Bose Professional Systems Division

Design | Performance | Support

ControlSpace® Serial Control Protocol v4.4

ControlSpace® ESP engineered sound processors
PowerMatch® configurable professional power amplifiers

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1 About

The ControlSpace® Serial Control Protocol is supported on the following products:

> *ControlSpace ESP-00 Series II, ESP-00, ESP-88 processors*
> *ControlSpace ESP-880, ESP-1240, ESP-4120, ESP-1600 processors*
> *PowerMatch PM8500N, PM8250N, PM4500N, PM4250N amplifiers*

This protocol can be used over RS-232 (ESP processors only) or Ethernet (TCP/IP) and helps provide a communication mechanism for Bose ControlSpace and PowerMatch products to interface with third-party control systems such as; AMX, Crestron, Extron, or any other controller capable of following this protocol.

The purpose of this document is to provide programmers and integrators the necessary details on the commands available, their behavior and syntax.

Note: Where this document references the ESP-00 it applies equally to the current ESP-00 II and to the legacy ESP-00 and ESP-88 processors

2 Connection

Using the RS-232 Serial Port (ESP only)

When using RS-232, a 3-wire connection is sufficient to communicate with the ESP, although the use of the CTS/RTS pins is optional. A crossover (or null-modem) cable will be required to connect the ESP directly to a PC. The default communication settings are shown below. If required these settings can be changed via ControlSpace Designer™ software.

	ESP-00	ESP-880/1240/4120/1600
Baud	38,400	115,200
Data bits	8	8
Parity	None	None
Stop bits	1	1
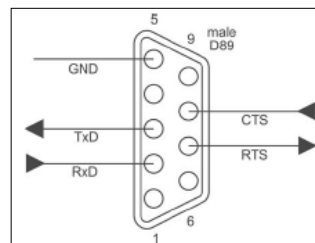
RS-232 Panel Connector Pinout (DTE)

Using Serial-over-Ethernet (ESP and PowerMatch)

Both ESP and PowerMatch products can be controlled via serial commands sent over Ethernet using a TCP/IP connection. Communication is via the same physical Ethernet connection used for ControlSpace Designer software/Bose system control but an additional, dedicated port number (10055) is provided for third-party control allowing them to operate simultaneously.

Note: The third-party control connection will be closed when going on-line with ControlSpace Designer software to allow the new design to be loaded. The control connection can be re-established once on-line. Most control systems can do this automatically.

ESP and networked PowerMatch products can support up to eight simultaneous serial-over-Ethernet connections (for ESPs, these are in addition to the physical RS232 serial port). These connections are shared with any instances of ControlSpace Remote which use the same communication method. Once eight connections have been established, additional requests will be refused until one of the existing connections has been closed. Serial output and asynchronous feedback is sent to all active connections (including the physical RS232 port on ESPs) and Serial input will monitor all active connections for the specified strings. In contrast, responses to query commands are only returned to the connection that initiated the query.

The ESP-00 and PowerMatch products use a fixed port number of '10055' for third-party control connections. ESP-880/1240/4120/1600 devices also use the same port by default, but allow the port to be changed or disabled via the device properties in ControlSpace Designer software if required.

Reserved Port Numbers	
Serial-over-Ethernet	10055
ControlSpace Designer software	10001,10002
Scan/Discovery	9010
Firmware updates	9008, 9009
Inter-device communication	2005, 2006, 2007

It's important to note that ESP and PowerMatch products only act as a server for serial-over-Ethernet connections. The connection must be initiated by the remote device.

Using 'Hyperterminal' configured for TCP/IP (as shown below) is a convenient way to test these commands.
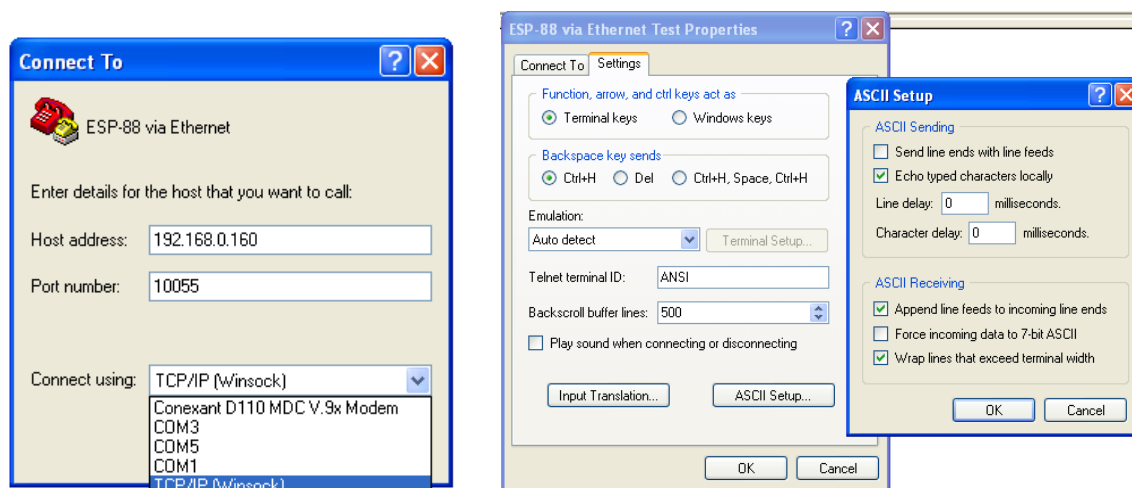
Note: HyperTerminal is no longer be bundled with newer versions of Microsoft Windows® operating systems. Freeware solutions such as *ClearTerminal* are available online and can be used to test commands as well.

3 Command Format

All commands and responses are sent using ASCII, terminated with a <CR> (carriage return, ASCII 0x0D). There is no time limit between characters of a command so it is possible to enter commands using a "dumb terminal". The available commands are divided into three categories according to their scope.

> **System Commands (Parameter Sets, Groups ..)**
> **Device Commands   (Inputs, Outputs, Set IP address, Get alarm status …)**
> **Module Commands (Signal processing parameters ..)**

System and Device Commands

Numerical values for System and Device Commands are entered using hexadecimal ASCII. For example, 16 (decimal) is entered as 10 (hex) and 34 (decimal) is entered as 22 (hex).

> > Command should be capital letters
> > A space after the command is optional (SS 10 or SS10 are both acceptable)
> > A comma "," is used as the separator
> > Hexadecimal values do not require a suffix ("A3h" not allowed – should be "A3")
> > Hexadecimal values can be sent in upper or lower case (SS A or SS a are both acceptable, but responses are always in lower case)
> > All commands are terminated with a <CR> (Carriage Return – ASCII 0x0D)
> > No acknowledgement is sent, following a 'Set' command with a 'Get' is a convenient method for confirming the command was successful.

Module Commands:

Numerical values for Module Commands are entered as simple ASCII text. For example, -28dB is entered simply as "-28"

> > Command should be 2 capital letters
> > A space after the command is optional (SA "xx" or SA"xx" are both acceptable)
> > Module name must be unique and should always be enclosed in quotes ("Name")
> > Command may have 1 or 2 Indices separated by ">" (ASCII 0x3E)
> > Set commands and Get responses always end with "=" (ASCII 0x3D) followed by the parameter Value
> > Numerical values are entered as simple ASCII text without the units (e.g. -28dB is simply entered as "-28")
> > Multiple commands sent on a single line are separated by a semi-colon (ASCII 0x3B)
> > All commands are terminated with a <CR> (Carriage Return – ASCII 0x0D)
> > Device will respond with 'ACK' (ASCII 0x06) if successful or 'NAK **nn**' if received but unsuccessful where **nn** is a 2 digit error code.

4   System Commands

System commands are used to invoke changes across multiple devices simultaneously and use constructs programmed via ControlSpace Designer software (such as Parameter Sets and Groups). Commands issued to the designated 'RTC/Main' device will be echoed to all other devices on the network (assuming they are correctly connected to the same network). Otherwise commands should be issued to one of the devices involved in the construct being controlled (e.g. if a Group spans two ESPs, then the Group command should only be issued to one of those two devices, not to others).

System commands use hexadecimal notation for numerical values and only 'Get' commands generate a response. Following a 'Set' command with a 'Get' is a useful way to confirm command success.

> **4.1   Set/Get Parameter Set (SS, GS)**
> **4.2   Set/Get Group Master Level (SG, GG)**
> **4.3   Set Group Volume Increment/Decrement (SH)**
> **4.4   Set/Get Group Master Mute (SN/GN)**

4.1   Set/Get Parameter Set (SS, GS)

To recall or invoke Parameter Set *n*:
   SS *n* <CR>   where *n* is the Parameter Set number, 1 - FFh (1-255 decimal)

To query for the last invoked Parameter Set
   GS <CR>

Response:
   S *n* <CR>   where *n* = 0 – FF (n = 0 if no Parameter Set recalled, e.g. after power-up)

EXAMPLES:

SS 5<CR>	*Recall Parameter Set 5*
GS<CR>	*Query for last invoked Parameter Set*
S 5<CR>	*Response indicating Parameter Set 5 was invoked last*

4.2 Set/Get Group Master Level (SG, GG)

Groups of ESP inputs, outputs or gain blocks have a range of -60dB to +12dB, whereas the PowerMatch Amplifier Outputs do not have gain and therefore have a maximum level of 0dB (78h).

To set the master level of Group *n* to level *l* :
  SG *n,l* <CR>   where *n* is the Group number, 1 – 40h (1-64 decimal)
                l is the level, 0h(-60dB) to 90h(+12dB) in 0.5dB steps (0-144 dec)
                  or PM, 0h(-60dB) to 78h(0dB) in 0.5dB steps (0-120 dec)

To query the level of Group *n*
  GG *n* <CR>   where *n* is the Group number, 1 – 40h (1-64 decimal)
  Response:
  GG *n,l*   where *n,l* are the same as above.

EXAMPLES:

SG 2, 78<CR>	*Set level for Group 2 to 0dB*
GG 2<CR>	*Query the level for Group 2*
GG 2,78<CR>	*Response indicating Group 2 is set to 0dB*

4.3 Set Group Level Increment/Decrement (SH)

To increment (or decrement) the master level of Group *n* by **x** number of 0.5dB steps:
  SH *n,d,x*<CR> where *n* is the Group number, 1 – 40h (1-64 decimal)
                d is the direction, 1=up or 0=down
                x is the number of 0.5dB steps in hexadecimal (e.g. 5dB = A)

EXAMPLES:

SH 2,1,6<CR>	*Increase the level of Group 2 by 3dB*
SH 7,0,3<CR>	*Decrease the level of Group 7 by 1.5dB*

4.4 Set/Get Group Master Mute (SN, GN)

To set or change the Mute state for Group *n*:
  SN *n,m*<CR> where *n* is the Group number, 1 – 40h (1-64 decimal)
                m is the state, M = Mute, U = Un-mute, T = Toggle mute state

To query the Mute state of Group *n*
  GN *n* <CR>   where *n* is the Group number, 1 – 40h (1-64 decimal)
  Response:
  GN *n,m*   where *n,m* are the same as above.

EXAMPLES:

SN 4,M<CR>	*Engage Mute for Group 4*
GN 4<CR>	*Query the Mute status for Group 4*
GN 4,M<CR>	*Response indicating Group 4 is Muted*

5 Device Commands

Device commands should be issued directly to the relevant ControlSpace device and will invoke changes locally within that device. Device commands use hexadecimal notation for numerical values and generally only 'Get' commands generate a response. Following a 'Set' command with a 'Get' is a useful way to confirm the success of a command.

      5.1   **Set/Get Input/Output Volume (SV, GV)**
      5.2   **Set Volume Increment/Decrement (SI)**
      5.3   **Set/Get Input/Output Mute (SM, GM)**
      5.4   **Get Signal Level (GL)**
      5.5   **Set/Get IP Address (IP)**
      5.6   **Network Parameters (NP)**
      5.7   **Reset/Reboot Device (RESET)**
      5.8   **Set/Get Standby Status (SY,GY)** [PowerMatch Only]
      5.9   **Get Configuration (GC)** [PowerMatch Only]
    5.10   **Set/Get Fault Status (SF, GF)** [PowerMatch Only]
    5.11   **Clear Fault/Alarms (CF)** [PowerMatch Only]
    5.12   **Set/Get Alarm Reporting/Status (SR, GR)** [PowerMatch Only]
    5.13   **Get/Clear Alarm History/Log (GH, CH)** [PowerMatch Only]

The Volume (SV,GV,SI) and Mute (SM,GM) commands allow control of input/output levels and mutes directly, referenced by a slot and channel number according to the physical architecture of the device, rather than by Module name. Whilst these commands are still currently supported it is recommended that Module commands (SA,GA) be used to control the input and output modules for new projects.

The ESP-00 has 8 audio card slots and each card can support up to 8 channels, although many cards only have 4 channels and do not use channels 5-8. These commands are not supported on Surround decoder, Dante and CobraNet cards.

ESP-880/1240/4120/1600 and PowerMatch devices have a fixed architecture but still allow channels to be referenced using the following pseudo 'slot' numbers:

Slot	ESP-00	ESP-880	ESP-1240	ESP-4120	ESP-1600	PM8xxxN	PM4xxxN
1		In 1-4	In 1-4	In 1-4	In 1-4	In A-D	In A-D
2		Out 1-4	Out 1-4	Out 1-4	In 5-8	Out 1-4	Out 1-4
3		In 5-8	In 5-8	Out 5-8	In 9-12	In E-H	
4	Flexible	Out 5-8	In 9-12	Out 9-12	In 13-16	Out 5-8	
5		ESPLink	ESPLink	ESPLink	ESPLink		
6							
7							
8							

Table 1

> **Note**: For 8ch PowerMatch devices the Get Signal Level (GL) command only uses Slot 1 (for Inputs) and Slot 2 (for Outputs) for all 8 channels.

5.1   Set/Get Input/Output Volume (SV, GV)

Input and output volume levels are referenced by slot and channel numbers according to the physical architecture of the device (see Table 1). PowerMatch devices only support volume control of the outputs

Note: Set Volume commands will be ignored if the channel is muted.

To set the input/output volume of slot **s**, channel **c,** to level **l** :
    SV **s,c,l**<CR> where **s** is the slot number, 1 – 8 (for ESP-00), 1 – 5 (for ESP-880/1240/4120/1600), 2 or 4 (for PM)
        c is the channel number, 1 – 8 (for ESP), 1 - 4 (for PM)
        l is the level,   0h(-60dB) to 90h(+12dB) in 0.5dB steps (0-144 dec)
        or PM 0h(-60dB) to 78h(0dB) in 0.5dB steps (0-120 dec)

To query the input/output level of slot **s**, channel **c:**
    GV **s,c**<CR>   where **s** is the slot number, 1 – 8 (for ESP-00), 1 – 5 (for ESP-880/1240/4120/1600), 2 or 4 (for PM)
        c is the channel number, 1 – 8 (for ESP), 1 - 4 (for PM)
    Response:
    GV **s,c,l**   where **s,c,l** are the same as above.

EXAMPLE:

SV 1,3,50<CR>	*Set volume for slot 1, channel 3 to -20dB*
GV 2,1<CR>	*Query the volume level for slot 2, channel 1*
GV 2,1,78<CR>	*Response indicating the level for slot 2 channel 1 is set to 0dB*

5.2   Set Volume Increment/Decrement (SI)

Input and output volume levels are referenced by slot and channel numbers according to the physical architecture of the device (see Table 1). PowerMatch devices only support volume control of the outputs.

Note: Set Volume Increment/Decrement commands will be ignored if the channel is muted.

To increment (or decrement) the level of slot **s**, channel **c**:
    SI **s,c,d,x**<CR>where **s** is the slot number, 1 – 8 (for ESP-00), 1 – 5 (for ESP-880/1240/4120/1600), 2 or 4 (for PM)
        c is the channel number, 1 – 8 (for ESP), 1 - 4 (for PM)
        d is the direction, 1=up or 0=down
        x is the number of 0.5dB steps in hexadecimal (e.g. 5dB = A)

EXAMPLE:

SI 2,3,1,6<CR>	*Increase the level of slot 2, channel 3 by 3dB*
SI 4,1,0,3<CR>	*Decrease the level of slot 4, channel 1 by 1.5dB*

5.3   Set/Get Input/Output Mute (SM, GM)

Input and output volume levels are referenced by slot and channel numbers according to the physical architecture of the device (see Table 1). PowerMatch devices only support volume control of the outputs.

To set or change the Mute status for slot *s*, channel *c*:
   SM *s,c,m*<CR>where *s* is the slot number, 1 – 8 (for ESP-00), 1 – 5 (for ESP-880/1240/4120/1600), 2 or 4 (for PM)
   c is the channel number, 1 – 8 (for ESP), 1 – 4 (for PM)
   m is the state, M = Mute, U = Un-mute, T = Toggle mute state

To query the Mute status for slot *s*, channel *c*:
   GM *s,c*<CR>   where *s* is the slot number, 1 – 8 (for ESP-00), 1 – 5 (for ESP-880/1240/4120/1600), 2 or 4 (for PM)
   c is the channel number, 1 – 8 (for ESP), 1 – 4 (for PM)

Response:
GM *s,c,m*   where *s,c,m* are the same as above.

EXAMPLE:

SM 2,1,M<CR>	*Engage Mute for slot 2, channel 1*
GM 3,2<CR>	*Query the Mute status for slot 3, channel 2*
GM 3,2,U<CR>	*Response indicating slot 3, channel 2 is un-muted*

5.4   Get Signal Level (GL)

This command can be used to query the current signal levels for inputs or outputs on an ESP or PowerMatch device. The levels returned for inputs and ESP outputs are dBFS in hexadecimal format. To convert to dBu, first convert to decimal and then add 24dB for ESP-00 and 25dB for ESP-880/1240/4120/1600. For PM outputs the levels returned are dBVmax in hexadecimal format. For a mono channel Vmax (0dB/78h/120d) = 71V and for a bridged/quad channel Vmax (0dB/78h/120d) = 141V.

To query the current signal level for channels in slot *s*:
   GL *s*<CR> where *s* is the slot number, 1 – 8 (for ESP-00), 1 – 5 (for ESP-880/1240/4120/1600), 1 for PM input, 2 for PM output

Response:
GL *s [1,2,3,4,5,6,7,8]* *s* is the slot number, 1 – 8
   1-8 are the dBFS levels for each channel (ESP/PM input)
   or dBVmax for each channel (PM output)
   0h(-60dB) to 78h(0dB) in 0.5dB steps (0-120 decimal)

   Note: 4 channel cards will only return 4 values.

EXAMPLE:

GL 1<CR>	*Query signal levels for slot 1*
GL 1 [78,1,40,64]<CR>	*Response indicating levels are 0,-59.5,-28,-10dBFS*
GL 2<CR>	*Query signal levels for PowerMatch output levels*
GL 2 [0,0,0,0,0,0,64,64]<CR>	*Response indicating ch7& 8 are at -10dBVmax*

5.5 Set/Get IP Address (IP)

The Set and Get IP address commands provide an alternative method for querying and changing the IP address of ControlSpace Devices when the Network Setup utility in ControlSpace Designer software is not available. In particular for ESP devices when the IP address is unknown (PowerMatch amps show the network IP address on the front panel).

To query the current IP address for the device:
> IP<CR>
> *Response:*
> IP xxx.xxx.xxx.xxx <CR>

To set or change the IP address for the device:
> IP xxx.xxx.xxx.xxx<CR>

EXAMPLE:
> IP<CR>   *Query the current IP address for the device*
> IP 192.168.0.160<CR>*Response indicating an IP address of 192.168.0.160 is set*
> IP 192.168.1.160<CR>*Command changing the IP address to 192.168.1.160 (after boot)*

Note: When using the IP command to change IP address, the changes do not take effect until after the device has been re-booted.

5.6 Network Parameters (NP)

The Network Parameter command allows additional network settings such as; Subnet Mask, Default Gateway and DHCP mode to be set or queried. There is also a command to return all the network settings (including the IP address) to their factory default settings. This can be particularly useful when the network settings for an ESP are unknown, but you do have access to the RS232 serial port.

To query a particular network setting for the device:
> NP *p*<CR>   where   *p* is the network parameter to query
> T = Type (DHCP or Static, not available for ESP-00),
> M = Subnet Mask, G = Default Gateway
>
> *Response:*
> NP *p,v* <CR> where   *p* is the network parameter queried
> *v* is the value, D = DHCP or S = Static IP for Type <or>
> xxx.xxx.xxx.xxx address for Subnet Mask and Default Gateway

To set a particular network setting for the device:
> NP *p,v*<CR>   where *p* is the network parameter to set
> T= Type (DHCP or Static), M = Subnet Mask,G = Default Gateway
> *v* is the value, D = DHCP or S = Static IP for Type <or>
> xxx.xxx.xxx.xxx address for Subnet Mask and Default Gateway

To reset all network parameters for the device to factory defaults:
> NP F<CR>

Note: Any changes to network parameters do not take effect until after the device has been re-booted, or restarted using the 'RESET<CR>' command.

EXAMPLE:

NP M<CR>	*Query the current Subnet Mask for the device*
NP M,255.255.255.0<CR>	*Response indicating a Subnet Mask of 255.255.255.0*
NP M,255.255.255.128<CR>	*Command to change Mask to 255.255.255.128 (after boot)*
NP G,192.168.0.2<CR>	*Command to change Gateway to 192.168.0.2 (after boot)*
NP T<CR>	*Query the current networking mode for the device*
NP T,D<CR>	*Response indicating device is currently set to DHCP*
NP T,S<CR>	*Command for device to change to static IP addresses*
NP F<CR>	*Command to reset network settings to factory defaults*

Factory default network settings

Device Type	IP Address	Subnet Mask	Default Gateway	Type
ESP-00/88	192.168.0.160	255.255.255.0	192.168.0.1	N/A
ESP-880/4120/1240/1600	192.168.0.160	255.255.255.0	192.168.0.1	DHCP
PM8500N/PM8250N	192.168.0.80	255.255.255.0	192.168.0.1	DHCP
PM4500N/PM4250N	192.168.0.40	255.255.255.0	192.168.0.1	DHCP

5.7 Reset/Reboot Device (RESET)

The Reset command instructs a device to restart (the equivalent of power-cycling or rebooting). This can be useful when making IP address or Network Parameter changes remotely since the changes only take effect after the device has been rebooted.

When connected via RS232 an ESP will send a "Ready" string once the boot process is completed, whereas serial-over-Ethernet connections will need to be re-established once sufficient time has elapsed. The time it takes for a device to boot varies depending on the device type and the installed cards.

To reset/reboot a device:
    RESET<CR>

Note: Just like when the device is rebooted manually, all the current settings in the device will be lost and the device will revert to its power-on (flashed) settings.

EXAMPLE:

RESET<CR>	*Request the device to restart/reboot.*

5.8   Set/Get Standby Status (SY, GY) [PowerMatch Only]

The Set and Get Standby Status commands allow the power status of an individual PowerMatch device to be controlled remotely. Since entering or exiting standby is not immediate, adequate time should be allowed for the process to complete.

Alternatively the power status can also be controlled via Parameter Set using the device's 'Standby' property. This option allows multiple PowerMatch devices to be controlled together.

Note: This command is not supported on ESP devices

To set or change the standby state for a PowerMatch amplifier
   SY *s* <CR>   where *s* is the state, S = Standby, N = Normal

To query the current standby state for the device:
   GY<CR>
   Response:
   GY *s* <CR>   where *s* is the state, S = Standby, N = Normal

EXAMPLE:

SY S<CR>	*Put the PowerMatch device into standby mode*
GY<CR>	*Query the current standby state*
GY N<CR>	*Response indicating PowerMatch device is in Normal (ON) mode*

5.9   Get Configuration (GC) [PowerMatch Only]

The Get Configuration (GC) command returns the current output configuration of a PowerMatch amplifier. Knowledge of the output configuration can be useful when using the module (SA/GA) commands to change parameters.

To query the current output configuration
   GC<CR>
   Response:
   GC *1,2,3,4,5,6,7,8*<CR>   where *1-8* is the configured state for each channel of the Amplifier (*1-4* for PM4250N/PM4500N): IN= Independent (Mono), BL = Bridged (LoZ), B7 = Bridged (70v), B1 = Bridged (100v), PA = Parallel, QL = Quad (LoZ), Q7 = Quad (70v), Q1 = Quad (100v)

EXAMPLE:

GC <CR>	*Query the current output configuration*
GC IN,IN,BL,BL,Q7,Q7,Q7,Q7<CR>	*Response indicating channels 1&2 are Independent, 3&4 are Bridged (Lo-Z) and 5-8 are in Quad (70v) mode.*

5.10   Set/Get Fault Status (SF, GF) [PowerMatch Only]

The Get Fault Status (GF) command queries the current state of the Fault Output on a PowerMatch amplifier. The Set Fault status (SF) command enables or disables unsolicited transmission of changes to the Fault Output state. The format of the unsolicited message is the same as the response to the Get Fault status (GF) command.

Note: The Set Fault status (SF) preference is not retained on power down and will default to 'Off' each time the amplifier is powered up.

To set (enable or disable) unsolicited notification of Fault Output state changes:
    SF *n*<CR>   where *n* is the notification state, O = ON, F = OFF

To query the current Fault status:
    GF <CR>
    Response:
    GF *f* <CR>   where *f* is the current Fault status, F= Fault, C = No Fault

EXAMPLE:

SF O<CR>	*Enable unsolicited output of Fault Output state changes*
GF<CR>	*Query the current status of the Fault Output*
GF F<CR>	*Response indicating that the PowerMatch device is currently in a fault state.*

5.11   Clear Fault/Alarms (CF) [PowerMatch Only]

The Clear Fault/Alarms (CF) command clears any currently active alarm conditions and resets the Fault Output on a PowerMatch device. Note that if any alarm or fault conditions are still present after the reset, the alarm status and Fault output will automatically be set again.

To clear currently active alarm conditions/Fault output:
    CF<CR>
    Response:
    <ACK><CR>

EXAMPLE:

CF<CR>	*Command to clear active alarms/reset fault state*
<ACK><CR>	*Response indicating action was successful*

5.12   Set/Get Alarm Reporting/Status (SR, GR) [PowerMatch Only]

The Get Alarm Status (GR) command queries the current alarm/fault status for a channel of the PowerMatch amplifier, whilst the Set Alarm Reporting (SR) command enables or disables unsolicited transmission of alarm and fault events when they occur. The format of the unsolicited message is the same as the response to the Get Alarm Status (GR) command.

Note: The Set Alarm Reporting (SR) preference is not retained on power down and will default to 'Off' each time the amplifier is powered up.

To set (enable or disable) unsolicited notification of alarm/fault notifications:
SR *n*<CR>   where *n* is the notification state, O = ON, F = OF

Unsolicited notification format:
GR *c,s,t,x*<CR> where *c* is the channel number, 1 – 8 (or 0 for non-channel specific
                alarms such as Digital Audio Loss or AC Mains Loss)
              s is the severity; W=Warning, F=Fault, S= System
              t is the alarm type; N=No Alarm, O=Open, S=Short, A=ACLoss,
              D=Digital Audio Loss, I=I-Share Jumper Missing, L=Limiting,
              C=Clip (Input), P=Protection, Z = Other
              x is the condition; S=Set, C=Clear (not used for all alarms/faults)

To query the current alarm status for a single channel:
GR *c*<CR>   where *c* is the channel number, 1 – 8 (1 – 4 for PM4500N/PM4250N)
Response:
GR *c,s,t,*<CR> where *c* is the channel number, 1 – 8
              s is the severity; W= Warning, F=Fault, S= System, N=No Alarm
              t is the alarm type; N=None, O=Open, S=Short, I=I-Share Jumper
              Missing, Z = Other

              *Note: In the event that multiple alarms/faults exist for the same
              channel the one with the highest severity will be returned.*

              *The transient nature of alarms such as limiting or clipping means
              they cannot be queried manually, to receive such alarms turn on
              the automatic notification. Only the first instance of limiting or
              clipping for a given channel is reported, so for continued
              monitoring alarms should be cleared after each notification.*

EXAMPLE:

SR O<CR>	*Enable unsolicited notification of Alarm/Fault conditions*
GR 5,F,I,S<CR>	*Unsolicited notification that ch5/6 I share jumper is missing*
GR 6,F,I,S<CR>	
GR 4<CR>	*Query the current alarm/fault status for channel 4*
GR 4,F,S<CR>	*Response indicating that ch4 has a 'FAULT-SHORT'*

5.13 Get/Clear Alarm History/Log (GH, CH) [PowerMatch Only]

The Get Alarm History (GH) command requests a dump of the internal alarm history/log to the serial output, whilst the Clear Alarm History (CH) command causes the internal alarm log to be cleared.

Note: The alarm log is returned in a similar format to the front panel display or the alarm panel in ControlSpace Designer software. Actual time/date values will only be returned if there has been no loss in power since last connected to ControlSpace Designer, otherwise relative values since last power-up will be returned.

To query/request the alarm log:
    GH<CR>
    Response:
    GH [Time, Date, Description<CR>
    Time, Date, Description<CR>
    ……
    Time, Date, Description]<CR

To clear the internal alarm history/log
    CH<CR>
    Response:
    <ACK><CR>

EXAMPLE:

CH<CR>	*Request Alarm log be cleared*
<ACK><CR>	*Response indicating command was successful*

6 Module Commands

Module commands allow control of parameters for a specific signal processing module on a specific device.

6.1. Set/Get Module Parameter (SA,GA)

The Set and Get Module Parameter commands provide access to virtually any parameter from any signal processing module of any ControlSpace device. Devices and Modules are referenced by their 'Label' assigned via the ControlSpace Designer software application. Unlike the ESP where all signal processing module Labels are user-definable, only the Input and Amp Output modules can be renamed on PowerMatch devices. All other signal processing module Labels are currently fixed.

Note: Module labels must be unique. If two modules within the same device have the same label then the SA and GA commands will not work correctly. For example; if an output module and a PEQ module are both named "Left" neither module will respond correctly.

In combination with the module label, the parameter to change or query is identified using 1 or 2 indices. These indices are unique to each type of module and are detailed at the end of this section.

Automatic notification (#Module Name)

It is also possible to receive automatic notification when a module's parameters change by prefixing the module name with "#" in ControlSpace Designer software. For example; by renaming module "Hall" to "#Hall" a GA (Get Module Parameter) response will be issued over the serial connection when any of the parameters for that module are changed by a CC-16 or CC-64 etc.

Note: A response will not be sent if the change is made via serial command.

To set or change a module parameter (SA)

SA "Module Name">Index 1>Index 2=Value<CR>

where	"Module Name"	is a unique Label set using Designer software
	>	'greater than' (ASCII 0x3E) is the separator between indices
	Index 1	Index 1 is the primary index (all modules)
	Index 2	Index 2 is a secondary index (some modules)
	=	'equals' (ASCII 0x3D) indicates Value follows
	Value	Value of parameter referenced by Module/Indices
Response:		
ACK		if command is successful (ASCII 0x06)
<or>		
NAK **nn**		if command is received but unsuccessful (ASCII 0x15), where **nn** is a 2 digit error code, detailed in table overleaf:

Code	Error
01	Invalid Module Name (no match found for module name)
02	Illegal Index (index value or quantity incorrect for specified module)
03	Value is out-of-range (value is not out-of-range for the specified parameter)
99	Unknown error

To query a module parameter (GA)

GA "Module Name">Index 1>Index 2<CR>

where	"Module Name"	is a unique Label set using Designer software
>	'greater than' (ASCII 0x3E) is the separator between indices
Index 1	Index 1 is the primary index (all modules)
Index 2	Index 2 is a secondary index (some modules)

Response:
GA "Module Name">Index 1>Index 2>=Value<CR>

When using ESPs it is possible to send a module command to a different device than the device on which the module resides, provided the ESPs are correctly networked together.

Note: This facility is not currently available for PowerMatch devices so commands should be sent to each device individually.

To set or change a module parameter on a different Device (SA)

SA @ "Device Name" "Module Name">Index 1>Index 2=Value<CR>

where	@	'at' (ASCII 0x40) indicates command is for a different Device
"Device Name"	is a unique Label set using Designer software

Response:
ACK   if command is successful (ASCII 0x06)
<or>
NAK **nn**   if command is received but unsuccessful (ASCII 0x15),
             where **nn** is a 2 digit error code – same as above

To query a module parameter on a different Device (GA)

GA @ "Device Name" "Module Name">Index 1>Index 2 <CR>

where	@	'at' (ASCII 0x40) indicates command is for a different Device
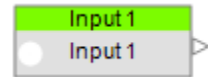	"Device Name"	is a unique Label set using Designer software

Response:
GA "Module Name">Index 1>Index 2>=Value<CR>

6.1 ESP Module Indices

6.1.1 INPUT Module

There are 5 parameters which can be set for this module selected simply by using the appropriate value for **Index 1**.
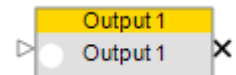
			Value	Mic/Line II and 1U ESPs	Legacy Mic/Line or 4x4
Index 1	1	Type	M,L	Unused	M=Mic, L=Line
	2	Gain	NN	0,14,24,32,44,54,64	0,14,24,42,48,54,64
	3	Level	NN.N	-999 to +12.0dB, 0.5dB step	
	4	Mute	O,F,T	O=On, F=Off, T=Toggle	
	5	Phantom	O,F,T	O=On, F=Off, T=Toggle	

EXAMPLES:

SA"In 1">3=-21<CR>	*Set the level for Input module "In 1" to -21dB*
SA"In 1">4=O<CR>	*Set the mute for Input module "In 1" to On*
GA"In 2">5<CR>	*Query whether phantom is active for Input module "In 2"*
GA"In 2">5=F<CR>	*Response indicating phantom for "In 2" is currently Off*

6.1.2 OUTPUT Module

There are 3 parameters which can be set for this module, selected simply by using the appropriate value for **Index 1**.

			Value	Range
Index 1	1	Level	NN.N	-999 to +12.0dB, 0.5dB step
	2	Mute	O,F,T	O=On, F=Off, T=Toggle
	3	Polarity	O,F,T	O=On, F=Off, T=Toggle
	4	*Reserved*		

EXAMPLES:

SA"Out Main">1=-3.5<CR>	*Set the level for Output module "Out Main" to -3.5dB*
SA"Output L">2=F<CR>	*Set the mute for Output module "Output L" to Off*
GA"Out 1">1<CR>	*Query the current level for Output module "Out 1"*
GA"Out 1">1=-6<CR>	*Response indicating "Out 1" is currently set to -6dB*

6.1.3   ESPLink Module

ESPLink outputs are presented as a single composite module but they are controlled as individual outputs. By default the channels are labeled "Ch 1" to "Ch 8" and are addressed by "ESPLink-Ch 1" to "ESPLink-Ch 8" respectively. Alternatively custom channel labels can be assigned in the Properties window of ControlSpace Designer.
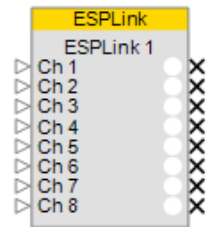
There are 3 parameters which can be set for each output, selected simply by using the appropriate value for **Index 1**.

|			*Value*	*Range*
	1	Level	NN.N	-999 to +12.0dB, 0.5dB step
Index 1	2	Mute	O,F,T	O=On, F=Off, T=Toggle
	3	Polarity	O,F,T	O=On, F=Off, T=Toggle
	4	*Reserved*		

EXAMPLES:

SA"ESPLink-Ch 1">1=-3.5<CR>   *Set the level for ESPLink output 1 to -3.5dB*
SA"ESPLink-Ch 5">2=F<CR>   *Set the mute for ESPLink output 5 to Off*
GA"ESPLink-Ch 3">1<CR>   *Query the current level for ESPLink output 3*
GA"ESPLink-Ch 3">1=-6<CR>   *Response indicating output 3 is set to -6dB*

### 6.1.4   DANTE I/O Modules

Direct control of Dante Input and Output modules via serial command is not currently supported, instead parameters can be changed indirectly using Parameter Sets.
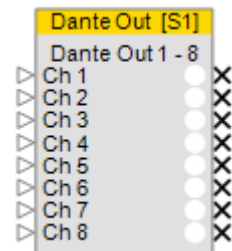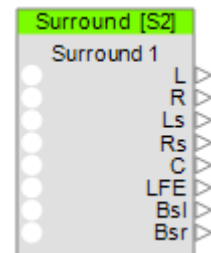
6.1.5   COBRANET I/O Modules [ESP-00 only]

Direct control of CobraNet Input and Output modules via serial command is not currently supported, instead parameters can be changed indirectly using Parameter Sets.
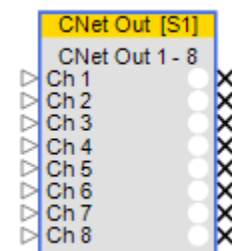
6.1.6 SURROUND INPUT Module [ESP-00 only]

In total there are 11 parameters which can be accessed for this module, selected simply by using the appropriate value for **Index 1**. By their nature Output Format and Room Type will be read-only.

			Value	*Range*
	1	Input Source	O,C	O=Optical, C=Coaxial
Index 1	**2**	Output Format (read-only)	XXXXX	N=No Signal, PCM16=PCM, DD51=Dolby5.1, DTS51=DTS5.1, ES61D=DTS6.1 Discrete ES61M=DTS6.1 Matrix DD1=Dolby1.0, DD2=Dolby2.0, DTS1=DTS1.0, DTS2=DTS2.0, DTS21=DTS2.1, DTS30=DTS3.0, DTS40=DTS4.0, DTS50=DTS5.0
	3	Room Type (read-only)	S,L,N	S=Small, L=Large, N=None
	4	Left Front Level	NN.N	-60.5 to 12.0, 0.5 step
	5	Right Front Level	NN.N	-60.5 to 12.0, 0.5 step
	6	Left Surround Level	NN.N	-60.5 to 12.0, 0.5 step
	7	Right Surround Level	NN.N	-60.5 to 12.0, 0.5 step
	8	Center Level	NN.N	-60.5 to 12.0, 0.5 step
	9	LFE (Sub) Level	NN.N	-60.5 to 12.0, 0.5 step
	10	Back Surround Left Level	NN.N	-60.5 to 12.0, 0.5 step
	11	Back Surround Right Level	NN.N	-60.5 to 12.0, 0.5 step

EXAMPLES:

SA"Surround 1">1=C<CR>   *Select the coaxial input for Surround card "Surround 1"*
SA"Surround 1">8=-5<CR>   *Set the center channel level for "Surround 1" to -5dB*
GA"Surround 1">2<CR>   *Query the current Output Format from the digital stream*
GA"Surround 1">2=DD51<CR>*Response indicating current format is Dolby Digital 5.1*

6.1.7 AGC Module

This module has 3 parameters selected simply by using the appropriate value for **Index 1**. The mono AGC module does not have Detector selection and hence Index 1=1 would not be used. Index 1=3,4,5 are reserved and should not be used for either module.
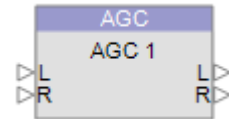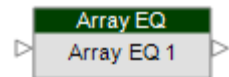
			Value	Range
Index 1	1	Detector (stereo)	L,R,M	L=Left, R=Right, M=Mix
	2	Threshold	NN.N	0 to -40 dBFS 0.5 Step
	3	Reserved		
	4	Reserved		
	5	Reserved		
	6	Bypass	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"AGC 1">1=M<CR>	*Set the detector of stereo AGC module "AGC 1" to Mix*
SA"AGC 1">2=-20<CR>	*Set the threshold for AGC module "AGC 1" to -20dBFS*
GA"BGM">6<CR>	*Query the current state of the bypass for "BGM"*
GA"BGM">6=F<CR>	*Response indicating bypass for module "BGM" is Off*

6.1.8 ARRAY EQ Module

Index 1 should always be set to 1 to access this module. There are 7 parameters which can be set for the Array EQ module on the ESP using the appropriate value for **Index 2**. By the nature of the module you would not use the Array parameters (7 & 8) and the Advanced parameters (1,2 & 3) at the same time. Parameter 4 is reserved and should not be used.

Index 1: Selects module (always=1)

			Value	Range
Index 2	1	Cntr Freq	NNN	220 to 700Hz
	2	Tilt	NN.N	0.0 to 10.0. 0.1 step
	3	Gain	+/-NN.N	-12.0dB to +2.0dB, 0.1dB step
	4	Reserved		
	5	Bypass	O,F,T	O=On, F=Off, T=Toggle
	6	Advanced	O,F,T	O=On, F=Off, T=Toggle
	7	# Modules	N	2 to 8, 1 step
	8	Vert. Angle	NN	20-100, 5 step

EXAMPLES:

SA"Array EQ 1">1>7=6<CR>	*Set the qty of RoomMatch™ modules for "Array EQ 1"to 6*
SA"Main L">1>8=80<CR>	*Set the Vertical coverage angle for "Main L" to 80 deg*
GA"Array EQ">1>5<CR>	*Query the current state of Bypass for "Array EQ"*
GA"Array EQ">1>5=O<CR>	*Response indicating Bypass for "Array EQ" is currently On*

6.1.9 AUTOMATIC MIC MIXER – GAIN SHARING Module

The Gain Sharing AMM module can be configured with 4-32 inputs, each input has the same parameters that can be adjusted. **Index 1** is used to select the input (1-32) and **Index 2** is used to select the parameter to adjust according to the table below. In addition there are some output and overall module parameters that may be adjusted by setting **Index 1** = 0.
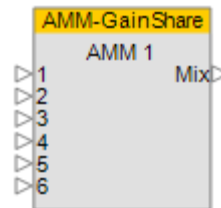
Index 1:   Selects desired Input (1-32) or 0 for Output/Module

Output/Module (Index 1 = 0)		*Value*	*Range*
	1 Gain	NN.N	-60.5 to 12.0 dB, 0.5 step
	2 Mute	O,F,T	O=On, F=Off, T=Toggle
	3 Slope	N.NN	0.01 to 2.00, 0.01 step
Index 2	**4** Attack	NN.N	0.5 to 100.0 ms, 0.5 step
	5 Hold	NNNN.N	0 to 1000.0 ms, 1 step
	6 Decay	NNNNN.N	5 to 50000.0 ms, 5 step
	7 Input RMS Avg.	NNN.N	1 to 500.0 ms, 1 step
	8 Output RMS Avg.	NNN.N	1 to 500.0 ms, 1 step
	9 Bypass All	O,F,T	O=On, F=Off, T=Toggle

Input (Index 1 = 1-32)		*Value*	*Range*
	1 Gain	NN.N	-60.5 to 12.0 dB, 0.5 step
Index 2	**2** Mute	O,F,T	O=On, F=Off, T=Toggle
	3 Priority	N	1,2,3,4,5 (1=Highest)
	4 Bypass	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"AMM 1">0>2=T<CR>	*Toggle the state of the output mute for module "AMM 1"*
SA"AMM 1">0>3=1.00<CR>	*Set the Slope parameter for "AMM 1" to 1.00*
SA"AMM 1">6>1=-10<CR>	*Set the Gain for input 6 of "AMM 1" to -10dB*
SA"AMM 1">4>3=2<CR>	*Set the Priority for input 4 of "AMM 1" to 2 (2nd highest)*
SA"AMM 1">24>4=O<CR>	*Set the Bypass for input 24 of "AMM 1" to On*
GA"AMM 1">16>2<CR>	*Query the current state of Mute for input 16 of "AMM 1"*
GA"AMM 1">16>2=O<CR>	*Response indicating input 16 of "AMM 1" is Muted*

6.1.10 AUTOMATIC MIC MIXER - GATED Module

Gated Automatic Mic Mixer modules are available with 4, 6 or 8 inputs. The same parameters are adjustable for each of the inputs. **Index 1** is used to select the input (1-8) and **Index 2** is used to select the parameter to adjust according to the table below. In addition there are some output parameters that may be adjusted by setting **Index 1** = 0. Some parameters are only relevant for particular detection modes (such as Push-to-talk) and would otherwise be unused. Parameters that are indicated as 'Reserved' should not be used in any mode.
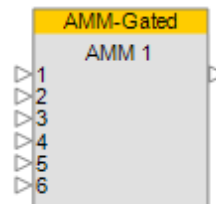
**Index 1:**   Selects desired Input (1-8) or 0 for Output

Output (Index 1 = 0)			*Value*	*Range*
Index 2	**1**	Gain	NN.N	-999 to 0.0 dB, 0.5 step
	2	NOM	O,F,T	O=On, F=Off, T=Toggle
	3	Mute	O,F,T	O=On, F=Off, T=Toggle
	4	NOM Limit	N	1 to # Channels (4,6,8)

Input (Index 1 = 1-8)			*Value*	*Range*
Index 2	**1**	Priority	O, F, T	O=On, F=Off, T=Toggle
	2	Gain	NN.N	-999 to 0.0 dB, 0.5 step
	3	Detection	N	1=Threshold, 2=LastOn, 3=PushToTalk, 4=Bypass
	4	Threshold	NN.N	-80.0 to 0.0 dB, 0.5 step
	5	Gate Depth	NN.N	-70.0 to 0.0 dB, 0.5 step
	6	Hold	NNNNN	1 to 50000 ms, 1 step
	7	Ducking Depth	NN.N	-60.0 to 0.0 dB, 0.5 step
	8	Decay	NNNNN	5 to 50000 ms, 1 step
	9	*Reserved*		
	10	High Pass	NNNN	20 to 1000 Hz
	11	Low Pass	NNNNN	1000 to 20000 Hz
	12	RMS Avg.	NNN	1 to 500 ms, 1 step
	13	*Reserved*		
	14	Attack	NN.N	0.5 to 100.0ms, 0.5 step
	15	Push to Talk	O, F, T	O=On, F=Off, T=Toggle
	16	Mute	O, F, T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"AMM 1">0>3=T<CR>	*Toggle the state of the output mute for module "AMM 1"*
SA"AMM 1">6>4=-40<CR>	*Set the Threshold for input 6 of "AMM 1" to -40dB*
SA"AMM 1">4>3=2<CR>	*Set the Detection mode for input 4 of "AMM 1" to Last On*
GA"AMM 1">3>1<CR>	*Query the current state of Priority for input 3 of "AMM 1"*
GA"AMM 1">3>1=O<CR>	*Response indicating input 3 of "AMM 1" is set to Priority*

6.1.11 COMPRESSOR/LIMITER Module

This module has 6 parameters selected simply by using the appropriate value for **Index 1**. For a mono Compressor module set the Detection Input to 'L' (Left) to use the Signal input or 'S' to use the Sidechain input, 'R' and 'M' are unused.
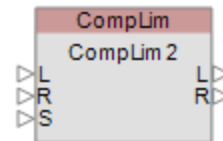
			Value	*Range*
Index 1	**1**	Detect Input	L,R,M,S	L=Left, R=Right, M=Mix, S=Sidechain
	2	Threshold	NN.N	0 to -40dBFS, 0.5 step
	3	Ratio	NN.N	1 to 20, 0.1 step
	4	Attack	NNN.N	0.5 to100ms, 0.5 step
	5	Release	NNNN.N	1 to 1000ms, 0.5 step
	6	Bypass	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"CompLim 1">1=M<CR>	*Set the detection input for module "CompLim 1" to Mix*
SA"CompLim 1">2=-20<CR>	*Set the threshold for module "CompLim 1" to -20dBFS*
GA"Main Out">6<CR>	*Query the current state of the bypass for "Main Out"*
GA"Main Out">6=F<CR>	*Response indicating bypass for "Main Out" is currently Off*

6.1.12 CROSSOVER Module

Available parameters for the Crossover vary per section (Low, Mid and High) and depending on the type of Crossover there can be 2, 3 or 4 sections.
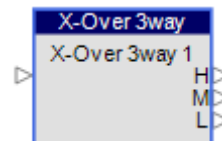
Index 1 is used to select the Crossover section to control according to the Crossover type as shown in the table below:

Type		**2 Way**	**3 Way**	**4 Way**
Index 1	**1**	LOW	LOW	LOW
	2	HIGH	MID	LO MID
	3	-	HIGH	HIMID
	4	-	-	HIGH

Index 2 is then used to select the parameter to change dependant on the Crossover section selected by Index 1 as illustrated in the tables overleaf:

LOW			Value	Range
Index 2	**1**	Type	*1	→
	2	Frequency	NNNNN	20Hz to 20000Hz
	3	*Reserved*		
	4	Polarity	O,F,T	O=On, F=Off, T=Toggle
	5	Mute	O,F,T	O=On, F=Off, T=Toggle

HIGH			Value	Range
Index 2	**1**	Type	*1	→
	2	Frequency	NNNNN	20Hz to 20000Hz
	3	*Reserved*		
	4	Polarity	O,F,T	O=On, F=Off, T=Toggle
	5	Mute	O,F,T	O=On, F=Off, T=Toggle

MID			Value	Range
Index 2	**1**	Type (HPF)	*1	→
	2	Frequency	NNNNN	20Hz to 20000Hz
	3	Type (LPF)	*1	→
	4	Frequency	NNNNN	20Hz to 20000Hz
	5	*Reserved*		
	6	Polarity	O,F,T	O=On, F=Off, T=Toggle
	7	Mute	O,F,T	O=On, F=Off, T=Toggle

*1 Filter type descriptions

	Slope	Strings
Butterworth	6dB/oct	**But6**
	12dB/oct	**But12**
	18dB/oct	**But18**
	24dB/oct	**But24**
	36dB/oct	**But36**
	48dB/oct	**But48**
Bessel	12dB/oct	**Bes12**
	18dB/oct	**Bes18**
	24dB/oct	**Bes24**
	36dB/oct	**Bes36**
	48dB/oct	**Bes48**
Linkwitz-Reilly	12dB/oct	**Lin12**
	24dB/oct	**Lin24**
	36dB/oct	**Lin36**
	48dB/oct	**Lin48**

EXAMPLES:

SA"X-Over">1>2=80<CR>   *Set the freq. for the Low section of "X-Over" to 80Hz*
SA"X-Over">1>1=But24<CR> *Set the Low section of "X-Over" to Butterworth 24dB/oct*
GA"X-Over 2">4>5<CR>   *Query mute status of the High section of 4way "X-Over 2"*
GA"X-Over 2">4>5=F<CR>   *Response indicating High section of "X-Over 2" is unmuted*

6.1.13 DELAY Module

Delay modules are available with 1, 2, 4 or 8 output taps. The delay time for each tap can be adjusted individually or bypassed. **Index 1** is used to select the desired tap and **Index 2** is used to select the parameter to adjust as shown in the table below:
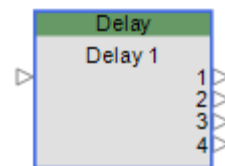
**Index 1:**   Selects the desired Delay output tap (1-8)

Index 2			Value	Range
	1	Delay time	NNNNNN	0 to 144000 as number of samples
	2	Bypass	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"Delay 1">4>1=2592<CR> *Set the delay time for tap 4 of module "Delay 1" to 54msec*
                          (54msec = 0.054sec, 0.054x48000 = 2592 samples)
SA"Out Delay">2>2=F<CR> *Set bypass for tap 2 of Delay module "Out Delay" to Off*
GA"Delay 2">1>1<CR>   *Query the current delay time for tap 1 of "Delay 2"*
GA"Delay 2">1>1=9600<CR> *Response with delay time for tap 1 of "Delay 2" is 200ms*

6.1.14 DUCKER Module

There are 6 parameters which can be set for this module, selected simply by using the appropriate value for **Index 1**. Index 1=1 is reserved and should not be used.
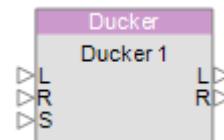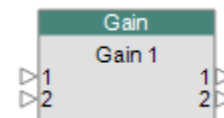
			Value	Range
Index 1	**1**			*Reserved*
	2	Threshold	NN.N	0 to -40 dBFS 0.5 Step
	3	Range	NN.N	0 to -70dBFS, 0.5 step
	4	Attack	NNN.N	0.5 to 100ms, 0.5 step
	5	Hold	NNNN	0 to1000ms, 1 step
	6	Decay	NNNNN	5 to 50000ms, 1 step
	7	Bypass	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"Ducker 1">2=-5<CR>	*Set the threshold for module "Ducker 1" to -5dBFS*
SA"Ducker 1">3=-60<CR>	*Set the range (attenuation) for "Ducker 1" to -60dBFS*
GA"Page Over">7<CR>	*Query the current state of the bypass for "Page Over"*
GA"Page Over">7=O<CR>	*Response indicating bypass for "Page Over" is On*

6.1.15 GAIN Module

Gain modules have a single Level and Mute parameter irrespective of the number of channels. These can be selected simply by using **Index 1** as shown in the table below.
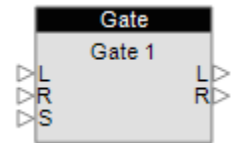
			Value	Range
Index 1	**1**	Level	+/-NN.N	-999.0dB to +12.0dB, 0.5dB step
	2	Mute	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"Gain 1">1=-30<CR>	*Set the level of Gain module "Gain 1" to –30dB*
SA"Main Volume">2=F<CR>	*Set mute state of Gain module "Main Volume" to un-muted*
GA"Gain 4">1<CR>	*Query the current level of Gain module "Gain 4"*
GA"Gain 4">1=3<CR>	*Response indicating level of "Gain 4" is currently 3dB*

6.1.16 GATE Module

There are 7 parameters which can be set for this module, selected simply by using the appropriate value for **Index 1**. For a mono Gate module set the Detector to 'L' (Left) to use the Signal input or 'S' to use the Sidechain input, 'R' and 'M' are unused.
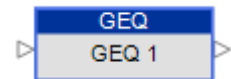
			Value	*Range*
Index 1	**1**	Detector	L,R,M,S	L=Left, R=Right, M=Mix, S=Sidechain
	2	Threshold	NN.N	0 to -40 dBFS 0.5 Step
	3	Range	NN.N	0 to -70dBFS, 0.5 step
	4	Attack	NNN.N	0.5 to 100ms, 0.5 step
	5	Hold	NNNN	0 to 1000ms, 1 step
	6	Decay	NNNNN	5 to 50000ms, 1 step
	7	Bypass	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"Gate 1">6=2000<CR>	*Set the Decay time for module "Gate 1" to 2000ms*
SA"Gate 1">7=T<CR>	*Toggle the state of the Bypass for module "Gate 1"*
GA"Gate1">7<CR>	*Query the current state of the Bypass for "Gate 1"*
GA"Gate 1">7=F<CR>	*Response indicating Bypass for module "Gate 1" is Off*

6.1.17 1/3 OCTAVE 31-BAND GRAPHIC EQ Module

Each of the 31 bands can be adjusted individually and is selected simply by using the appropriate value for **Index 1**. In addition there is also a "Bypass all" function selected by setting **Index 1** to 32.

		Freq.	*Value*	*Range*
Index 1	**1**	20Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	2	25Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	3	31.5Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	4	40Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	5	50Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	6	63Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	7	80Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	8	100Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	9	125Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	10	160Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	11	200Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	12	250Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	13	315Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	14	400Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	15	500Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	16	630Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	17	800Hz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step

	18	1kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	19	1.25kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	20	1.6kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	21	2kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	22	2.5kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	23	3.15kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
Index 1	**24**	4kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	25	5kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	26	6.3kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	27	8kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	28	10kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	29	12.5kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	30	16kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	31	20kHz	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	32	Bypass All	O,F,T	O=On, F=Off, T=Toggle
	33	*Reserved*		

EXAMPLES:
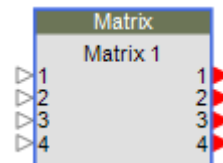
SA"GEQ 1">18=-3.5<CR>	*Reduce the 1kHz band of GEQ module "GEQ 1" by 3.5dB*
SA"GEQ 1">24=5<CR>	*Increase the 4kHz band of GEQ module "GEQ 1" by 5dB*
GA"GEQ Bar">11<CR>	*Query the current level for the 200Hz band of "GEQ Bar"*
GA"GEQ Bar">11=-6<CR>	*Response indicating the 200Hz band is currently at -6dB*

6.1.18 MATRIX MIXER Module

The Matrix Mixer module allows cross-points to be switched on/off or the level at the cross-point to be adjusted.

Index 1 is used to select whether the cross-point state (on/off) or level will be adjusted according to the table below:

		Parameter	**Notes**
Index 1	**1**	On/Off	Set Cross-Point On/Off
	2	Level	Set Level

Index 2 is then used to select which cross-point is to be controlled; stepping through available outputs for input 1, then through the outputs for input 2 and so on. **Index 2** will be the same irrespective of whether the state (on/off) or level is being controlled, but **Index 1** and the **Value** will change. In the following tables M = # of inputs and N = # of outputs in the module.

On/Off			*Value*	*Range*
Index 2	**1**	Cross Point(1,1)	O,F,T	O=On, F=Off, T=Toggle
	2	Cross Point(1,2)	O,F,T	O=On, F=Off, T=Toggle
		Index 2 = (Input # -1) x Size of Matrix + Output #:		
	MxN	Cross Point(M,N)	O,F,T	O=On, F=Off, T=Toggle

Level			Value	Range
Index 2	**1**	Cross Point(1,1)	NN.N	-999 to 0.0dB, 0.5 step
	2	Cross Point(1,2)	NN.N	-999 to 0.0dB, 0.5 step
	Index 2 = (Input # -1) x Size of Matrix + Output #:			
	MxN	Cross Point(M,N)	NN.N	-999 to 0.0dB, 0.5 step

EXAMPLES:

SA"Matrix 1">1>2=O<CR>   *Set cross-point 2 (input 1, output2) for "Matrix 1" to On*
SA"Mix">2>8=-20<CR>   *Set level for cross-point 8 (in2,out4 for 4x4) "Mix" to -20dB*
GA"My Matrix">1>16<CR>   *Query the current state for cross-point 16 (in4,out4 for 4x4)*
GA"My Matrix">1=16=F<CR>   *Response indicating cross-point 16 is currently Off*

6.1.19 PARAMETRIC EQ Module

Parametric EQ modules are available with 3, 5, 7 or 9 fixed bands, or a variable number of bands (max 16). The same parameters are adjustable for each band. **Index 1** is used to select which band to adjust (1-16) and **Index 2** is used to select the parameter to adjust according to the table below:
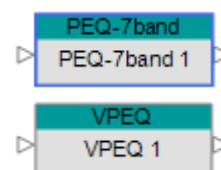
Index 1:   Selects desired Parametric EQ band 1-16

			Value	Range
Index 2	**1**	Frequency	NNNNN	20 to 20000Hz
	2	Q	NN.N	0.10 to 10.0, 0.1 step
	3	Gain	+/-NN.N	-20.0dB to +20.0dB, 0.1dB step
	4	Slope	-NN	0,-6,-12dB/oct
	5	Type	XX	*1
	6	Bypass	O,F,T	O=On, F=Off, T=Toggle

The parameters in use for each band will be dependent on the Type of filter selected as illustrated in the table below:

Type (*1)	Freq.	Q	Gain	Bypass	Slope	String
Band	o	o	o	o		B
High shelf	o		o	o		HS
Low shelf	o		o	o		LS
High cut (Low Pass)	o			o	o	HC
Low cut (High pass)	o			o	o	LC
Notch	o	o	o	o		N

EXAMPLES:

SA"PEQ 1">1>1=2000<CR> *Set the frequency for band 1 of module "PEQ 1" to 2kHz*
SA"Room EQ">2>5=LC<CR>*Use a 'Low Cut' (High Pass) filter for band 2 of "Room EQ"*
GA"House L">5>3<CR>   *Query the gain for band 5 of PEQ module "House L"*
GA"House L">5>3=-2<CR> *Response indicating band 5 of "House L" is at -2dB*

6.1.20 PEAK/RMS LIMITER Module

There are 8 parameters which can be set for this module, selected simply by using the appropriate value for **Index 1**. For a mono Peak/RMS Limiter module set the Detection Input to 'L' (Left) to use the Signal input or 'S' to use the Sidechain input, 'R' and 'M' are unused. Parameters indicated as 'Reserved' should not be used.
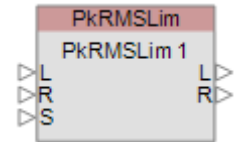
<table>
<tr><th></th><th></th><th></th><th>Value</th><th>Range</th></tr>
<tr><td rowspan="10">Index 1</td><td>1</td><td>Detect Input</td><td>L,R,M,S</td><td>L=Left, R=Right, M=Mix, S=Sidechain</td></tr>
<tr><td>2</td><td>PK Threshold</td><td>NN.N</td><td>0 to -40 dBFS 0.5 Step</td></tr>
<tr><td>3</td><td colspan="3">Reserved</td></tr>
<tr><td>4</td><td colspan="3">Reserved</td></tr>
<tr><td>5</td><td colspan="3">Reserved</td></tr>
<tr><td>6</td><td>Bypass</td><td>O,F,T</td><td>O=On, F=Off, T=Toggle</td></tr>
<tr><td>7</td><td>RMS Threshold</td><td>NN.N</td><td>0 to -40 dBFS 0.5 Step</td></tr>
<tr><td>8</td><td>RMS Attack</td><td>NNNNN</td><td>500 to 10,000ms, 100 step</td></tr>
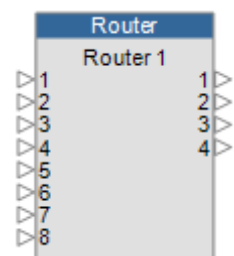<tr><td>9</td><td>RMS Release</td><td>NNNNN</td><td>500 to 10,000ms, 100 step</td></tr>
<tr><td>10</td><td colspan="3">Reserved</td></tr>
</table>

EXAMPLES:

SA"PkRMSLim 1">1=R<CR> *Set the Detect Input for stereo "PkRMSLim 1" to R(ight)*
SA"Limiter 1">7=-20<CR> *Set the RMS limiter threshold for "Limiter 1" to -20dBFS*
GA"Array L">2<CR> *Query the Peak limiter threshold for "Array L"*
GA"Array L">2=-6<CR> *Response indicating the Peak limiter threshold is -6dBFS*

6.1.21 ROUTER Module

The Router module is available in a number of different input/output combinations, but the command format is essentially the same. **Index 1** is used to select the output channel and the Value indicates the desired input to be routed to that output.

Index 1:   Output number: 1-32
**Value:**   Input number: 0-32 where 0 = Off (no input routed)

EXAMPLES:

SA"Router 1">1=5<CR> *Set output 1 of Router module "Router 1" to input 5*
SA"Router 2">3=0<CR> *Set output 3 of Router module "Router 2" to Off (no input)*
GA"Select">4<CR> *Query which input is routed to output 4 of "Select"*
GA"Select">4=2<CR> *Response indicating output 4 of "Select" is set to input 2*

6.1.22 SIGNAL GENERATOR Modules

The available parameters for Signal Generator modules vary according to the type (Sine, Noise and Sweep), but the same command format is used.

Index 1 is used to select the type of Signal Generator module being controlled according to the table below.

		Signal
Index 1	**1**	Sine Wave
	2	White Noise
	3	Pink Noise
	4	Sweep
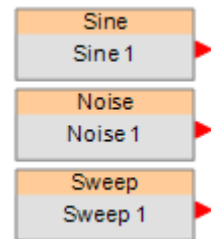
When a Noise module is used it is possible to switch between White or Pink noise by setting **Index 1** to values 2 or 3 respectively without additional indices (e.g. SA "Noise 1">1=3 to set Pink Noise)

Index 2 is then used to select the parameter to change dependent on the Generator type selected by Index 1 as illustrated in the tables below:

Sine Wave			*Value*	*Range*
Index 2	**1**	Frequency	NNNNN	20 to 20000Hz
	2	Gain	NN.N	-999 to +12.0dB, 0.5 step
	3	Mute	O,F,T	O=On, F=Off, T=Toggle

White/Pink Noise			*Value*	*Range*
Index 2	**1**	Gain	NN.N	-999 to +12.0dB, 0.5 step
	2	Mute	O,F,T	O=On, F=Off, T=Toggle

Sweep			*Value*	*Range*
Index 2	**1**	Gain	NN.N	-999 to +12.0dB, 0.5 step
	2	Slow/Fast	S,F	S=Slow,F=Fast
	3	Repeat	O,F	O=On (repeat), F=Off (no repeat)
	4	Start/Stop	O,F	O=On (start), F=Off (stop)

EXAMPLES:

SA"Sine 1">1>1=500<CR>	*Set the frequency for Sine Generator "Sine 1" to 500Hz*
SA"Noise 1">1=2<CR>	*Set Noise Generator "Noise 1" to White noise*
SA"Noise 1">2>2=O	*Set the Mute state of White noise gen "Noise 1" to Muted*
GA"Sweep 1">4>2<CR>	*Query whether module "Sweep 1" is set to Slow or Fast*
GA"Sweep 1">4>2=F<CR>	*Response indicating "Sweep 1" is currently set to Fast*

6.1.23 SOURCE SELECTOR Module

The Source Selector module available in both mono and stereo versions and with different quantities of inputs, but the command format is essentially the same. **Index 1** is always 1 and the **Value** is used to select the input.
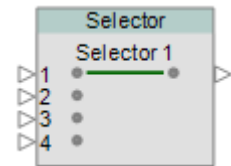
Index 1:   Channel (always =1)
Value: Input number: 1-16

EXAMPLES:

SA"Selector 1">1=5<CR>	*Set Source Selector module "Selector 1" to input 5*
GA"Bar">1<CR>	*Query which input is currently selected for module "Bar"*
GA"Bar">1=2<CR>	*Response indicating input 2 is currently selected*

6.1.24 SPEAKER PARAMETRIC EQ Module

The Speaker Parametric EQ module has 9 bands of parametric EQ, a band-pass filter and alignment delay. The same parameters are adjustable for each parametric EQ band. **Index 1** is used to select the EQ band to adjust (1-9) or setting **Index 1** to 0 accesses the Band Pass, Alignment Delay and EQ Gain parameters. **Index 2** is then used to select the desired parameter to adjust according to the tables below. Parameters indicated as 'Reserved' should not be used.
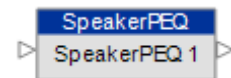
Index 1:   Selects the desired EQ Band (1-9) or 0 for Band Pass/Delay/EQ Gain

Band Pass, Alignment Delay & EQ Gain (Index 1 = 0)

	Band Pass/Align Delay/EQ Gain	*Value*	*Range*
	1	*Reserved*	
	2	*Reserved*	
	3	Gain	+/- NN.N	-15.0B to +15.0dB, 0.5dB step
	4	Align Delay	NNN	0 to 480 as number of samples
Index 2	5	Type (High)	*1	→
	6	Frequency	NNNNN	20 to 20000Hz
	7	Type (Low)	*1	→
	8	Frequency	NNNNN	20 to 20000Hz
	9	Lo Bypass	O,F,T	O=On, F=Off, T=Toggle
	10	Hi Bypass	O,F,T	O=On, F=Off, T=Toggle

*1 Filter type descriptions

	Slope	Strings
Butterworth	6dB/oct	**But6**
	12dB/oct	**But12**
	18dB/oct	**But18**
	24dB/oct	**But24**
	36dB/oct	**But36**
	48dB/oct	**But48**
Bessel	12dB/oct	**Bes12**
	18dB/oct	**Bes18**
	24dB/oct	**Bes24**
	36dB/oct	**Bes36**
	48dB/oct	**Bes48**
Linkwitz-Reilly	12dB/oct	**Lin12**
	24dB/oct	**Lin24**
	36dB/oct	**Lin36**
	48dB/oct	**Lin48**

Parametric EQ Band (Index 1 = 1 – 9)

	PEQ Band		*Value*	*Range*
Index 2	**1**	Frequency	NNNNN	200 to 20000Hz
	2	Q	NN.N	0.10 to 10.0, 0.1 step
	3	Gain	+/-NN.N	-20.0dB to +20.0dB, 0.1dB step
	4	*Reserved*		
	5	Type	XX	B=Band/PEQ, HS=High Shelf, LS=Low Shelf, N=Notch
	6	Bypass	O,F,T	O=On, F=Off, T=Toggle

The parameters in use for each band will be dependent on the Type of filter selected as illustrated in the table below:

Type	Freq.	Q	Gain	Bypass	Strings
Band	o	o	o	o	B
High shelf	o		o	o	HS
Low shelf	o		o	o	LS
Notch	o	o	o	o	N

EXAMPLES:

SA"SPEQ 1">0>5=Bes36<CR> *Set the HP Filter type for "SPEQ 1" to Bessel 36dB/oct*
SA"Array L">2>1=200<CR> *Set the frequency for PEQ band 2 of "Array L" to 200Hz*
GA"Array L">0>3<CR> *Query the EQ gain SPEQ module "Array L"*
GA"Array L">0>3=2<CR> *Response indicating the EQ gain is currently at +2dB*

6.1.25 STANDARD MIXER Module

The Standard Mixer module allows control of input level/mute, output level/mute and cross-point routing. Cross-point routing can be set using two different methods; the first routes all the outputs for a particular input with a single command, the second allows an individual cross-point (input,output) to be controlled directly.

Index 1 is used to select whether an input, output or a cross-point (and the cross-point method) is being controlled according to the table below:

		Parameters	*Notes*
Index 1	**1**	Input	Set Input Parameters
	2	Output	Set Output Parameters
	3	Cross-Point 1	Route Input to Multiple Outputs
	4	Cross-Point 2	Set Cross-Point On/Off Directly
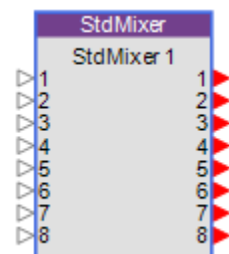
Index 2 is then used to select the parameter to set or query dependent on whether an input, output or cross-point was selected by the first index. In the following tables M = # of inputs and N = # of outputs in the module.

Input (Index 1=1)			*Value*	*Range*
Index 2	**1**	Input 1 Level	NN.N	-999 to +12.0dB, 0.5 step
	2	Input 1 Mute	O,F,T	O=On, F=Off, T=Toggle
	Mx2-1	Input M Level	NN.N	-999 to +12.0dB, 0.5 step
	Mx2	Input M Mute	O,F,T	O=On, F=Off, T=Toggle

Output (Index 1=2)			*Value*	*Range*
Index 2	**1**	Output 1 Level	NN.N	-999 to +12.0dB, 0.5 step
	2	Output 1 Mute	O,F,T	O=On, F=Off, T=Toggle
	Nx2-1	Output N Level	NN.N	-999 to +12.0dB, 0.5 step
	Nx2	Output N Mute	O,F,T	O=On, F=Off, T=Toggle

Cross-point 1 – Routing an input to multiple outputs with a single command (Index 1=3)

CrossPoint 1 (Index 1=3)			*Value*	*Range*
Index 2	**1**	Input 1 Routing	XXXXXXXX	Hex representation of routing
	2	Input 1 Routing	XXXXXXXX	Hex representation of routing
	M	Input M Routing	XXXXXXXX	Hex representation of routing

The desired output routing for an input is sent as an array of eight Hex values, where each Hex value represents the routing for 4 channels converted from Binary. This allows the routing for 32 outputs to be set in a single command. Even when the Standard Mixer module used has less than 32 outputs all 8 Hex values should be sent.

Example: To route input 1 to outputs: 1,6,9,12,15,18,21,22,23,24,27,28,29 & 31 the array of Hex values would be '84924F3A' as illustrated below:

				Output channel																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
In 1	O	–	–	–	O	–	–	O	–	–	O	–	–	O	–	–	O	–	–	O	O	O	O	–	–	O	O	O	–	O	–	
HexValue	8				4				9				2				4				F				3				A			

Cross-point 2 – Controlling a cross-point (input,output) directly (Index 1=4)

Index 2: (input,output)
Value: O=On,F=Off,T=Toggle

EXAMPLES:

SA"StdMixer 1">1>1=-3<CR>*Set the level for input 1 of module "StdMixer 1" to -3dB*
SA"My Mixer">2>16=O<CR> *Set mute state for output 8 of module "My Mixer" to On*
SA"Mix">3>2=C0000000<CR>*Route input 2 to outputs 1&2 on "Mix" using Cross-point 1*
SA"Theatre">4>(4,5)=O<CR> *Route input 4 to output 5 on "Theatre" using Cross-point 2*
GA"Mix">3>4<CR>   *Query the routing for input 4 of "Mix" using Cross-point 1*
GA"Mix">3>4=03000000<CR>*Response indicating input 4 is routed to outputs 7&8*
GA"Theatre">4>(6,8)<CR>   *Query whether input 6 is routed to output 8 on "Theatre"*
GA"Theatre">4>(6,8)=F<CR> *Response indicating input 6 is not routed to output 8*

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6.1.26 TONE CONTROL EQ Module

Each of the 3 bands can be adjusted or can be bypassed by simply selecting the appropriate value for **Index 1** as shown in the table:
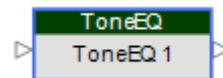
			Value	*Range*
Index 1	**1**	L-Gain	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	2	L-Bypass	O,F,T	O=On, F=Off, T=Toggle
	3	M-Gain	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	4	M-Bypass	O,F,T	O=On, F=Off, T=Toggle
	5	H-Gain	+/-NN.N	-15.0dB to +15.0dB, 0.1dB step
	6	H-Bypass	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"ToneEQ L">1=-4<CR>	*Set the Low band of ToneEQ module "ToneEQ L" to -4dB*
SA"Hall EQ">6=O<CR>	*Bypass the High band of ToneEQ module "Hall EQ"*
GA"ToneEQ 1">3<CR>	*Query the current level for the Mid band of "ToneEQ 1"*
GA"ToneEQ 1">3=-3<CR>	*Response indicating the Mid band is currently at -3dB*

6.2. PowerMatch® Module Indices

6.2.1 INPUT Module

There are 3 parameters which can be set for this module selected simply by using the appropriate value for **Index 1**.
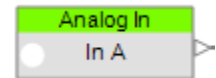
Note: Digital Sensitivity is global and is set via the properties for the PowerMatch device.

			Value	Range
Index 1	1	Analog Sensitivity	NN.N	0,4,12,24dBu
	2	Mute	O,F,T	O=On, F=Off, T=Toggle
	3	Source	O,F,T	O=Digital, F=Analog, T=Toggle

EXAMPLES:

SA"In A">1=4<CR>	*Set the Input Sensitivity for "In A" to 4dBu*
SA"Desk L">3=O<CR>	*Select Digital input source for input "Desk L"*
GA"In D">2<CR>	*Query the current Mute state for "In D"*
GA"In D">2=F<CR>	*Response indicating that "In D" is currently un-muted*

6.2.2 SIGNAL GENERATOR Module

Index 1 should always be set to 5 to access this module. The 8 parameters which can be set for this module are selected by using the appropriate value for **Index 2**.
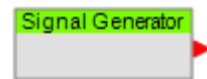
Note: The routing for the Signal Generator is set via the Matrix Mixer module, where the Signal Generator appears as input 9.

Index 1:
  PowerMatch Signal Generator (always=5)

			Value	Range
Index 2	1	Level	NN.N	-999 to 12.0dB, 0.5 step
	2	Repeat	O, F	O=On (Repeat), F=Off
	3	Mute	O,F,T	O=On, F=Off, T=Toggle
	4	Type	*1	→
	5	Tone Freq	NNNNN	20 to 20000Hz
	6	Start Freq	NNNNN	20 to 20000Hz
	7	End Freq	NNNNN	20 to 20000Hz
	8	Duration	N	1 to 5s, step 1

*1 Sig Gen Type	
1	Pink Noise
2	White Noise
3	Tone
4	Sweep

EXAMPLES:

SA"SigGen 1">5>4=1<CR>	*Set the Signal Generator "SigGen 1" to output Pink Noise*
SA"SigGen 1">5>1=-10<CR>	*Set the level for Signal Generator "SigGen 1" to -10dB*
GA"SigGen 1">5>3<CR>	*Query the current Mute state for module "SigGen 1"*
GA"SigGen 1">5>3=O<CR>	*Response indicating that "SigGen 1" is currently muted*

6.2.3 INPUT PARAMETRIC EQ Module

The Input Parametric EQ modules have 5 bands. The same parameters are adjustable for each band. **Index 1** is used to select the band to adjust (1-5) and **Index 2** is used to select the parameter to adjust according to the table below:

PEQ-5band
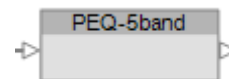
Index 1: Selects desired Parametric EQ band 1-5

			Value	*Range*
Index 2	**1**	Frequency	NNNNN	20 to 20000Hz
	2	Q	NN.N	0.10 to 10.0, 0.1 step
	3	Gain	+/-NN.N	-20.0dB to +20.0dB, 0.1dB step
	4	Slope	-NN	0,-6,-12dB/oct
	5	Type	XX	*1
	6	Bypass	O,F,T	O=On, F=Off, T=Toggle

The parameters in use for each band will be dependent on the Type of filter selected as illustrated in the table below:

*1: Parameters are enabled according to Band type						
Type	Freq.	Q	Gain	Bypass	Slope	String
Band	o	o	o	o		B
High shelf	o		o	o		HS
Low shelf	o		o	o		LS
High cut (Low Pass)	o			o	o	HC
Low cut (High pass)	o			o	o	LC
Notch	o	o	o	o		N

Note: Labels for PowerMatch Signal Processing modules (other than Input and Amp Output) are fixed and cannot be changed in the same way as ESP modules. Module labels are "PEQ-5band A" through to "PEQ-5band H" according to the channel.
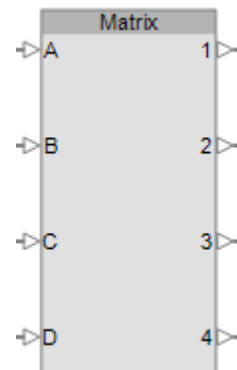
EXAMPLES:

SA"PEQ-5band A">1>1=2000<CR>	*Set the frequency for band 1 of channel A to 2kHz*
SA"PEQ-5band D">4>5=HS<CR>	*Use a 'High Shelf" filter for band 4 of channel D*
GA"PEQ-5band F">3>6<CR>	*Query the Bypass state for band 3 of channel F"*
GA"PEQ-5band F">3>6=F<CR>	*Response indicating Bypass for band 3 is Off*

6.2.4 ARRAY EQ Module

Due to the internal architecture of the PowerMatch the Array EQ module is actually addressed as band 6 of the Input Parametric EQ module, hence **Index 1 = 6**. **Index 2** is then used to select the parameter to adjust according to the table below. Parameters that are indicated as 'Reserved' should not be used.
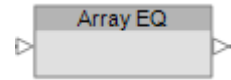
Index 1:   Selects Array EQ band of Input Parametric module (always=6)

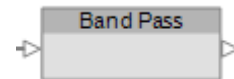|			*Value*	*Range*
	1	Cntr Freq	NNN	220 to 700Hz
	2	Tilt	NN.N	0.0 to 10.0. 0.1 step
Index 2	**3**	Gain	+/-NN.N	-12.0dB to +2.0dB, 0.1dB step
	4	Array	M.VVV	M=2 to 8, VVV=20 to 100, 5 step
	5	*Reserved*		
	6	Bypass	O,F,T	O=On, F=Off, T=Toggle
	7	Advanced	O,F,T	O=On, F=Off, T=Toggle

Note: Labels for PowerMatch Signal Processing modules (other than Input and Amp Output) are fixed and cannot be changed in the same way as ESP modules. Module labels are "PEQ-5band A" through to "PEQ-5band H" according to the channel.

EXAMPLES:

SA"PEQ-5band A">6>4=4.080<CR>	*Set the Array settings for channel A, Array EQ module to 4x modules & 80 deg vertical coverage*
SA"PEQ-5band C">6>3=-6<CR>	*Set the Gain for channel C Array EQ to -6dB*
GA"PEQ-5band E">6>6<CR>	*Query the Bypass state for Array EQ on channel E*
GA"PEQ-5band E">6>6=O<CR>	*Response indicating Bypass for channel E is On*

6.2.5 MATRIX MIXER Module

The Matrix Mixer module allows cross-points to be switched on/off or the level at the cross-point to be adjusted.

Index 1 is used to select whether the cross-point state (on/off) or level will be adjusted according to the table below:

		Parameter	Notes
Index 1	**1**	On/Off	Set Cross-Point On/Off
	2	Level	Set Level

Index 2 is then used to select which cross-point is to be controlled; stepping through available outputs for input 1, then through the outputs for input 2 and so on. **Index 2** will be the same irrespective of whether the state (on/off) or level is being controlled, but **Index 1** and the **Value** will change. In the following tables M = # of inputs and N = # of outputs in the module.

On/Off			Value	Range
Index 2	**1**	Cross Point(1,1)	O,F,T	O=On, F=Off, T=Toggle
	2	Cross Point(1,2)	O,F,T	O=On, F=Off, T=Toggle
	Index 2 = (Input # -1) x 8 + Output #:			
	72	Cross Point(9,8)	O,F,T	O=On, F=Off, T=Toggle

| **Level**			Value	Range
Index 2	**1**	Cross Point(1,1)	NN.N	-60.5 to 0.0dB, 0.5 steps
	2	Cross Point(1,2)	NN.N	-60.5 to 0.0dB, 0.5 steps
	Index 2 = (Input # -1) x 8 + Output #:			
	72	Cross Point(9,8)	NN.N	-60.5 to 0.0dB, 0.5 steps

Note: Labels for PowerMatch Signal Processing modules (other than Input and Amp Output) are fixed and cannot be changed in the same way as ESP modules. Module label is "Matrix 1".

EXAMPLES:

SA"Matrix 1">1>26=O<CR>	*Set cross-point 26 (Input D, Output2) on "Matrix 1" to On*
SA"Matrix 1">1>65=O<CR>	*Set cross-point 65 (SigGen, Output1) on "Matrix 1" to On*
GA"Matrix 1">2>4<CR>	*Query the current level for cross-point 4 (Input A, Output 4)*
GA"Matrix 1">2>4=F<CR>	*Response indicating cross-point 4 is currently Off*

6.2.6 BAND PASS Module

Index 1 should always be set to 1 to access this module. The 6 parameters that can be set for this module are then selected by using the appropriate value for **Index 2**. Parameters that are indicated as 'Reserved' should not be used.

Band Pass

Index 1:   Selects module (always=1)

<table>
<tr><th rowspan="10">Index 2</th><th></th><th></th><th>*Value*</th><th>*Range*</th></tr>
<tr><td>1</td><td>Type(HPF)</td><td>*1</td><td>→</td></tr>
<tr><td>2</td><td>Frequency</td><td>NNNNN</td><td>20 to 20000Hz</td></tr>
<tr><td>3</td><td>Type(LPF)</td><td>*1</td><td>→</td></tr>
<tr><td>4</td><td>Frequency</td><td>NNNNN</td><td>20 to 20000Hz</td></tr>
<tr><td>5</td><td colspan="3">*Reserved*</td></tr>
<tr><td>6</td><td colspan="3">*Reserved*</td></tr>
<tr><td>7</td><td colspan="3">*Reserved*</td></tr>
<tr><td>8</td><td>HP Bypass</td><td>O,F,T</td><td>O=On, F=Off, T=Toggle</td></tr>
<tr><td>9</td><td>LP Bypass</td><td>O,F,T</td><td>O=On, F=Off, T=Toggle</td></tr>
</table>

*1 Filter type descriptions

|	Slope	Strings
Butterworth	6dB/oct	**But6**
	12dB/oct	**But12**
	18dB/oct	**But18**
	24dB/oct	**But24**
	36dB/oct	**But36**
	48dB/oct	**But48**
Bessel	12dB/oct	**Bes12**
	18dB/oct	**Bes18**
	24dB/oct	**Bes24**
	36dB/oct	**Bes36**
	48dB/oct	**Bes48**
Linkwitz-Reilly	12dB/oct	**Lin12**
	24dB/oct	**Lin24**
	36dB/oct	**Lin36**
	48dB/oct	**Lin48**

Note: Labels for PowerMatch Signal Processing modules (other than Input and Amp Output) are fixed and cannot be changed in the same way as ESP modules. Module labels are "Band Pass 1" through to "Band Pass 8" according to the channel.

EXAMPLES:

SA"Band Pass 1">1>3=But24<CR>	*Set LP filter for channel 1 to Butterworth 24db/oct*
SA"Band Pass 5">1>2=80<CR>	*Set frequency for channel 5 high-pass to 80Hz*
GA"Band Pass 7">1>9<CR>	*Query the Bypass state for LPF on channel 7*
GA"Band Pass 7">1>9=F<CR>	*Response channel 7 LPF Bypass is currently Off*

6.2.7 SPEAKER PARAMETRIC EQ Module

The Speaker Parametric EQ module has; 9 bands of parametric EQ, a band-pass filter and alignment delay, but on the PowerMatch the Band Pass is addressed as a separate module (see above). The same parameters are adjustable for each parametric EQ bands. **Index 1** is used to select the EQ band to adjust (1-9) or setting **Index 1** to 0 accesses the EQ Gain parameter. **Index 2** is then used to select the desired parameter to adjust according to the tables below. Parameters indicated as 'Reserved' should not be used.
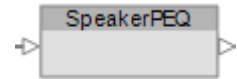
Index 1:   Selects the desired EQ Band (1-9) or 0 for EQ Gain

EQ Gain (Index 1=0)		*Value*	*Range*
Index 2	**1**	*Reserved*	
	2	*Reserved*	
	3	Gain	+/-NN.N	-15.0B to +15.0dB, 0.5dB step
	4	Align Delay	NNN	0 to 480 as number of samples

PEQ Band (1-9)		*Value*	*Range*
Index 2	**1**	Frequency	NNNNN	20 to 20000Hz
	2	Q	NN.N	0.10 to 10.0, 0.1 step
	3	Gain	+/-NN.N	-20.0dB to +20.0dB, 0.1dB step
	4	*Reserved*	
	5	Type	XX	B=Band, HS=High Shelf, LS=Low Shelf, N=Notch
	6	Bypass	O,F,T	O=On, F=Off, T=Toggle

The parameters in use for each band will be dependent on the Type of filter selected as illustrated in the table below:

| Type	Freq.	Q	Gain	Bypass	Strings
Band	o	o	o	o	B
High shelf	o		o	o	HS
Low shelf	o		o	o	LS
Notch	o	o	o	o	N

Note: Labels for PowerMatch Signal Processing modules (other than Input and Amp Output) are fixed and cannot be changed in the same way as ESP modules. Module labels are "SpeakerPEQ 1" through to "SpeakerPEQ 8" according to the channel.

EXAMPLES:

SA"SpeakerPEQ 1">6>5=LS\<CR>	*Set type for PEQ band 6 of Channel 1 to Low-Shelf*
SA"SpeakerPEQ 4">2>1=200\<CR>	*Set the freq. for PEQ band 2 of Channel 4 to 200Hz*
GA"SpeakerPEQ 6">0>3\<CR>	*Query the EQ gain for Channel 6 SPEQ module*
GA"SpeakerPEQ 6">0>3=2\<CR>	*Response indicating the EQ gain is currently +2dB*

6.2.8 LIMITER Module

Index 1 should always be set to 0 to access this module. The 6 parameters that can be set for this module are then selected by using the appropriate value for **Index 2**. Parameters indicated as 'Reserved' should not be used.

Limiter
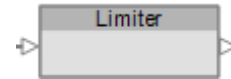
Index 1:   Selects module (always=0)

			Value	*Range*
	1	Peak Threshold	NN.N	0.5 to 71.0 V (or 142.0 for bridged), 0.5 Step
	2	RMS Threshold	NN.N	0.5 to 71.0 V (or 142.0 for bridged), 0.5 Step
	3	RMS Attack	NNNNNN	500 to 10,000ms, 100 step
	4	RMS Release	NNNNNN	500 to 10,000ms, 100 step
Index 2	**5**	Link Group	N	0=No Link Group, 1-4= Link Group 1-4
	6	*Reserved*		
	7	*Reserved*		
	8	*Reserved*		
	9	*Reserved*		
	10	*Reserved*		
	11	*Reserved*		
	12	*Reserved*		

Note: Labels for PowerMatch Signal Processing modules (other than Input and Amp Output) are fixed and cannot be changed in the same way as ESP modules. Module labels are "Limiter 1" through to "Limiter 8" according to the channel.

EXAMPLES:

SA"Limiter 3">0>1=50<CR>	*Set the Peak limiter threshold for channel 3 to 50V*
SA"Limiter 1">0>2=25<CR>	*Set the RMS limiter threshold for channel 1 to 25V*
GA"Limiter 5">0>5<CR>	*Query whether channel 5 is part of a limiter Link Group*
GA"Limiter 5">0>5=2<CR>	*Response indicating ch 5 is a member of Link Group 2*

6.2.9 DELAY Module

Delay

The Delay module for the PM8500 has a single tap and hence **Index 1** is always 1. **Index 2** is then used to select the parameter to adjust as shown in the table below:
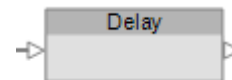
Index 1: Selects Delay tap (always=1)

			Value	***Range***
Index 2	**1**	Delay time	NNNNN	0 to 144000 as number of samples
	2	Bypass	O,F,T	O=On, F=Off, T=Toggle

Note: Labels for PowerMatch Signal Processing modules (other than Input and Amp Output) are fixed and cannot be changed in the same way as ESP modules. Module labels are “Delay 1” through to “Delay 8” according to the channel.

EXAMPLES:

SA"Delay 1">1>1=2592<CR>	*Set the delay time for channel 1 to 54msec* *(54msec = 0.054sec, 0.054x48000 = 2592 samples)*
SA"Delay 6">1>2=F<CR>	*Set Delay bypass for channel 6 to Off*
GA"Delay 2">1>1<CR>	*Query the current delay time channel 2*
GA"Delay 2">1>1=9600<CR>	*Response with delay time for channel 2 is 200ms* *(9600 samples, 9600/48000 = 0.2sec = 200msec)*

6.2.10 AMP OUTPUT Module

Amp Output
Out 1

There are 3 parameters which can be set for this module, selected simply by using the appropriate value for **Index 1**.
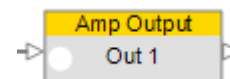
			Value	***Range***
Index 1	**1**	Level	NN.N	-60 to 0.0dB, 0.5dB step
	2	Mute	O,F,T	O=On, F=Off, T=Toggle
	3	Polarity	O,F,T	O=On, F=Off, T=Toggle

EXAMPLES:

SA"Out Main">1=-3.5<CR>	*Set the level for Output module “Out Main” to -3.5dB*
SA"Output L">2=T<CR>	*Toggle the mute state for Amp Output “Output L”*
GA"Out 1">1<CR>	*Query the current level for channel 1 Amp Output*
GA"Out 1">1=-6<CR>	*Response indicating channel 1 is currently set to -6dB*

7 Revision History

v1.1
- added increment amount to set volume Increment/Decrement
- added comma delimiters between parameters and space after command
- added command format section (3).

v1.2 (requires firmware version 3135 or greater)
- Set/Get volume parameter range changed to "0- 90h" from "1-90h"

v1.3 (requires firmware version 3240 or greater)
- Added Get Level (in dBFS) command

v1.4 (requires firmware version 1.1 or greater)
- added Set Group volume commands
- added start-up strings when ESP boots.
- added comment re: crossover cable needed to connect PC.

v2.0
- Added SA, GA command and description of each algorithm.
- Added AMX device discovery command

v2.3
- Removed Speaker EQ & Meter from SA/GA commands
- Added type change of signal generator in SA/GA command.
- Change Error codes. ('00' ->'01', '01' -> '02', '02' ->'03')

v2.3d November 9, 2007
- Removed '#' from the examples. In general, you would not use '#' in most commands since '#' is only needed on those modules for which you want automatic feedback.
- Clarified that quotation marks '"' are required on all module names.

v2.4 December 3, 2007
- Added 4.8 & 4.9 Group Master volume Increment/Decrement & Mute

v2.4b March 17, 2008
- Various text changes

v2.5 July 7, 2008, requires firmware 2.040 or later
- Added surround module & automatic mic mixing module commands
- Added multi-ESP addressing

v2.6 September 25, 2008, requires firmware 2.050 or later
- Added IP address commands
- Added two surround module commands (Index 2&3)

v2.6a February 20, 2009
- Noted SA/GA commands won't work when 2 modules have same name
- Added firmware versions required to the change history

v2.6b March 17, 2009, requires firmware 2.075 or later
- Added Serial-over-Ethernet connection details
- Various text and formatting changes

v2.6c October 5, 2009, requires firmware 2.075 or later
- Clarified that Hexadecimal values can be sent in upper or lower case but will always be returned in lower case
- Corrected SA/GA examples in 'Error Codes' and 'Mulit-ESP Communication' sections
- Various text and formatting changes

v3.0   October 12, 2011, requires firmware ESP = 3.04 or later, PM = 1.04 or later
- Major re-format of document to include PowerMatch in addition to ESP
- Commands divided into System, Device and Module categories
- Addition of PowerMatch module indices
- Examples re-formatted to clearly distinguish between commands/responses.
- Removed AMX device discovery command
- Set/Get Preset commands now only supported on legacy systems

v3.1   March 16, 2012, requires firmware ESP = 3.07 or later, PM = 1.09 or later
- Addition of PM8500N Device commands:
  - Set/Get Standby Status (SY, GY)
  - Get Configuration (GC)
  - Set/Get Fault Status (SF, GF)
  - Clear Fault/Alarms (CF)
  - Get/Clear Alarm History/Log (GH, CH)
  - Set/Get Alarm Reporting/Status (SR, GR)
- Added PM8500N support for Get Signal Level (GL)

v3.2   April, 2013, requires firmware ESP = 3.07 or later, PM = 1.09 or later
- Correction – LPF and HPF reversed on ESP SpeakerPEQ Module
- Correction – NOM Limit added to ESP Automatic Mic Mixer Module

v4.0   August, 2013
(requires firmware: ESP-00 = 4.07, ESP-880/1240/4120 = 1.00, PM = 1.34 or later)
- Updated to include ESP-880/1240/4120, PM4250N/PM4500N/PM8250N and change ESP references to ESP-00 and PM8500N references to PowerMatch.
- ESP module indices re-ordered alphabetically to match ControlSpace Designer software
- Removed RoomCombinerMixer module reference (not supported since 3v0)
- Removed Set/Get Preset System Command (not supported since v3.0)
- System commands should now be sent to Main/RTC or device involved in construct being controlled.
- Added table for 'Slot' references used for Device commands

v4.1   September, 2014
(requires firmware: ESP-00 = 4.20, ESP-880/1240/4120 = 1.13, PM = 1.43 or later)
- Updated 2.Connection text to reflect that 3rd party connection is now closed correctly, rather than dropped
- Updated ESP Input module for Mic/Line Input II card
- Updated ESPLink module to relect new channel labels
- Updated some module images and corrected section numbering

v4.2   January, 2015
(requires firmware: ESP-00 = 4.23, ESP-880/1240/4120 = 1.16, PM = 1.46 or later)
- Added ESP-1600
- Updated the 'Connection' section to reflect added support for multiple serial-over-Ethernet connections.
- Clarified that only the first instance of limiting or clip for a given PowerMatch channel is reported. Clearing of alarms is required for continuous monitoring.

v4.3   May, 2015
(requires firmware: ESP-00 = 4.570, ESP-880/1240/4120 = 1.570, PM = 2.060 or later)
- Added 'Network Parameter' device command
- Added 'Reset' device command
- Modified 'Gain' module to include mention of multi-channel variants
- Increased max channel numbers for 'Router' module to suit maximum custom size
- Corrected "" in examples.

v4.4   January, 2016
(requires firmware: ESP-00 = 4.610, ESP-880/1240/4120/1600 = 1.610, PM = 2.110 or later)
- Added 'AutoMicMixer-GainSharing' module to ESP module commands
- Modified 'Parametric EQ' module for ESP to include variable band versions