button >> "searching for bootloader" message
- Power vaux unit off for a second, then back on >> "writing, please wait" message
- PROG light is on during download (about 45 secs)
- If file has been transferred correctly, "all ok" message
- Light-bar on front panel, and boot message (!S,100,...) indicate download complete
- Press Mem\_Erase button on rear panel to restore factory settings (PROG light on for a second, then light bar)
- Done