Vaux Lattis Matrix Switchers

Version 10.0 Programming Reference

January 2010

Routing Commands & Messages:

• not every switcher responds to all commands, or returns a status message – see notes for details

Description	Command	Status-Message Returned
Route-All	***LW,10,zon,src**	**!M,10,zon,src,bal,sta,vol**
Route-X-All	***LW,11,zon,src,vra,tpr,mut**	**!M,10,zon,src,bal,sta,vol**
Route-Audio	***LW,12,zon,ssa**	**!M,12,zon,ssa,bal,sta,vol**
Route-X-Audio	***LW,13,zon,ssa,vra,tpr,mut**	**!M,12,zon,ssa,bal,sta,vol**
Route-Component	***LW,14,zon,ssc**	**!M,14,zon,ssc**
Route-DA/CV	***LW,15,zon,ssd**	**!M,15,zon,ssd**
Route-Component-and-DA/CV	***LW,16,zon,src**	**!M,16,zon,src**

(see related programming commands: *PW,26/28/30/31)

Primary Parameters:

zon is zone   0 to 255 <u>(0 allowed for routing "all-zones, on all switchers" – see note R1)</u>

src is all possible audio/video sources   0 (=zone-off) to max source for switcher(s) (eg: max = 6, 8, 12, 16, or 24)

ssa is audio source   0 (=zone-off) to max source for switcher (eg: max = 8, 12, 16, or 24)

ssc is component- video source   0 (=zone-off) to max source for switcher (eg: max = 6 or 12)

ssd is digital-aud/composite- vid source   0 (=zone-off) to max source for switcher (eg: max = 12 or 24)

Audio "X" Parameters (see note R8):

vra is route-at volume   20 to 106 (-80dB to +6 dB; 1-dB/increment) (see note R10)

tpr is tapered-volume-enable   1 = normal routes with volume tapering, 0 = fast-routing

mut is route-muted-enable   0 = normal-routing, 1 = route-muted

Additional Message Parameters:

vol is zone's current volume   20 to 106 (-80dB to +6 dB; 1-dB/increment) (see note R10)

bal is zone's balance   40 to 160 (full-left to full-right; 100 = center) (see note R11)

sta is zone's audio-state code   0 = off, 1 = on, 2 = on-with-muted-audio

Routing Notes:

Note R1 – To route all zones (on all switchers):
- set zon to 0; first switcher on daisy chain (ie: switcher whose bzn=1) will send zon-0 route message.
- if it is an !M,10 or !M,12 message, the audio parameters will be set to 255, indicating IGNORE.
- example: *LW,12,0,7 will route source 7 to all zones, and returned message will be !M,12,0,7,255,255,255

Note R2 – DA/CV is Digital-Audio/Composite-Video signal
- yellow or orange jack on switchers.
- either Digital-Audio or Composite-Video signal may be connected, as both use same switching circuitry.
- cannot pass a mono analog audio signal.

Note R3 – Switchers that are (stereo line level) Audio-only   (eg: LE-808A, LE-1616A):
- respond to *LW,10/11 commands, and send !M,10 message   (route-all).
- respond to *LW,12/13 commands, and send !M,12 message   (route audio-only).
- flash NAK for other route commands.

Note R4 – Switchers that are Audio/Component-Video (eg: LE-808AHD, CT-808AHD):
- respond to *LW,10/11 commands, and send !M,10 message (route-all).
- respond to *LW,12/13 commands, and send !M,12 message (route audio-only).
- respond to *LW,14 command, and send !M,14 message (route component-only).
- respond to *LW,16 command, and send !M,16 message (route component-and-DA/CV).
- flash NAK for other route commands.

Note R5 – Switchers that are Audio/Component-Video/Digital-Audio   (eg: CT-808HX):
- respond to *LW,10/11 commands, and send !M,10 message (route-all).
- respond to *LW,12/13 commands, and send !M,12 message (route audio-only).
- respond to *LW,14 command, and send !M,14 message (route component-only).
- respond to *LW,15 command, and send !M,15 message (route DA/CV-only).
- respond to *LW,16 command, and send !M,16 message (route component-and-DA/CV).
- flash NAK for other route commands.

Note R6 – Switchers that are Component-Video-only   (eg: LE-608/1208/1216HD, CT-608/1208/1216HD)
- respond to *LW,14 command, and send !M,14 message (route component-only).
- respond to *LW,16 command, and send !M,16 message (route component-and-DA/CV).
- respond to *LW,10/11 commands, AND FLASH ACK ONLY (presumed to be paired with audio-only switcher).
- flash NAK for other route commands.

Note R7 – Switchers that are Component-Video/Digital-Audio   (eg: CT-608/1208/1216HX)
- respond to *LW,14 command, and send !M,14 message (route component-only).
- respond to *LW,15 command, and send !M,15 message (route DA/CV-only).
- respond to *LW,16 command, and send !M,16 message (route component-and-DA/CV).
- respond to *LW,10/11 commands, AND FLASH ACK ONLY (presumed to be paired with audio-only switcher).
- flash NAK for other route commands.

Note R8 – Switchers that are Digital-Audio/Composite-Video-only (eg: LE-1216V, LE-2416V):
- respond to *LW,15 command, and send !M,15 message (route DA/CV-only).
- respond to *LW,16 command, AND FLASH ACK ONLY.
        (presumed to be paired with component-only or audio/component switcher).
- respond to *LW,10/11 commands, AND FLASH ACK ONLY (presumed to be paired with audio-only switcher).
- flash NAK for other route commands.

Note R9 – Routing Stereo Line-Level Audio:

- when tpr = 1, volume tapering gives smooth transition between sources;   when tpr = 0, zone switches quickly.

- routing a source when ZONE IS CURRENTLY OFF:
      - if mut and vra are 0 or not invoked, switcher routes and sets zone volume to:
            a) normal (factory setting) route volume which uses programmed "Zone-Turn-On-Volume."
            b) optionally, may configure each zone's route volume to turn on at "Previous-Volume"
               (this is the volume level when zone was last turned off).
               (the implementation actually updates Zone-Turn-On-Volume at every zone turn-off).
      - if vra is non-zero (and mut=0), switcher routes, and sets zone volume to specified volume level vra.
      - if mut=1 (and vra=0), routes muted; unmute vol is set to Zone-Turn-On-Volume or Previous-Volume.
      - if mut=1 and vra is non-zero, routes with zone muted; unmute vol is set to vra.

- routing a source when ZONE IS CURRENTLY ON:
      - if mut and vra are 0 or not invoked, switcher routes to new source at current zone volume.
      - if vra is non-zero (and mut=0), routes at specified level vra (if source is the same, just updates volume).
      - if mut=1 (and vra=0), >>> does not mute if zone is currently on; routes at current zone volume.
      - if mut=1 and vra is non-zero, >>> does not mute if zone is currently on; routes at specified level vra.

- routing a source when ZONE IS CURRENTLY MUTED:
      - if mut and vra are 0 or not invoked, switcher routes and unmutes to volume set before zone was muted.
      - if vra is non-zero (and mut=0), routes and unmutes to specified volume level vra.
      - if mut=1 (and vra=0), routes and leaves zone muted (unmute volume is level before zone was muted).
      - if mut=1 and vra is non-zero, routes and leaves zone in muted state (unmute volume set to vra).

Note R10 – Volume Levels (vol, vra) are 1-dB/increment (100 = 0dB):

106	+6 dB	91	-9 dB	76	-24 dB	61	-39 dB	46	-54 dB	31	-69 dB
105	+5 dB	90	-10 dB	75	-25 dB	60	-40 dB	45	-55 dB	30	-70 dB
104	+4 dB	89	-11 dB	74	-26 dB	59	-41 dB	44	-56 dB	29	-71 dB
103	+3 dB	88	-12 dB	73	-27 dB	58	-42 dB	43	-57 dB	28	-72 dB
102	+2 dB	87	-13 dB	72	-28 dB	57	-43 dB	42	-58 dB	27	-73 dB
101	+1 dB	86	-14 dB	71	-29 dB	56	-44 dB	41	-59 dB	26	-74 dB
100	**0 dB**	85	-15 dB	70	-30 dB	55	-45 dB	40	-60 dB	25	-75 dB
99	-1 dB	84	-16 dB	69	-31 dB	54	-46 dB	39	-61 dB	24	-76 dB
98	-2 dB	83	-17 dB	68	-32 dB	53	-47 dB	38	-62 dB	23	-77 dB
97	-3 dB	82	-18 dB	67	-33 dB	52	-48 dB	37	-63 dB	22	-78 dB
96	-4 dB	81	-19 dB	66	-34 dB	51	-49 dB	36	-64 dB	21	-79 dB
95	-5 dB	80	-20 dB	65	-35 dB	50	-50 dB	35	-65 dB	20	-80 dB
94	-6 dB	79	-21 dB	64	-36 dB	49	-51 dB	34	-66 dB		
93	-7 dB	78	-22 dB	63	-37 dB	48	-52 dB	33	-67 dB		
92	-8 dB	77	-23 dB	62	-38 dB	47	-53 dB	32	-68 dB		

Note R11 – Balance Levels (bal) are 1-dB/increment (40 = full-left, 100 = center, 160 = full-right):

bal:	left:	right:	
160	off	0 dB	FULL RIGHT, which is right channel at 0dB, and left channel off
159	-59 dB	0 dB	
158	-58 dB	0 dB	
…	…	...	
102	-2 dB	0 dB	
101	-1 dB	0 dB	balance to RIGHT
100	**0 dB**	**0 dB**	**balance centered**
99	0 dB	-1 dB	balance to LEFT
98	0 dB	-2 dB	
…	…	...	
42	0 dB	-58 dB	
41	0 dB	-59 dB	
40	0 dB	off	FULL LEFT, which is left channel at 0dB, and right channel off

Volume, Mute, Balance, and EQ Commands & Messages:

• a muted zone will be unmuted if volume adjustment commands are received

Description	Command	Status-Message Returned
Absolute-Volume	*LW,20,zon,vol,tpr	!M,20,zon,bal,sta,vol
Percent-Volume (0-100)	*LW,21,zon,vpc,tpr	!M,21,zon,idp,vpc,vol
Byte-Volume (0-255)	*LW,22,zon,vpc,tpr	!M,21,zon,idp,vpc,vol
Relative-Volume (1-dB step)	*LW,24,zon,dir	!M,20,zon,bal,sta,vol
Start-Ramping-Volume	*LW,26,zon,dir	(none)
Stop-Ramping-Volume	*LW,27,zon	!M,20,zon,bal,sta,vol
Audio-Mute	*LW,30,zon,mti	!M,20,zon,bal,sta,vol
Absolute-Balance	*LW,38,zon,bal	!M,38,zon,bal
Relative-Balance (1-dB step)	*LW,39,zon,bad	!M,38,zon,bal
Absolute-EQ	*LW,40,zon,bas,mid,trb	!M,40,zon,bas,mid,trb
Flat-EQ	*LW,41,zon	!M,40,zon,bas,mid,trb
Relative-EQ (1-dB step)	*LW,42,zon,bbr,mmr,ttr	!M,40,zon,bas,mid,trb
Parametric-EQ	*LW,46,zon,bbf,mmf,ttf,bbq,mmq,ttq	!M,46,zon,bbf,mmf,ttf,bbq,mmq,ttq

(see related programming commands: *PW,26/28/30/31/32/33)

Primary Parameters:

zon is zone	1 to 255 (zone-0 not permitted)
vol is volume level	20 to 106 (-80dB to +6 dB; 1-dB/increment) (see note V6)
vpc is percent/byte-volume level	0 to 100 for percent cmd, 0 to 255 for byte cmd (see note V3)
tpr is taper-enable	1 = normal adjustment with volume tapering, 0 = fast-adjustment
dir is relative volume direction	0 = down, 1 = up
mti is mute id	0 = mute-off, 1 = mute-on, or 2 = mute-toggle
bal is balance level	40 to 160 (full-left to full-right; Fact-Set = 100 = center) (see notes V7, V8)
bad is relative balance direction	0 = to-left, 1 = to-right
bas is bass level	85 to 115 (-15dB to +15 dB; Fact-Set=100), or X = ignore (see note V10)
mid is midrange level	85 to 115 (-15dB to +15 dB; Fact-Set=100), or X = ignore (see note V10)
trb is treble level	85 to 115 (-15dB to +15 dB; Fact-Set=100), or X = ignore (see note V10)
bbr is relative bass direction	0 = down, 1 = up, or X = ignore
mmr is relative midrange direction	0 = down, 1 = up, or X = ignore
ttr is relative treble direction	0 = down, 1 = up, or X = ignore

EQ Parametrics:

bbf is bass center frequency		**60, 70, 80, 100, 120, 140, 160, 200**	**(Fact-Set=100=100Hz)**	**or X = ignore**
mmf is midrange center freq	**(/10)**	**50, 100**	**(Fact-Set=100=1000 Hz)**	**or X = ignore**
ttf is treble center frequency	**(/100)**	**50, 75, 100, 125**	**(Fact-Set=100=10 KHz)**	**or X = ignore**
bbq is bass Q	**(x100)**	**50, 75, 100, 125**	**(Fact-Set=100=1.0 Q)**	**or X = ignore**
mmq is midrange Q	**(x100)**	**100**	**(Fact-Set=100=1.0 Q)**	**or X = ignore**
ttq is treble Q	**(x100)**	**100**	**(Fact-Set=100=1.0 Q)**	**or X = ignore**

Additional Message Parameters:

sta is audio-state code   **0 = off, 1 = on, 2 = on/muted-audio**

idp is percent/byte-volume id   **100 = percent, 255 = byte**

Volume/Mute/Balance/EQ Notes:

Note V1 – Volume/Mute/Balance/EQ commands:
- volume/mute commands will only affect zones that are *on* or are *on-with-muted-audio* (sending to off zones will just result in NAK flash).
- a muted zone will be unmuted if volume adjustment commands are received.
- balance/eq commands may be sent to an "off" zone to set up zone.

Note V2 – Tapering with Absolute-Volume/Percent-Volume/Byte-Volume commands (*LW,20/21/22):
- normal operation will use tpr = 1, resulting in the volume level smoothly tapering up or down using the switcher's tud/tdd taper delays – see the Programming section for the *PW,26 command to change delays.
- if parameter tpr = 0, the new volume level is set immediately.

Note V3 – Percent-Volume/Byte-Volume commands (*LW,21/22):
- for the Percent-Volume command, a percentage of 0 to 100 is used instead of an absolute (20 to 106) dB level.
- for the Byte-Volume command, a volume range of 0 to 255 is used.
- these are handy for updating a readout or bar-graph display, without the need for additional calculations.
- the resulting message indicates, in the vpc parameter, either percent (idp = 100) or byte (idp = 255).
- the actual volume level in dB is also returned in the vol parameter.
- the absolute range is more granular (20 to 106) than the percentage (0 to 100) or byte (0 to 255) ranges – for this reason there will be some steps that resolve to the same absolute volume.
- see the Programming section for the *PW,28 command, which is used to change the Volume-Range used by these cmds (the factory setting lets the cmds operate on the full absolute volume range of -80 to +6 dB, but can define a smaller range).

Note V4 – Relative-Volume command (*LW,24):
When this command is used, there must be a 200ms minimum delay between successive commands. Otherwise there will be an "overshoot" effect, due to commands still in the serial buffer (eg: if a "vol-up" button is programmed with a too-short loop delay, volume will continue to increase somewhat after the button is released).

Note V5 – Volume-Ramping commands (*LW,26/27):
- volume level is reported only when ramping is stopped (not at each increment during ramp).
- volume ramps at 1-dB/50-msec until stopped, or Min/Max-Vol reached!

Note V6 – Volume Levels (vol) are 1-dB/increment (100 = 0dB):

106	+6 dB	91	-9 dB	76	-24 dB	61	-39 dB	46	-54 dB	31	-69 dB
105	+5 dB	90	-10 dB	75	-25 dB	60	-40 dB	45	-55 dB	30	-70 dB
104	+4 dB	89	-11 dB	74	-26 dB	59	-41 dB	44	-56 dB	29	-71 dB
103	+3 dB	88	-12 dB	73	-27 dB	58	-42 dB	43	-57 dB	28	-72 dB
102	+2 dB	87	-13 dB	72	-28 dB	57	-43 dB	42	-58 dB	27	-73 dB
101	+1 dB	86	-14 dB	71	-29 dB	56	-44 dB	41	-59 dB	26	-74 dB
100	**0 dB**	85	-15 dB	70	-30 dB	55	-45 dB	40	-60 dB	25	-75 dB
99	-1 dB	84	-16 dB	69	-31 dB	54	-46 dB	39	-61 dB	24	-76 dB
98	-2 dB	83	-17 dB	68	-32 dB	53	-47 dB	38	-62 dB	23	-77 dB
97	-3 dB	82	-18 dB	67	-33 dB	52	-48 dB	37	-63 dB	22	-78 dB
96	-4 dB	81	-19 dB	66	-34 dB	51	-49 dB	36	-64 dB	21	-79 dB
95	-5 dB	80	-20 dB	65	-35 dB	50	-50 dB	35	-65 dB	20	-80 dB
94	-6 dB	79	-21 dB	64	-36 dB	49	-51 dB	34	-66 dB		
93	-7 dB	78	-22 dB	63	-37 dB	48	-52 dB	33	-67 dB		
92	-8 dB	77	-23 dB	62	-38 dB	47	-53 dB	32	-68 dB		

Note V7 – Balance commands (*LW,38/39):
- balance cmds attenuate left or right channel in 1-dB increments over bal range of 40 to 160 (100 = centered).
- bal from 40 to 99 is "Balance to Left," which means the right channel is attenuating.
- bal from 101 to 160 is "Balance to Right," which means the left channel is attenuating.
- bal of 40 is "Full Left," which means the right channel is off.
- bal of 160 is "Full Right," which means the left channel is off.

Note V8 – Balance Levels (bal) are 1-dB/increment (40 = full-left, 100 = center, 160 = full-right):

bal:	left:	right:	
160	off	0 dB	FULL RIGHT, which is right channel at 0dB, and left channel off
159	-59 dB	0 dB	
158	-58 dB	0 dB	
…	…	...	
102	-2 dB	0 dB	
101	-1 dB	0 dB	balance to RIGHT
100	**0 dB**	**0 dB**	**balance centered**
99	0 dB	-1 dB	balance to LEFT
98	0 dB	-2 dB	
…	…	...	
42	0 dB	-58 dB	
41	0 dB	-59 dB	
40	0 dB	off	FULL LEFT, which is left channel at 0dB, and right channel off

Note V9 – Absolute-EQ/Relative-EQ/Parametric-EQ (*LW,40/42/46) commands:
Parameters may all be defined, or, one or more may be set to IGNORE by inserting the 'X' character in place of the parameter (a parameter can also be set to IGNORE by setting it to 255).

Note V10 – EQ Levels (bas, mid, trb) are 1-dB/increment (100 = 0dB):

115	+15 dB	110	+10 dB	105	+5 dB	**100**	**0 dB**	95	-5 dB	90	-10 dB		
114	+14 dB	109	+9 dB	104	+4 dB	99	-1 dB	94	-6 dB	89	-11 dB		
113	+13 dB	108	+8 dB	103	+3 dB	98	-2 dB	93	-7 dB	88	-12 dB		
112	+12 dB	107	+7 dB	102	+2 dB	97	-3 dB	92	-8 dB	87	-13 dB		
111	+11 dB	106	+6 dB	101	+1 dB	96	-4 dB	91	-9 dB	86	-14 dB		
										85	-15 dB		

Group Routing/Volume Commands & Messages:

• a group of up to eight zones may be controlled with these group commands

Description	Command	Status-Message Returned
Group-Route-All	*LW,60,gbz,gzd,src,tpr,mut	!M,10,zon,src,bal,sta,vol ***
Group-Route-Audio	*LW,62,gbz,gzd,ssa,tpr,mut	!M,12,zon,ssa,bal,sta,vol ***
Group-Route-Component	*LW,64,gbz,gzd,ssc	!M,14,zon,ssc ***
Group-Route-DA/CV	*LW,65,gbz,gzd,ssd	!M,15,zon,ssd ***
Group-Relative-Volume	*LW,74,gbz,gzd,dir	!M,20,zon,bal,sta,vol ***
Group-Start-Ramping-Volume	*LW,76,gbz,gzd,dir	(none)
Group-Stop-Ramping-Volume	*LW,77,gbz,gzd	!M,20,zon,bal,sta,vol ***
Group-Audio-Mute	*LW,80,gbz,gzd,mti	!M,20,zon,bal,sta,vol ***
(toggle not allowed)		

*** for each zon in group

(see related programming commands: *PW,60/62/64)

Primary Parameters:

gbz is group-base-zone	1 to 249; on 8-zone increments (eg: 1, 9, 17...) (see notes G1 to G5)
gzd is group-zone-definition	0 to 255 (specifies up to 8 zones, starting at gbz) (see notes G1 to G5)
src is all possible audio/video sources	0 (=zone-off) to max source for switcher(s) (eg: max = 6, 8, 12, 16, or 24)
ssa is audio source	0 (=zone-off) to max source for switcher (eg: max = 8, 12, 16, or 24)
ssc is component- video source	0 (=zone-off) to max source for switcher (eg: max = 6 or 12)
ssd is digital-aud/composite- vid source	0 (=zone-off) to max source for switcher (eg: max = 12 or 24)
tpr is tapered-volume-enable	1 = normal routes with volume tapering, 0 = fast-routing
mut is route-muted-enable	0 = normal-routing, 1 = route-muted
dir is relative volume direction	0 = down, 1 = up
mti is mute id	0 = mute-off, or 1 = mute-on (mute-toggle is not allowed for groups)

Additional Message Parameters:

zon is zone	1 to 255
vol is zone's current volume	20 to 106 (-80dB to +6 dB; 1-dB/increment) (see note G6)
bal is zone's balance	40 to 160 (full-left to full-right; 100 = center) (see note G7)
sta is zone's audio-state code	0 = off, 1 = on, 2 = on-with-muted-audio

Group Routing/Volume Notes:

Note G1 – Group Routing/Volume commands:
Group commands apply to a group of eight consecutive zones, as defined in the command by gbz and gzd. Parameter gbz is the group-base-zone, and gzd is the group-zone-definition, which together define a group of up to eight zones. The group must be defined such that the zones are on the same switcher, therefore, gbz is restricted to 8-zone increments (1, 9, 17…).
Routes or volume adjustments are reported for each zone defined in the group.

Note G2 – Groups can be defined directly in commands:
The primary way to use groups is to simply define gbz and gzd directly in your commands. You have complete control over any groups of up to eight zones (anywhere in our zone range up to 255), you can document the groups easily in your driver code, and you do not need to rely on any prior programming of the switcher(s).

Note G3 – Groups can also be stored as Programmable-Groups:
Another way to use groups is to program your switcher(s) ahead of time to store up to eight "programmable-groups." See the *PW,60/62/64 commands in the programming section. Each of the Prog-Group definitions simply stores a gbz and gzd value, which is used to "look-up" the group when it is accessed. Why do this? Well, the main reason is to allow IR commands to access groups – since generic IR commands cannot include specialized gbz/gzd numbers, we use IR zones 91 to 98 to invoke Prog-Groups 1 to 8. You may also invoke these programmable-groups in your code by setting gbz to the Prog-Group (1 to 8), AND setting gzd to 0 (if gzd is non-zero, the command is expecting the normal inline definition).

Note G4 – Determining GBZ the hard way:
Like all parameters in VauxProtocol, gbz ranges from 0 to 255 (stored internally as an 8-bit byte). Each bit in gzd corresponds to one of eight zones, with bit-0 (LSB) being the lowest zone, and 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 from the group. The first zone (selected by bit-0) is defined as the group-base-zone gbz. The next seven bits in gzd correspond to the next seven zones above gbz.

Example: if gbz = 9 and gzd = 155, the group includes zones 9, 10, 12, 13, and 16. First, we choose gbz, then we select the appropriate gzd by setting the gzd bits corresponding to the desired zones. 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):

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
			= 10011011 =	155 = gzd

Note G5 – Determining GBZ the easy way:
Did the previous discussion of MSB and LSB to find GBZ make you think WTF? Yeah, it may be a very compact way to define a group, but it is a bit confusing (if you'll pardon the pun). We added a command that takes no action whatsoever, other than to calculate GBZ for you, and return it in a message so you can embed it in subsequent commands. See the *PW,64 command in the programming section.

Note G6 – Volume Levels (vol, vra) are 1-dB/increment (100 = 0dB):

106	+6 dB	91	-9 dB	76	-24 dB	61	-39 dB	46	-54 dB	31	-69 dB
105	+5 dB	90	-10 dB	75	-25 dB	60	-40 dB	45	-55 dB	30	-70 dB
104	+4 dB	89	-11 dB	74	-26 dB	59	-41 dB	44	-56 dB	29	-71 dB
103	+3 dB	88	-12 dB	73	-27 dB	58	-42 dB	43	-57 dB	28	-72 dB
102	+2 dB	87	-13 dB	72	-28 dB	57	-43 dB	42	-58 dB	27	-73 dB
101	+1 dB	86	-14 dB	71	-29 dB	56	-44 dB	41	-59 dB	26	-74 dB
100	**0 dB**	85	-15 dB	70	-30 dB	55	-45 dB	40	-60 dB	25	-75 dB
99	-1 dB	84	-16 dB	69	-31 dB	54	-46 dB	39	-61 dB	24	-76 dB
98	-2 dB	83	-17 dB	68	-32 dB	53	-47 dB	38	-62 dB	23	-77 dB
97	-3 dB	82	-18 dB	67	-33 dB	52	-48 dB	37	-63 dB	22	-78 dB
96	-4 dB	81	-19 dB	66	-34 dB	51	-49 dB	36	-64 dB	21	-79 dB
95	-5 dB	80	-20 dB	65	-35 dB	50	-50 dB	35	-65 dB	20	-80 dB
94	-6 dB	79	-21 dB	64	-36 dB	49	-51 dB	34	-66 dB		
93	-7 dB	78	-22 dB	63	-37 dB	48	-52 dB	33	-67 dB		
92	-8 dB	77	-23 dB	62	-38 dB	47	-53 dB	32	-68 dB		

Note G7 – Balance Levels (bal) are 1-dB/increment (40 = full-left, 100 = center, 160 = full-right):

bal:	left:	right:	
160	off	0 dB	FULL RIGHT, which is right channel at 0dB, and left channel off
159	-59 dB	0 dB	
158	-58 dB	0 dB	
…	…	...	
102	-2 dB	0 dB	
101	-1 dB	0 dB	balance to RIGHT
100	**0 dB**	**0 dB**	**balance centered**
99	0 dB	-1 dB	balance to LEFT
98	0 dB	-2 dB	
…	…	...	
42	0 dB	-58 dB	
41	0 dB	-59 dB	
40	0 dB	off	FULL LEFT, which is left channel at 0dB, and right channel off

Presets & Paging-Doorchime-Camera Features:

States

Vaux Lattis switchers have Preset and Paging modes of operation which allow an entire chain of a/v switchers to quickly re-configure routes and volumes using single commands. The switchers have seven programmable **States** (1 to 7) which each can each be programmed for a specific combination of a/v routes, volume levels, etc, using any or all of the zones. States are just memory areas, each of which contains all the information for all of the switcher's zones. States 1 to 7 are stored in non-volatile memory and remain intact when the switcher is powered off – they are not changed unless you explicitly alter or clear them. Each State stores the a/v route information for each zone, volumes for each zone, zone a/v status (on/off/muted), and unmute volumes for each zone.

Once a state is programmed, it may be *Recalled* for use as a **Preset,** for an application such as a party mode, boardroom mode, etc. When a state is recalled as a Preset, all zones are changed to routes and volumes of the stored preset.

Alternately, a state may define the zones and volume levels for **Paging,** with audio from a telephone-system, microphone preamp, doorchime-generator, or even video from a camera. Unlike Preset operation, Paging does not need to affect all zones – only those you define. Of course, we restore the original pre-page condition of all zones when the page is complete.

Normal Mode – State-0

The switchers are usually in *State-0*, which is initialized to all-zones-off when the switchers power-on. If you never use any of the state features (for presets or paging), you will simply stay in this *Normal* mode – in this mode, routes and other changes all occur in State-0, and you need read no further. State-0 is cleared at power-up, and changed when a new Preset is recalled, so it is a volatile (not saved at power-down) state.

Preset-Recall Mode

Any of the states 1 through 7 may be programmed as a *Preset* for a specific use, and then *recalled* when needed. When a Preset state is recalled, it is copied to the *Normal* State-0.

For example, you may have certain sources routed to various zones at specific volume levels (zones can even be muted), for a house party preset, or a boardroom or courtroom application. Recalling presets will change routes and volumes on all zones, with one simple **Preset-Recall command** (*LW,92,...). You may direct the command to a switcher at a specific Base-Zone, or to all switchers on the daisy chain.
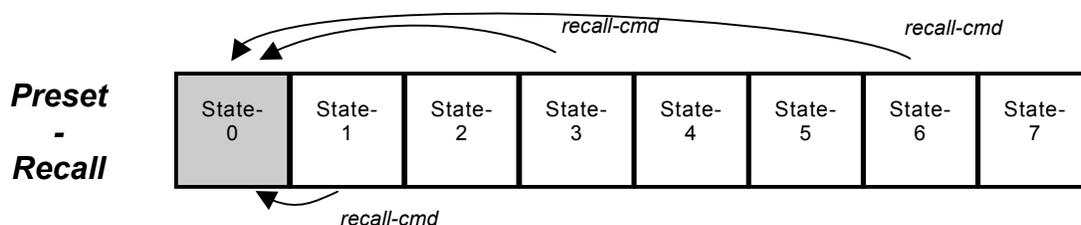
Each of these *Presets* store a completely different configuration of the machine, and since they are recalled (copied) into State-0, the presets are not changed if you subsequently change routes or volumes, since you will be changing the Normal (and volatile) State-0. Consequently, when you recall a preset, previous routes on all zones in state-0 are lost (unlike a Page, where the previous State-0 information is automatically saved and restored).

Paging-Doorchime-Camera Mode

Any of the states 1 through 7 may be programmed for use in a *Paging-Doorchime-Camera Mode,* for example, to page from a telephone-system (or microphone), sound a doorchime or annunciator message, or display security cameras. Unlike Preset operation, Paging does not need to affect all zones – only those you define. This mode can be considered an *Interrupt* mode, since it uses a programmed state temporarily – paging is activated when needed, and, when deactivated, the previous state of all zones is automatically restored.

In a paging application, the state used for paging is programmed to route the paging source to the desired zones, at the desired paging volume levels for each of the zones. The page source is typically connected to the highest source on the switcher (eg: 8 or 16), although any source input may be used.

You may wish to have different paging states for upstairs, downstairs, outside, etc.

An important distinction: Unlike Preset mode, which changes all zones, during paging use you do not want to affect zones that are not getting the page, but instead leave those zones as they are (on, off, or muted). Therefore, zones that are programmed *off* in the state used for paging will be unaffected by the page operation. Zones that are not to receive the page remain as they are, whether off or listening to music, etc. This would not be the case if you simply used a preset, since the *off* zones would actually turn off.
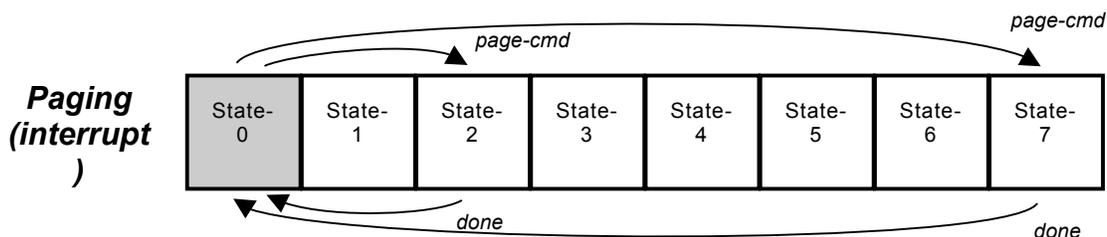
Another important distinction: Note also that when the page is invoked, the switcher automatically saves the current State-0, and when the page is terminated, the original State-0 is restored – there is no additional programming required to implement this powerful function.

To prevent any undesired changes when paging, any route, volume, or other commands are disabled for the duration of the page. Also, only one page may be active at a time (you may not page from a page).

The **Activate-Page-State command** (*LW,91...mst) changes the switcher to reflect the routes and volumes for all non-off zones in the programmed paging state (1 to 7). Paging always routes audio fast (no volume tapering), for immediate activation. To terminate the page, you issue the **Deactivate-Page-State command** (*LW,91...0). You may direct these commands to a switcher at a specific Base-Zone, or to all switchers on the daisy chain.

Contact-Closure Input for Paging with State-1: Available on the switcher's rear-panel is the PAGE_PB_IN contact-closure input. When this contact is closed/opened, is used to activate/deactivate paging with *State-1* (only). This is useful for telephone systems that provide relay contact closure during paging.

A configuration command (*PW,230...) may be used to disable the paging function of the PAGE_PB_IN contact-closure, and allow this input to simply issue status messages, to be then used as a general input for the control system.

Paging (interrupt)	State-0	State-1	State-2	State-3	State-4	State-5	State-6	State-7

page-cmd   page-cmd

done   done

State 1 to 7 Programming

Any of the states 1 through 7 may be programmed for use as a preset or paging state. But how do you program these states? You *change* to that state, then simply issue standard routing and volume commands to *program* the state, and then change back to Normal State-0. When you are in a state other than State-0, you are in **State-Program-Mode**. Just don't forget to change back to State-0 after you program your state!

The **Change-State command** (*LW,90...) changes the *Current-State* (from 0 to 7). When you in are a state other than 0, changes you make (routes, volume adjusts...) are immediately saved to the non-volatile state memory. You may direct the command to a switcher at a specific Base-Zone, or to all switchers on the daisy chain.
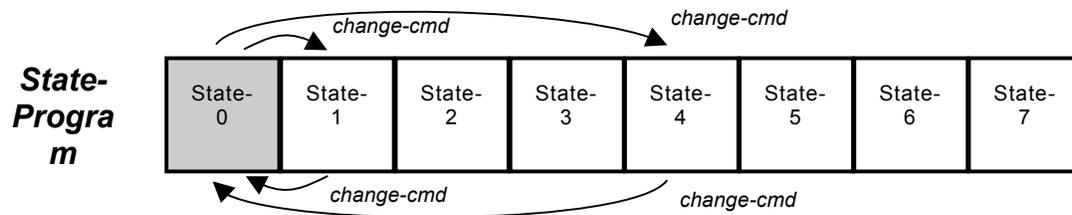
Manual State Programming: State programming can be done interactively with an installed system. You are simply changing to the state to be programmed, entering the commands to configure the state however you wish, and then exiting this *program-mode* by changing back to State-0. Just don't forget to change back to State-0! To allow for programming states manually, you just need to provide the commands to enter and exit the state-program mode, and leave all other configuration to the installer, who will manually route and adjust volumes. Here is an example of programming State-5:

*LW,90,0,0,0,5,0 <cr>	**Change all switchers (bzn=0), fast (tpr=0), to State-5**
*LW cmds, or IR cmds	Manually select routes, while you listen
*LW cmds, or IR cmds	Adjust volume levels for each zone, while you listen
*LW,90,0,0,0,0,0 <cr>	**Restore all switchers (fast) to State-0**

One-button "Scripted" State Programming: State programming can also be done by scripting up the commands needed, and then simply sending the series of commands to the switcher(s) from the control system. You are doing the same thing as above, but without the benefit of listening to the actual zone volume levels to fine-tune them – but perhaps you don't need volumes particularly precise, and you want to pre-configure a system quickly. For example we will program State-2 for all switchers on the daisy-chain, for a paging application using source-16 to page on zones 1, 2, & 4:

*LW,90,0,0,0,2,0 <cr>	**Change all switchers (bzn=0), fast (tpr=0), to State-2**
*LW,11,0,0,0,0,0 <cr>	Clear the state on all switchers: Fast (tpr=0), all zones (zon=0), off (src=0)
*LW,11,1,16,0,0,0 <cr>	Fast Route to select audio source-16 on zone-1
*LW,11,2,16,0,0,0 <cr>	Fast Route to select audio source-16 on zone-2
*LW,11,4,16,0,0,0 <cr>	Fast Route to select audio source-16 on zone-4
*LW,21,1,40,0 <cr>	Fast Volume set to 40% on zone-1
*LW,21,1,50,0 <cr>	Fast Volume set to 50% on zone-2
*LW,21,1,45,0 <cr>	Fast Volume set to 45% on zone-4
*LW,90,0,0,0,0,0 <cr>	**Restore all switchers (fast) to State-0**

This sequence of commands can be issued in a split-second by the control system to *program* this state, provided you have an idea what it should be ahead of time. In a typical application, you will likely need to manually tweak the zone volumes to proper final levels for each zone – but this can easily be fine-tuned during installation by changing to the state, adjusting the volumes in each zone and then exiting to state-0.

Preset & Paging State Commands & Messages:

• Switchers power-up in *Normal* State 0, which is initialized to all-zones-off.

Control-Write Cmd Description	Command	Status-Message	
Change-State:	***LW,90,bzn,0,0,mst,tpr**	**!M,90,bzn,fam,fid,0,0,0,mst**	(success)
		!M,189,bzn,fam,fid,2 \<cr\>	(err: invalid mst)
Activate-Paging-State:	***LW,91,bzn,0,0,mst**	**!M,90,bzn,fam,fid,0,0,1,mst**	(success)
		!M,189,bzn,fam,fid,2 \<cr\>	(err: invalid mst)
		!M,189,bzn,fam,fid,3 \<cr\>	(err: already paging)
Deactivate-Page-State:	***LW,91,bzn,0,0,0**	**!M,90,bzn,fam,fid,0,0,0,0**	
Preset-State-Recall:	***LW,92,bzn,0,0,mst,tpr**	**!M,90,bzn,fam,fid,0,0,0,mst**	(success)
		!M,189,bzn,fam,fid,2 \<cr\>	(err: invalid mst)

(see related programming commands: *PW,230)

Primary Parameters:

bzn is base-zone of switcher   **1 to 249; on switcher-max-zone increments (eg: 1, 9, 17, 25, 33,...)**
         or 0   **(0=all-switchers on daisy-chain)**

mst is machine-state   **0 = normal-state, 1 to 7 for preset or paging use**

tpr is taper-enable   **0 = fast-routing, 1 = normal routes with volume tapering**

Additional Message Parameters:

fam   **Family:**
         10 = Lattis LE Family (standard switchers)
         12 = Lattis CT Family (CAT5 output switchers)

fid   **Family-ID:**
         14 = LE-1216V – 12x16 composite-video (or digital-audio)
         15 = LE-2416V – 24x16 composite-video (or digital-audio)
         16 = LE-608HD – 6x8 component-video
         17 = LE-1208HD – 12x8 component-video
         18 = LE-1216HD – 12x16 component-video
         22 = CT-608HX – 6x8 CAT5-component-video/digital-audio
         23 = CT-608HD – 6x8 CAT5-component-video
         24 = CT-1208HX – 12x8 CAT5-component-video/dig-audio
         25 = CT-1208HD – 12x8 CAT5-component-video
         26 = CT-1216HX – 12x16 CAT5-component-video/dig-audio
         27 = CT-1216HD – 12x16 CAT5-component-video
         40 = LE-808A – 8x8 stereo audio
         42 = LE-1616A – 16x16 stereo audio
         49 = LE-808AHD – 8x8 audio & 6x8 component-video
         50 = CT-808AHX – 8x8 aud & 6x8 CAT5-comp-video/dig-aud
         51 = CT-808AHD – 8x8 audio & 6x8 CAT5-component-video

Presets and Paging Notes:

Note PP1 – Change-State command (*LW,90) – State-Programming:

The switchers are usually in the *Normal State-0*, which is initialized to all-zones-off when the switchers power-on. If you never use any of the state features, you simply stay in this *Normal* mode – in this mode, routes and other changes all occur in State-0. Each state is a memory area storing the a/v route information for each zone, volumes for each zone, zone a/v status (on/off/muted), and unmute volumes for each zone. States 1 to 7 may be programmed for Preset or Paging use, and are non-volatile (not affected by power-down).

To *program* a state (1 to 7), you need to *change* to that state, select routes and volumes, and then change back to State-0. You can change your *Current-State* to any of the machine states, 0 to 7. When you in are a state other than 0, changes you make (routes, volume adjusts...) are immediately saved to the non-volatile state memory. To make a subsequent adjustment to a page/preset state (eg: change a zone volume), you simply change to the state again, make the adjustment, and return to State-0.

The Change-State command (*LW,90,bzn,0,0,mst,tpr) changes the *Current-State* to mst (0 to 7). The tpr parameter selects either normal routing (with volume tapering), or fast routing (no tapering). Using the bzn parameter, you may direct the command to a switcher at a specific Base-Zone, or to all switchers on the daisy chain. A Change-State command will also terminate any paging command in progress.

If there are multiple switchers daisy-chained together for a large number of zones, you may direct the *LW,90 command to a specific switcher by providing the Switcher-Base-Zone parameter bzn. If there are both audio and video switchers set to this base zone, they both change to the new state. <u>If bzn is set to 0, all switchers in the daisy chain change state, and all switchers in the chain will reply with their state-change messages.</u>

Note PP2 – Page-State command (*LW,91):

Any of the states 1 through 7 may be programmed for use in paging mode, which only uses a state temporarily – paging is activated when needed, State-0 is saved, and, when paging is deactivated, the previous State-0 is restored.

Zones that are programmed *off* in the page state will be unaffected by the page operation. Zones that are not to receive the page remain as they are, whether off or listening to music, etc. This would not be the case if you recalled a Preset, since the *off* zones would actually turn off, and State-0 would not be saved.

Note also that when the page is terminated, the original state is restored. To prevent any undesired changes when paging, any routes, volume, or other commands are disabled for the duration of the page. Also, only one page may be active at a time (you may not page from a page).

The *Activate-Page-State* command (*LW,91,bzn,0,0,mst) changes the *Current-State* to paging state mst (1 to 7). Paging always routes fast (no volume tapering), for immediate activation. Using the bzn parameter, you may direct the command to a switcher at a specific Base-Zone, or to all switchers on the daisy chain. To terminate the page, you issue the *Deactivate-Page-State* command (*LW,91,bzn,0,0,0).

A message (!M,90,bzn,fam,fid,0,0,1,mst) is returned when paging, indicating the current paging state. When paging terminates, a message (!M,90,bzn,fam,fid,0,0,0,0) is returned indicating the restored State-0.

If there are multiple switchers daisy-chained together for a large number of zones, you may direct the *LW,91 command to a specific switcher by providing the Switcher-Base-Zone parameter bzn. If there are both audio and video switchers set to this base zone, they both change to the new state. <u>If bzn is set to 0, all switchers in the daisy chain change state, and all switchers in the chain will reply with their state-change messages.</u>

A configuration command related to paging, is *PW,230,1,3,1 – this may be used to disable the paging function of the PAGE_PB_IN contact-closure, and allow this input to simply issue status messages, to be then used as a general input for the control system.

Note PP3 – Preset-State-Recall command (*LW,92):

Any of the states 1 through 7 may be programmed as a *Preset* for a specific use, and then *recalled* when needed. When a Preset (state 1 to 7) is recalled, it is copied to *Normal* state-0. Since state-0 it is cleared at power-up, and changed when a new Preset is recalled, it is volatile. States 1 to 7 are stored in non-volatile memory and remain when the switcher is powered off – they are not changed unless you explicitly alter or clear them. Each *State* stores the a/v route information for each zone, left and right volumes for each zone, zone a/v status (on/off/muted), and unmute volumes for each zone.

Each of these *Presets* store a completely different configuration of the machine, and since they are recalled (copied) into state-0, the presets are not changed if you subsequently change routes, volumes, etc. However, previous routes on all zones in state-0 are lost (unlike a page, where the previous state is restored).

The *Preset-Recall command* (*LW,92,bzn,0,0,mst,tpr) copies the preset-state mst (1 to 7) to state-0. The tpr parameter selects either normal routing (with volume tapering), or fast routing (no tapering). Using the bzn parameter, you may direct the command to a switcher at a specific Base-Zone, or to all switchers on the daisy chain. A State-Change message (!M,90,bzn,fam,fid,0,0,0,mst) is returned when presets are recalled.

If there are multiple switchers daisy-chained together for a large number of zones, you may direct the *LW,92 command to a specific switcher by providing the Switcher-Base-Zone parameter bzn. If there are both audio and video switchers set to this base zone, they both change to the new state. If bzn is set to 0, all switchers in the daisy chain change state, and all switchers in the chain will reply with their state-change messages.

Programming Commands & Messages:

- In many applications, the factory settings are just right, but you may want to tweak some parameters, such as the Zone-Turn-On volume levels. You can adjust zone settings using the *PW commands below – some of the zone settings may also be adjusted using an RC-16 remote control.

- These Program-Read (*PR) and Program-Write (*PW) commands are for programming the system's non-volatile programmable parameters, and **are not to be employed in an everyday 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: when power is restored after an outage), could result in corrupted parameters. User application code should only use *LW/*LR commands.

The following are special commands for Base-Zone Programming. The Base-Zone (bzn) is a key switcher parameter that sets the zone range to which the switcher responds. For example, a 16-zone switcher, having bzn=1, responds to zones 1 to 16, and quietly ignores the rest (just flashing the NAK light for an out-of-zone-range command). A 16-zone switcher, having bzn set to 17, responds to zones 17 to 32.

Disconnect the daisy-chain first, and plug into the unit you wish to change, else all switchers on the daisy-chain will get changed. The Factory-Setting for bzn is 1.

Program-Cmd Description		Command	Message
Write-Switcher-Base-Zone	(note P1)	*PW,1,0,0,0,bzn <cr>	!C,1,0,bzn <cr>
Read-Switcher-Base-Zone	(note P1)	*PR,1,0 <cr>	!C,1,0,bzn <cr>

The following are programming commands for general switcher setup. Any of the following programming commands having a bzn parameter may be directed to a switcher on a specific Base-Zone (bzn), or to all switchers on the daisy chain (by setting bzn=0). If bzn is set to zero, all switchers will reply in sequence with their message.

Program-Cmd Description		Command	Message
Write-Prog-Group	(note P2/3/4)	*PW,60,bzn,pgp,gbz,gzd <cr>	!C,60,bzn,pgp,gbz,gzd <cr>
Read- Prog-Group	(note P2/3/4)	*PR,60,bzn,pgp <cr>	!C,60,bzn,pgp,gbz,gzd <cr>
Read-All-Prog-Groups	(note P2/3/4)	*PR,61,bzn <cr>	!C,60... for each pgp 1 to 8
Write-Prog-X-Group	(note P2/3/4)	*PW,62,bzn,pgp,gbz,g1,g2,g3,g4,g5,g6,g7,g8 <cr>	!C,60,bzn,pgp,gbz,gzd <cr>
Calculate-GZD	(note P2/3/4)	*PW,64,bzn,g1,g2,g3,g4,g5,g6,g7,g8 <cr>	!C,64,bzn,gzd <cr>
Write-Config-Flags	(note P5/6)	*PW,230,0,flg,fst <cr>	!C,230,bzn,flg,fst <cr>
Read-Config-Flags	(note P5/6)	*PR,230,bzn,flg <cr>	!C,230,bzn,flg,fst <cr>
Write-Tmp-Config-Flags	(note P5/7)	*PW,240,0,flg,fst <cr>	!C,240,bzn,flg,fst <cr>
Read-Tmp-Config-Flags	(note P5/7)	*PR,240,bzn,flg <cr>	!C,240,bzn,flg,fst <cr>
Set-New-Baud-Rate	(note P5/8)	*PW,250,0,1,bau <cr>	(no mssg, since baud rate changed)
Restore-All-Factory-Settings	(note P5)	*PW,254,0,0,1 <cr>	!C,254,0,0 <cr>
(factory-settings restored, and the front-panel light-bar will flash)			
Force-System-Reset	(note P5)	*PW,255,0,0,1 <cr>	!M,1... then !M,2... then !M,187...
(reset via watchdog, and the front-panel light-bar will flash)			

General Switcher Setup Parameters:

bzn is base-zone of switcher	**1 to 249; on switcher-max-zone increments (eg: 1, 9, 17, 25, 33,...)**
	or 0 (0=all-switchers on daisy-chain)
pgp is Prog-Group number	**1 to 8 (see note P2/3/4)**
gbz is group-base-zone	**1 to 249; on 8-zone increments (eg: 1, 9, 17...) (see note P2/3/4)**
gzd is group-zone-definition	**1 to 255 (each bit specifies 1 of 8 zones, starting at gbz) (see note P2/3/4)**
g1 is include/exclude gbz	**0 (exclude) or 1 (include)**
g2 is include/exclude gbz+1	**0 (exclude) or 1 (include)**
g3 is include/exclude gbz+2	**0 (exclude) or 1 (include)**
g4 is include/exclude gbz+3	**0 (exclude) or 1 (include)**
g5 is include/exclude gbz+4	**0 (exclude) or 1 (include)**
g6 is include/exclude gbz+5	**0 (exclude) or 1 (include)**
g7 is include/exclude gbz+6	**0 (exclude) or 1 (include)**
g8 is include/exclude gbz+7	**0 (exclude) or 1 (include)**
flg is flag	**1 to 199 (see note P6, P7)**
fst is flag state	**0 (off) or 1 (on) Factory-Setting = 0**
bau is New-Baud-Rate	**12,19,24,38,48,57,96,115 (see note P8) Factory-Setting = 38**

The following are general global (all-zone) program commands for audio switchers. Any of the following programming commands having a bzn parameter may be directed to a switcher on a specific Base-Zone (bzn), or to all switchers on the daisy chain (by setting bzn=0). If bzn is set to zero, all switchers will reply in sequence with their message.

Program-Cmd Description		Command	Message
Write-Source-Trim-Gain	(note P9)	*PW,24,bzn,ssa,stg <cr>	!C,24,bzn,ssa,stg <cr>
Read-Source-Trim-Gain	(note P9)	*PR,24,bzn,ssa <cr>	!C,24,bzn,ssa,stg <cr>
Read-All-Source-Trim-Gains	(note P9)	*PR,25,bzn <cr>	!C,24... for all sources on switcher
Write-Taper-Delays	(note P10)	*PW,26,bzn,tud,tdd <cr>	!C,26,bzn,tud,tdd <cr>
Read-Taper-Delays	(note P10)	*PR,26,bzn <cr>	!C,26,bzn,tud,tdd <cr>
Write-Percent-Volume-Range-Low/High	(note P11)	*PW,28,bzn,vrl,vrh <cr>	!C,28,bzn,vrl,vrh <cr>
Read-Percent-Volume-Range-Low/High	(note P11)	*PR,28,bzn <cr>	!C,28,bzn,vrl,vrh <cr>

General Global (all-zone) Audio Switcher Setup Parameters:

bzn is base-zone of switcher   1 to 249; on switcher-max-zone increments (eg: 1, 9, 17, 25, 33,...)
                                       or 0   (0=all-switchers on daisy-chain)

stg is source-trim-gain   0 to 15 (see note P9) Factory-Setting = 0 (0-dB)
ssa is audio source   0 to 8 (or 0 to 16, for 16-source switchers)
                                     when ssa=0 (and stg=0), you reset all source-trim-gains to stg=0

tud is Taper-Up-Delay   1 to 50 (ms/1-dB-step) (see note P10) Factory-Setting = 10
tdd is Taper-Down-Delay   1 to 50 (ms/1-dB-step) (see note P10) Factory-Setting = 2

vrl is Minimum-Percent-Volume   20 to 106 (1-dB/increment – note P15) Factory-Setting = 20 (-80 dB)
vrh is Maximum-Percent-Volume   20 to 106 (1-dB/increment – note P15) Factory-Setting = 106 (+6 dB)

The following are zone-specific program commands for audio switchers. These Program-Write commands may be directed to a specific Zone (zon), or to all zones on all daisy-chained switchers (by setting zon=0); if zon is set to zero, the zon=0 mssg is only returned from the switcher whose bzn=1. The Program-Read commands may be directed to a specific Zone (zon), but zon=0 is not allowed for read.

Program-Cmd Description	Command	Message
Zone-Interactive-Setup (note P12)	*PW,30,zon,sid <cr>	!C,31,zon,vll,vhh,vto,vmm,bal,mod <cr>
Write-Zone-Config-A (note P13)	*PW,31,zon,vll,vhh,vto,vmm,bal,mod <cr>	!C,31,zon,vll,vhh,vto,vmm,bal,mod <cr>
Read- Zone-Config-A (note P13)	*PR,31,zon <cr>	!C,31,zon,vll,vhh,vto,vmm,bal,mod <cr>
Write-Zone-Config-B (note P14)	*PW,32,zon,bas,mid,trb,0,0,0 <cr>	!C,32,zon,bas,mid,trb,0,0,0 <cr>
Read- Zone-Config-B (note P14)	*PR,32,zon <cr>	!C,32,zon,bas,mid,trb,0,0,0 <cr>
Write-Zone-Config-C (note P14)	*PW,33,zon,baf,mif,trf,baq,miq,trq <cr>	!C,33,zon,baf,mif,trf,baq,miq,trq <cr>
Read- Zone-Config-C (note P14)	*PR,33,zon <cr>	!C,33,zon,baf,mif,trf,baq,miq,trq <cr>

General Zone-Specific Audio Switcher Setup Parameters:

zon is zone	**1 to 255**	
	or 0	**(0=all-switchers on daisy-chain, for write only)**
sid is Zone-Setup id	**1 to 9 (see note P12/13)**	
vll is Minimum-Volume-Level	**20 to 106 (1-dB/increment) (see note P15) Factory-Setting = 20 (-80 dB)**	
vhh is Maximum-Volume-Level	**20 to 106 (1-dB/increment) (see note P15) Factory-Setting = 106 (+6 dB)**	
vto is Turn-On-Volume-Level	**20 to 106 (1-dB/increment) (see note P15) Factory-Setting = 80 (-20 dB)**	
vmm is Mute-Volume-Level	**20 to 106 (1-dB/increment) (see note P15) Factory-Setting = 20 (-80 dB)**	
bal is balance level	**40 to 160 (full-left to full-right; Factory-Setting = 100 = center) (note P16)**	
mod is Zone-Mode	**0 or 2 (see note P13) Factory-Setting = 0 (use-turn-on-vol)**	

EQ Parameters (see note P17):

bas is bass level		**85 to 115 (-15dB to +15 dB; Factory-Setting = 100 = 0-dB)**	
mid is midrange level		**85 to 115 (-15dB to +15 dB; Factory-Setting = 100 = 0-dB)**	
trb is treble level		**85 to 115 (-15dB to +15 dB; Factory-Setting = 100 = 0-dB)**	
bbf is bass center frequency		**60, 70, 80, 100, 120, 140, 160, 200**	**(Factory-Setting = 100 = 100Hz)**
mmf is midrange center freq	**(/10)**	**50, 100**	**(Factory-Setting = 100 = 1000 Hz)**
ttf is treble center frequency	**(/100)**	**50, 75, 100, 125**	**(Factory-Setting = 100 = 10 KHz)**
bbq is bass Q	**(x100)**	**50, 75, 100, 125**	**(Factory-Setting = 100 = 1.0 Q)**
mmq is midrange Q	**(x100)**	**100**	**(Factory-Setting = 100 = 1.0 Q)**
ttq is treble Q	**(x100)**	**100**	**(Factory-Setting = 100 = 1.0 Q)**

Note P1 – Switcher-Base-Zone command (*PW,1):
> *Do Not Connect Daisy Chain* – The Write-Base-Zone command is designed for configuring a single switcher. Disconnect the daisy-chain first, else all switchers on the chain will get changed.
>
> The Switcher-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, you will need to set its Base-Zone set to 17, so it can handle zones 17 to 32.
>
> The main 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 for a maximum of 255 zones in the system. The bzn parameter for an 8-zone switcher will get set to 1, 9, 17, 25…, while 16-zone switchers will use 1, 17, 33, 49…. The Factory-Setting for bzn is 1.

Note P2 – Programmable-Group (Prog-Group) commands (*PW,60/62/64):
> Prog-Groups are saved group definitions (gbz/gzd), which can be accessed via IR remote control, or RS-232 commands, for group routing and volume control. Each of the Prog-Group definitions simply stores a gbz and gzd value, which is used to "look-up" the group when it is accessed. For RS-232 drivers, it is generally easier to use the standard group commands directly (embedding the group definitions in each command). Stored Prog-Group definitions *are needed* for IR remote use. Routes or volume adjustments are reported for each zone defined in the group.
>
> A Vaux IR remote control can access eight Prog-Groups, which are pre-programmed zone group definitions stored in the switcher (not in the remote control). To access Prog-Groups 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 Prog-Group.
>
> To invoke these programmable-groups in your RS-232 code, you set gbz to the Prog-Group (1 to 8), AND set gzd to 0 (if gzd is non-zero, the command is expecting the normal inline group definition). Invoking Prog-Groups via RS-232 is primarily intended for testing, but you are free to use them in you control code as you wish.
>
> Prog-Groups have the same constraints as normal groups (ie: up to eight consecutive zones, starting at any zone on an increment of eight). Parameter gbz is the group-base-zone, and gzd is the group-zone-definition, which together define a group of up to eight zones. The group must be defined such that the zones are on the same switcher, therefore, gbz is restricted to 8-zone increments (1, 9, 17…). Prog-Groups are part of the switcher configuration -- the factory setting provides a few ready-to-use Prog-Groups, or they may be changed using programming commands. The factory-settings are:
> - Prog-Group 1 includes zones 1 and 2   (gbz = 1, gzd = 3)
> - Prog-Group 2 includes zones 1, 2, and 3   (gbz = 1, gzd = 7)
> - Prog-Group 3 includes zones 1, 2, 3, and 4   (gbz = 1, gzd = 15)
> - Prog-Group 4 to 8 include no zones   (gbz = 1, gzd = 0)

Note P3 – Determining GBZ the easy way (*PW,64):
> Did the previous discussion of MSB and LSB to find GBZ make you think WTF? Yeah, it may be a very compact way to define a group, but it is a bit confusing (if you'll pardon the pun). We added a command that takes no action whatsoever, other than to calculate GBZ for you, and return it in a message so you can embed it in subsequent commands.

Note P4 – Determining GBZ the hard way:
> Like all parameters in VauxProtocol, gbz ranges from 0 to 255 (stored internally as an 8-bit byte). Each bit in gzd corresponds to one of eight zones, with bit-0 (LSB) being the lowest zone, and 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 from the group. The first zone (selected by bit-0) is defined as the group-base-zone gbz. The next seven bits in gzd correspond to the next seven zones above gbz.

Example: if gbz = 9 and gzd = 155, the group includes zones 9, 10, 12, 13, and 16. First, we choose gbz, then we select the appropriate gzd by setting the gzd bits corresponding to the desired zones. 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):

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
			= 10011011 =	155 = gzd

Note P5 – Commands affects all switchers in daisy chain (*PW,230/240/250/254/255):
You will normally want to direct these commands to the entire daisy-chain of switchers. If not, disconnect the daisy-chain first, and plug into the unit you wish to change.

Note P6 – Configuration-Flags (*PW,230):
The Configuration-Flags (1 to 99) may be turned on to change aspects of the system – these flags are non-volatile, so they remain effective after power-cycles. The factory setting of these flags is 0 (off). Note: Flag 5 (IR-Legacy-Mode) can be quickly set in the field if Mem_Erase pushbutton is held/released at power-up.

flg = 1 = Leading-Zeroes-in-Mssgs	When on, message parameters use fixed 3-char format.
flg = 3 = Don't-Use-PAGE_PB_IN-to-Page	When on, the contact closure input will NOT activate/deactivate page-1. (sends general activate/deactivate messages instead)
flg = 5 = IR-Legacy-Mode	When on, allows IR commands to produce legacy (2-dB) messages (for RS-232, this is handled automatically based on *LW vs. *CW hdr).

Note P7 – Temporary-Configuration-Flags (*PW,240):
The Temporary-Configuration-Flags (100-199) may be turned on to temporarily change aspects of the system – the power-up for these flags is always 0 (off).

flg = 100 = Echo-Chars	When on, RS-232 characters are echoed (for testing only)
flg = 101 = Show-Diagnostic-Mssgs	When on, diagnostic messages (!M,190 to !M,199) are enabled

Note P8 – Set New Baud-Rate command (*PW,250):
The *PW,250,0,1,bau command is used to change the baud-rate:

bau	baud-rate	bau	baud-rate
12	1200	19	19200
24	2400	38	38400
48	4800	57	57600
96	9600	115	115200

The factory setting is 38400-baud, and this is the recommended baud-rate -- but this can be changed if your control system needs a faster or slower rate. No message is returned, as the baud rate has now been changed.

Note P9 – Source-Trim-Gain command (*PW,24):

If a source seems to be at a lower volume level than other sources, its gain may be increased up to 15-dB. By tweaking source-trim-gains, you may "level" sources so they all sound at a similar volume when switching. Also, you may reset all source-trim-gains to stg=0, by specifying ssa=0.

stg	gain	stg	gain	stg	gain
0	0 dB	7	+7 dB	14	+14 dB
1	+1 dB	8	+8 dB	15	+15 dB
2	+2 dB	9	+9 dB		
3	+3 dB	10	+10 dB		
4	+4 dB	11	+11 dB		
5	+5 dB	12	+12 dB	240	vol-down = stg-1
6	+6 dB	13	+13 dB	241	vol-up = stg+1

Note P10 – Zone Taper Delays command (*PW,26):

Taper delays are inserted between each 1-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. These delays are global for all zones.

Note P11 – Percent-Volume-Range-Low/High command (*PW,28):

When adjusting a zone's volume using the (0 to 100) Percent-Volume (*LW,21) command, or the (0 to 255) Byte-Volume (*LW,22) command, the volume range is normally the maximum of -80 dB to +6 dB (20 to 106, in the absolute scale). The *PW,28 command is used to program the Volume-Range-Low/High levels, to set a range less than the maximum.

For example, you may want your 0 to 100% levels to range over -40 dB to 0 dB (60 to 100 absolute). To do this you would issue an *PW,28,bzn,60,100 command (setting bzn as needed) – this example prevents the lower part of the percentage adjustment range from being barely audible, by setting the 0% point at -40 dB, and sets the 100% point at the passthrough level of 0-dB. Note that this Volume-Range is global for all zones on the switcher. Note also, that each zone has programmable Min/Max-Volume levels – each zone's min/max levels will overide this percent/byte Volume-Range, should they be set to more restrictive levels.

Note P12 – Zone-Interactive-Setup (*PW,30) command:

See note P13 (below) for more information on these parameters. The Zone-Interactive-Setup (*PW,30) command is handy for tweaking zones at installation time, especially while listening to a source so you can set each zone's Turn-On volume. The *PW,30 command functions identically 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-Turn-On-Volume (vto) to current volume level
sid = 2	Set Zone-Mute-Volume (vmm) to current volume level
sid = 3	Set Zone-Min-Volume (vll) to current volume level
sid = 4	Set Zone-Max-Volume (vhh) to current volume level
sid = 5	Set Previous-Volume-Flag Off (zone turns on with programmed Turn-On-Volume level – normal)
sid = 6	Set Previous-Volume-Flag On (zone turns on at previous volume level, saved when last turned off)
sid = 7	(not used)
sid = 8	(not used)
sid = 9	Restore Zone-Factory-Settings (restored on this one zone only)

Note P13 –Zone-Config-A (*PW,31) command:
>   Parameters in the Zone-Config-A set are the most commonly-modified. Note that this command is used for programming specific zones, and changes will not be noticed until the zone is turned off and then back on.
>
>   *Note some interaction between programmed zone volume parameters:*
>
>   The zone Minimum-Volume (vll) has priority over Mute-Volume (vmm) and Turn-On-Volume (vto), and is the zone's absolute minimum volume. If Minimum-Volume is incorrectly set above Maximum-Volume (vhh), then Minimum-Volume will be presumed to be zero. Maximum-Volume has priority over all other settings, and is the zone's absolute maximum volume level. If Turn-On-Volume is incorrectly set above Maximum-Volume, then Turn-On-Volume will be presumed to be Maximum-Volume. If Turn-On-Volume is incorrectly set below Minimum-Volume, then Turn-On-Volume will be presumed to be Minimum-Volume. The Turn-On-Volume level should be set after performing a balance adjustment on a zone.
>
>   Mute-Volume (vmm) should be chosen after selecting Minimum-Volume (vll) and Maximum-Volume (vhh). Mute-Volume is a ceiling, not an absolute level. If Mute-Volume is set above Minimum-Volume zone volume levels may go below Mute-Volume level. When muting, volumes above Mute-Volume will lower to Mute-Volume level, but volumes below Mute-Volume will not change. If Mute-Volume is incorrectly set above Maximum-Volume, then Mute-Volume will be presumed to be Maximum-Volume. If Mute-Volume incorrectly set below Minimum-Volume, then Mute-Volume will be presumed to be Minimum-Volume. Balance is preserved when zone is unmuted.
>
>   Audio-Mode byte mod is a collection of bits – only bit 1 is currently defined (MODE_PREVIOUS_VOL_BIT). The factory setting for mod is 0, which is using the programmed zone Turn-On-Volume (not previous-volume). To set a zone to turn-on at the previous-volume, set mod to 2.

Definition	mod-bit	bit-value
(unused)	bit-0	1
MODE_PREVIOUS_VOL_BIT	bit-1	2
(unused)	bit-2	4
(unused)	bit-3	8
(unused)	bit-4	16
(unused)	bit-5	32
(unused)	bit-6	64
(unused)	bit-7	128

Note P14 – Zone-Config-B (*PW,32), and Zone-Config-C (*PW,33) commands:
>   Parameters in the Zone-Config-B/C sets relate to EQ. There are analogous *LW commands, used for system operation, which will also update an active zone with the new bass/midrange/treble levels or parametrics. The *PW commands are used for programming specific zones, and changes will not be noticed until the zone is turned off and then back on.
>
>   The primary EQ settings for each zone – bass/midrange/treble *levels* – are typically adjusted using the normal control (*LW,40/41/42) commands, while listening to a zone. They are also included in the Zone-Config-B command (*PW,32) as zone programming parameters.
>
>   The secondary EQ settings for each zone – bass/midrange/treble *parametrics* – are typically adjusted using the normal control (*LW,46) command, while listening to a zone. They are also included in the Zone-Config-C command (*PW,33) as zone programming parameters.

Note P15 – Volume Levels are 1-dB/increment (100 = 0dB):

106	+6 dB	91	-9 dB	76	-24 dB	61	-39 dB	46	-54 dB	31	-69 dB
105	+5 dB	90	-10 dB	75	-25 dB	60	-40 dB	45	-55 dB	30	-70 dB
104	+4 dB	89	-11 dB	74	-26 dB	59	-41 dB	44	-56 dB	29	-71 dB
103	+3 dB	88	-12 dB	73	-27 dB	58	-42 dB	43	-57 dB	28	-72 dB
102	+2 dB	87	-13 dB	72	-28 dB	57	-43 dB	42	-58 dB	27	-73 dB
101	+1 dB	86	-14 dB	71	-29 dB	56	-44 dB	41	-59 dB	26	-74 dB
100	**0 dB**	85	-15 dB	70	-30 dB	55	-45 dB	40	-60 dB	25	-75 dB
99	-1 dB	84	-16 dB	69	-31 dB	54	-46 dB	39	-61 dB	24	-76 dB
98	-2 dB	83	-17 dB	68	-32 dB	53	-47 dB	38	-62 dB	23	-77 dB
97	-3 dB	82	-18 dB	67	-33 dB	52	-48 dB	37	-63 dB	22	-78 dB
96	-4 dB	81	-19 dB	66	-34 dB	51	-49 dB	36	-64 dB	21	-79 dB
95	-5 dB	80	-20 dB	65	-35 dB	50	-50 dB	35	-65 dB	20	-80 dB
94	-6 dB	79	-21 dB	64	-36 dB	49	-51 dB	34	-66 dB		
93	-7 dB	78	-22 dB	63	-37 dB	48	-52 dB	33	-67 dB		
92	-8 dB	77	-23 dB	62	-38 dB	47	-53 dB	32	-68 dB		

Note P16 – Balance Levels are 1-dB/increment (40 = full-left, 100 = center, 160 = full-right):

bal:	left:	right:	
160	off	0 dB	FULL RIGHT, which is right channel at 0dB, and left channel off
159	-59 dB	0 dB	
158	-58 dB	0 dB	
…	…	...	
102	-2 dB	0 dB	
101	-1 dB	0 dB	balance to RIGHT
100	**0 dB**	**0 dB**	**balance centered**
99	0 dB	-1 dB	balance to LEFT
98	0 dB	-2 dB	
…	…	...	
42	0 dB	-58 dB	
41	0 dB	-59 dB	
40	0 dB	off	FULL LEFT, which is left channel at 0dB, and right channel off

Note P17 – EQ Levels (bas, mid, trb) are 1-dB/increment (100 = 0dB):

115	+15 dB	110	+10 dB	105	+5 dB	**100**	**0 dB**	95	-5 dB	90	-10 dB
114	+14 dB	109	+9 dB	104	+4 dB	99	-1 dB	94	-6 dB	89	-11 dB
113	+13 dB	108	+8 dB	103	+3 dB	98	-2 dB	93	-7 dB	88	-12 dB
112	+12 dB	107	+7 dB	102	+2 dB	97	-3 dB	92	-8 dB	87	-13 dB
111	+11 dB	106	+6 dB	101	+1 dB	96	-4 dB	91	-9 dB	86	-14 dB
										85	-15 dB

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.

Control-Read Cmd Description	Command	Status-Message
Read-System-Info-1	*LR,1,bzn <cr>	!M,1,bzn,fam,fid,nza,nsa,nzc,nsc,nzd,nsd,0,0 <cr>
Read-System-Info-2	*LR,2,bzn <cr>	!M,2,bzn,ilm,mkb,brs,0,0,0,0,fvh,fvl,fvt <cr>
Read-Acknowledge	*LR,9,bzn <cr>	!M,9,bzn <cr>
Read-Zone-Audio-Status	*LR,12,zon <cr>	!M,12,zon,ssa,bal,sta,vol <cr>
Read-Zone-Component-Status	*LR,14,zon <cr>	!M,14,zon,ssc <cr>
Read-Zone-Digital-Audio-Status	*LR,15,zon <cr>	!M,15,zon,ssd <cr>
Read-Zone-Volume	*LR,20,zon <cr>	!M,20,zon,sta,vol <cr>
Read-Zone-Balance	*LR,38,zon <cr>	!M,38,zon,bal <cr>
Read-Zone-EQ	*LR,40,zon <cr>	!M,40,zon,bas,mid,trb <cr>
Read-Zone-EQ-Parametrics	*LR,46,zon <cr>	!M,46,zon,baf,mif,trf,baq,miq,trq <cr>
Read-All-Audio-Status	*LR,62,bzn <cr>	!M,12... (for all zones on bzn switcher)
Read-All-Component-Status	*LR,64,bzn <cr>	!M,14... (for all zones on bzn switcher)
Read-All-Digital-Audio-Status	*LR,65,bzn <cr>	!M,15... (for all zones on bzn switcher)
Read-Current-State	*LR,90,bzn <cr>	!M,90,bzn,fam,fid,0,0,pag,mst <cr>

bzn is base-zone of switcher	1 to 249; on 8/16-zone increments (eg: 1, 9, 17, 25, 33,...)
zon is zone	1 to 255 (zone-0 not permitted)
nza is number of audio zones	eg: 0, 8, or 16
nsa is number of audio sources	eg: 0, 8, or 16
nzc is number of component zones	eg: 0, 8, or 16
nsc is number of component sources	eg: 0, 6, or 12
nza is number of digital-audio zones	eg: 0, 8, or 16
nsa is number of digital-audio sources	eg: 0, 6, 12, or 24
ilm is IR-Legacy-Mode	0 = disabled = normal; 1 = enabled (IR cmds result in old !S mssgs)
mkb is non-volatile memory in kb	eg: 2, 4, 8, 16, 32, or 64
brs is boot-random-seed	0 to 255 (random number)
fvh,fvl,fvt is Firmware-Version	0 to 99 each (eg: 10,0,1 is version 10.0.1)

For other messages and parameters, see definitions in earlier sections