## SEEBURG acoustic line

# active systempanel 2.5

## User Manual

Oktober 2003


acoustic line
SEEBURG
Professional PA Systems

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# 1 Introduction

Congratulations! With the SEEBURG acoustic line SP2.5 you have purchased a versatile and professional controller for touring and installed applications. It´s flexible possibilities make the SP2.5 suitable and compatable for existing PA Systems. Operating in analog technology, it uses only highest grade components and garantees a very natural and first-class sound reproduction.

**Please read this manual carefully to allow your system to achieve it’s full potential. Keep this manual for further reference.**

The SP2.5 is used as a link between amplifiers and loudspeakers (Fig.1). It combines an active 2-way stereo crossover, system Controller and a I/O connection panel in a standard 19" housing using only one rack space (1U).

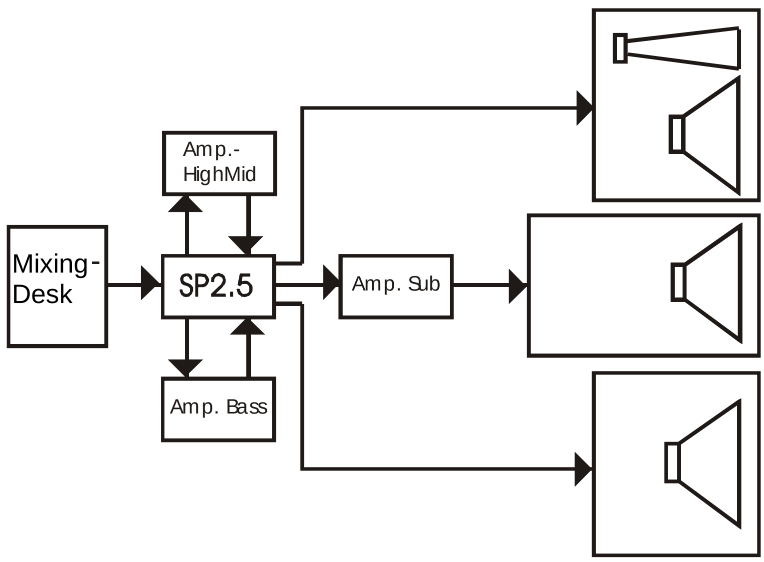


**fig 1** connection diagram SP2.5

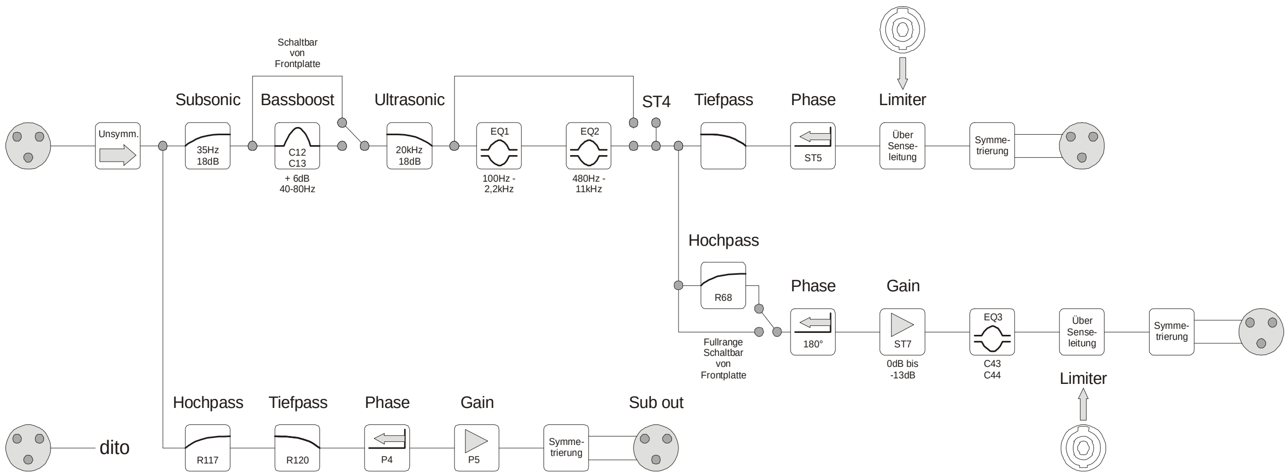


**fig 1** block diagram SP2.5

If ordered together with a SEEBURG acoustic line system the SP2.5 will be delivered with settings for the specific system. For allround applications the 2.5 will be delivered with a STD factory setting (see appendix, 4.3).

To make changes in the configuration the unit must be opened, SIPs (resistor arrays) or jumpers must be changed. In doubt please contact your SEEBURG acoustic line dealer.

**Important: The unit must be shut off, mains should be unplugged. The manufacterer will not be held responsible for any problems due to unortherized handling!**

## 1.1 Using this manual

We will briefly describe the teminology used to help you understand the unit and it´s functions. Since we cannot explain all technical terms regarding electroacoustics we have provided a glossary in the appendix. In case you come about any questions or problems while setting up your SP 2.5, please contact you SEEBURG acoustic line dealer.

# 2 Controls and connections of the SP2.5

You will find the following controls on the front panel of the SP2.5:

- **Power on-LED:** Signals the presence of Mains (plugged in and switched on).
- **Audio in** Channel A and B: Indicates presence of input singnal (from Mix) for Channel A and B.
- **Link to next panel** Channel A and B: Parallel link out of the unprocessed input signal, i.e. to other SP2.5 units or Amplifiers.
- **Signal A/B-LED:** Indicates the presence of an input signal with a level over -20dB.
- **Bass boost** : The additional bass boost (+6dB @ 55Hz) is switchable at the front panel. The LED next to the switch will light up if active.
- **Fullrange** (mounted decreased to prevent accidential switching): This switch changes the high-mid output to Fullrange mode. The according LED will light up if active.
- **Limit-LEDs for woofer and high-mid:** The four LEDs will light up if limiters are active.

- **output to speakers:** Speakon connectors for speaker connection. Pins 1+/- carry the high-mid signal, Pins 2+/- the bass signal.

Rear panel connectors on the of the SP2:

- **Amp Return woofer and high-mid**: Speakon connectors (coding: 1+/-=A; 2+/-=B) for connecting amplifier outputs to the SP2.5 inputs. Please check for correct polarity. (NL4FC is 1:1)
- **Signal to Amp sockets for high-mid A/B and woofer (bass) A/B**: Connectors for connecting the outputs of the SP2.5 to the corresponding amplifier inputs.
- **Sub out** (mono): This connector carries a additional bass mono signal which can be adjusted in phase & level using the controls PHASE & LEVEL.


**fig 2** Front panel connectors and controls


**fig 3** Rear panel connectors and controls

# 3 SP2.5 Functions

## 3.1 Active Crossover

The integrated 2-way crossover divides the audio spectrum into passbands for each transducer and distributes the preamplified signal from the mixer to the corresponding amp channels for bass, mid & high frequencies. The crossover frequencies are set using risistor arrays (SIPs). The bass band is limited by an highpass filter, the hi-mid band is limited by an lowpass Filter, both typs are Butterworth with 24dB/octave slopes.

The following parameters can be edited:

### 3.1.1 Cutoff frequency

By using different resistor values (SIPs) the crossovers cutoff frequencies can be set, also allowing the bands to overlap. The resistor values are listed in the appendix in **table 1**.

### 3.1.2 Phase correction

Difference in phase between the two bands can be adjusted by altering the phase of the bass band (0° to 180°, lightgreen jumper in positions 0. 35, 70, 105, 140 or 180). The phase of the hi-mid band can be reversed by 180°. To do this set the corresp onding lightgreen jumper to position 180.

This phase correction can be usefull in case the acoustic centres of two loudspekers radiating the same frequency are horizontally not in plane (transducer alignment). This geometrical distance lets the acoustic energy radiated by the closer loudspeaker arrive the listeners ear earlier due to the shorter distance it has to travel, resulting in unwanted interference at that particular frequency. [1]

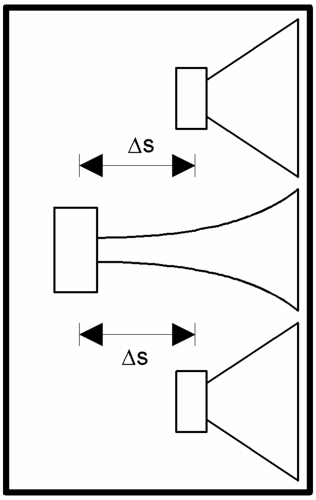


**fig 4** phase correction

[1] see glossary / appendix

The amount of phase correction ($\Phi$ in degrees) you need at a given distance between loudspeakers ($\Delta$s) is calculated as follows:

$$\Phi = \frac{\Delta s \cdot 360° \cdot f}{c}$$

$\phi$: Phase angle in degrees

$\Delta$s: Distance between the loudspeakers in meters

c: Speed of sound (in air at 101,3 hPa and 20 °C approximatly 340 m/s;
c increases/decreases approximatly 0,6m/s every 1°Celsius)

**Example:** A wedge with two 12“ and one 2“ drivers needs to be setup using the SP2.5 in two-way active configuration. The acoustic centre of the 2” driver is 11,5 cm behind the center of the 12” drivers. The crossover cutoff frequency is 1500 Hz. The amount of phase correction for the 11,5cm in this example is:

$$\Phi = \frac{0{,}115m \cdot 360° \cdot 1500\,\frac{1}{s}}{340\,\frac{m}{s}} = 182{,}64° \approx 180°$$

### 3.1.3 High-Mid Attenuation

The high-mid attenuator allows the high-mid band to be attenuated in 2,5dB steps in relation to the bass band, i.e. if the bass driver has a lower efficiancy than the high-mid driver. This is done by setting the red jumper on the circuit board to the desired position. The amount of attenuation is listed next to the socket **(fig.5)**. The first position marked “0” provides no attenuation, or 0 dB.

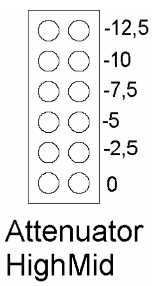


**fig 5** Jumper socket for the attenuation in the mid-high band

### 3.1.4 Full range mode (high-mid band)

Depressing the (decreased mounted) full range switch on the front panel bypasses the highpass of the crossover. This allows fullrange capable mid-high systems to be operated over the complete bandwidth. This full range mode is indecated by the corresponding LED lighting up.

## 3.2 Limiter

The SP2.5 includes four limiters (high-mid CH. A und CH. B, Bass CH. A und CH. B). attack/release can be individually adjusted for each limiter in three steps, the amount of power transmitted to the transducers can also be set here.

To insure correct limiter function it is important to connect the speakers using the two speakon connectors (“speaker out”) on the front panel. The amplifier outputs are connected via “amp return” connectors on the back panel of the SP2.5. By feeding the amplifiers output signal through the SP2.5, it is possible to exactly measure the amount of power fed to the speaker drivers. This measurement with internal sensing is a must for acurate limiter operation (see **fig.1**).

Time related limiter settings are made via blue jumpers in the limiter section of the circutboard. The jumper sockets are labeld **fast (A)**, **medium (B)** and **slow (C)**:

Time settings for bass- & high-mid are:

| | | | |
|---|---|---|---|
| Bass: | A = 20ms, | B = 100ms, | C = 200ms |
| HighMid: | A = 10ms, | B = 40 ms, | C = 100ms |

The maximal power values for each limiter are set with four 5-way DIP switches. Positions for power and impedance are listed in **table 2** in the appendix. Red LEDs on the front panel indicate limiter action. The SP2.5 limiter has a dynamic characteristic, which means the power is not totally limited immediately when threshold is reached, the compression ratio[2] rises as amp power does (**fig.6**).

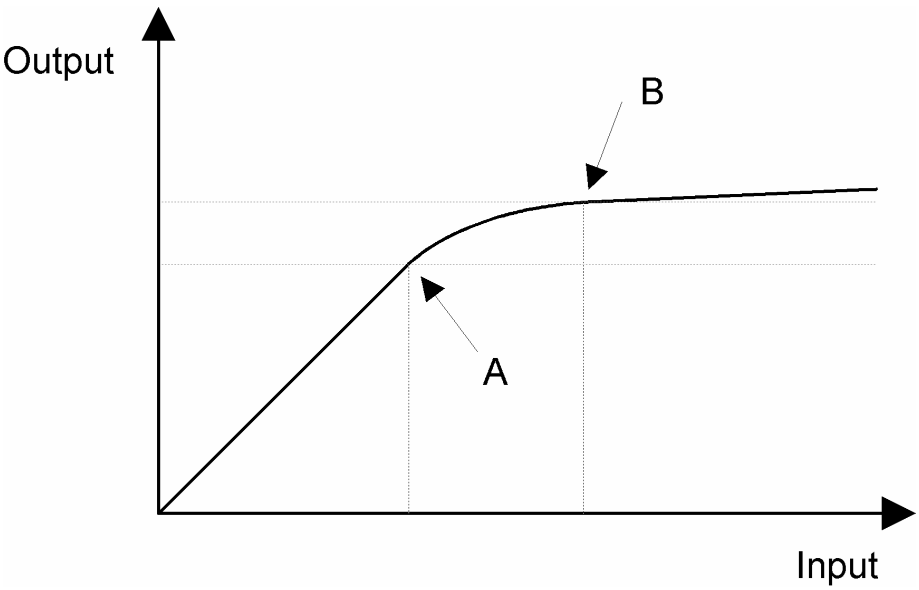


**fig 6** principle limiter charactertistic. The LED will light at point A. The compression ratio then rises as input signal does (range between point A & point B). The maximum compression ratio of approximately 1:20 is reached after the input signal reaches point B.

### 3.3 Subsonic and ultrasonic filter

The subsonic-filter is a highpass filter with an edge steepness of 18 dB/oct, the ultrasonic filter a lowpass with the same edge steepness. The –3dB cutoff frequency are at 35Hz and 20kHz. The idea is to damp frequencies outside of the relevant audible range (infra- and ultrasonic). These filters are always active and cannot be turned off.

[2] see glossary / appendix

### 3.4 Equalizer funktion

The SP2.5 offers two fully parametric EQs and one semi parametric EQ (fixed Q) on every channel. Adjustments are made via the corresponding trimmpots on the circuit board (**fig 8** and **fig 9**). A maximum cut/boost of +/- 12 db is available. Please try to avoid cutting or boosting too extremely.

In order to activate the circuts the black jumper must be inserted to the corresponding postions marked “EQ-INSERT”.

To deactivate the circuit insert the jumper to a position marked “bypass”

EQ1 and EQ2 have different ranges to set the cutoff frequencies. These frequencies are set by inserting different values of SIPs (resistor arrays, all E12 plus 20 kΩ from E24). The frequency ranges and resistor values for the SIPs are listed in table 1 in the appendix. The sockets for frequency selection (SIPs on the circuit board) are marked “FREQUENCY”

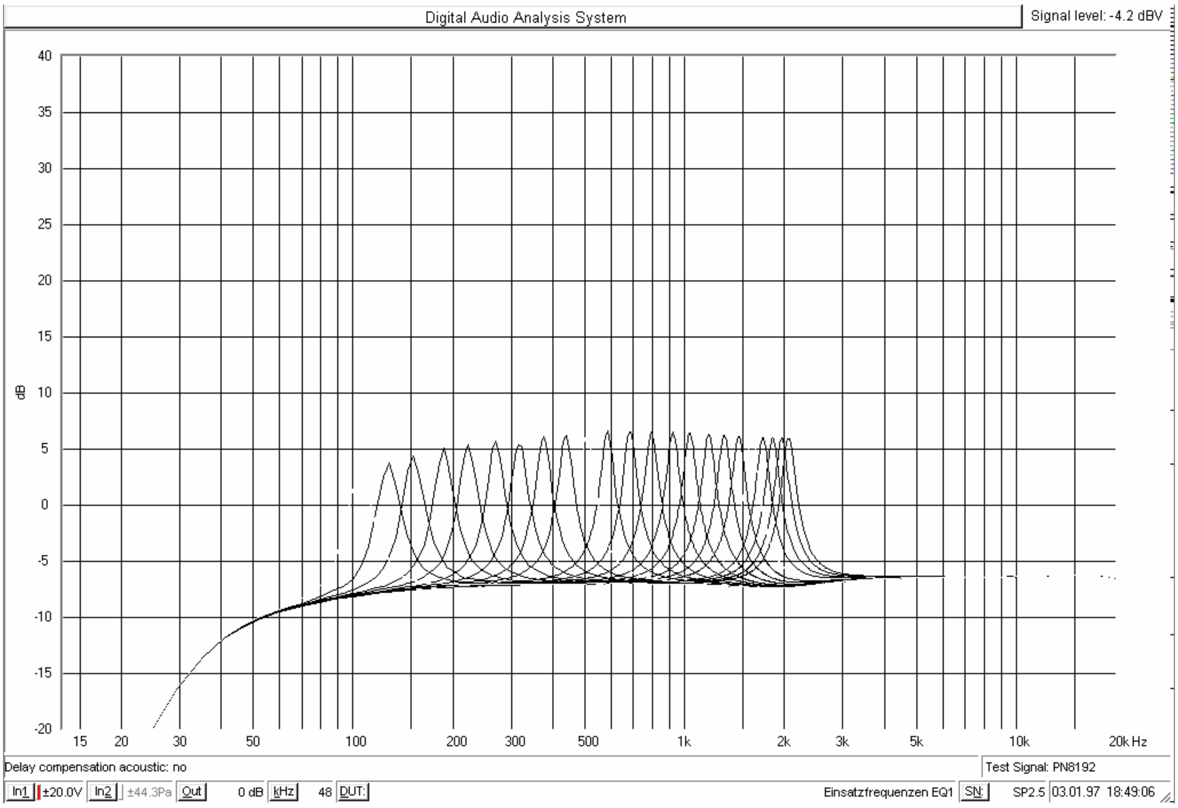


**fig 8** mesuered frequency curves EQ1 (Q=12)

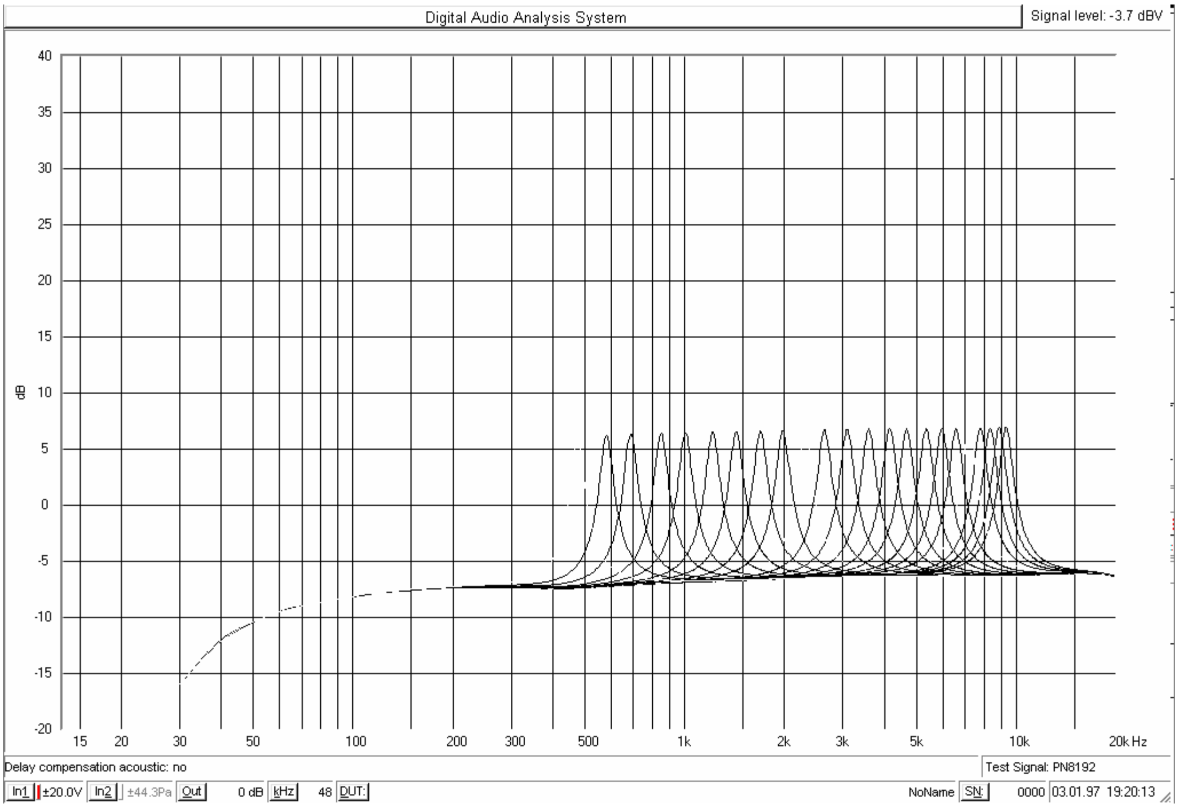


**fig 9** mesuered frequency curves EQ2 (Q=12)

**fig 8** and **fig 9** show a decrease of the zero lines under 50Hz and obove 15kHz. This effect results of the SP2.5´s built in subsonic and ultrasonic filters (see 3.3).

### 3.4.1 Adjusting the EQ slope (Q-factor)

The slope of the EQ filter (Q-Faktor [3]) can be adjusted by setting the yellow jumper on the circuit board, the socket ist marked "**bandwidth**". The three available types (**fig 10**) are:

- **Peak (Q = 12):** yellow jumper left position
- **Normal (Q = 3):** yellow jumper middle position
- **Shelve (Q = 1,5):** yellow jumper right position

The fourth position (far right) can be used for further optional slopes to be custom designed. Resistor R26 and/or R46 must be soldered: Please contact your SEEBURG acoustic line service.

[3] see glossary / appendix

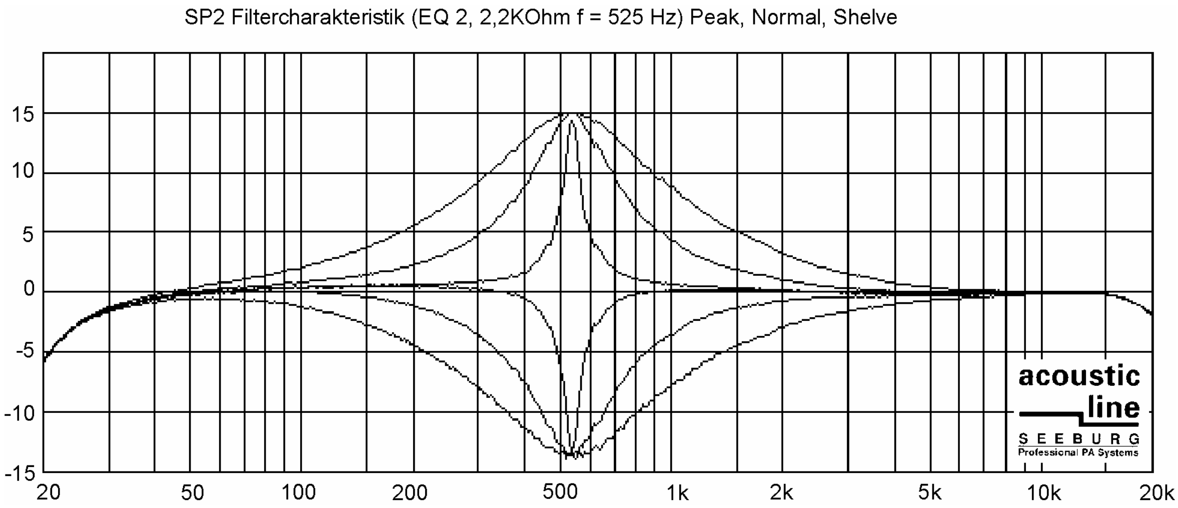


**fig 10** the three mesured filter slopes

## 3.4.2 Bass boost

Pressing the bass boost switch on the front panel activates a 6dB boost @ 55Hz. The corresponding LED indicates active boost.

# 4 Appendix

## 4.1 Tables

| resistor array | frequency x-over | frequency: EQ1 | frequency: EQ2 |
|---|---|---|---|
| 220 | - | - | 11K |
| 330 | 4K7 | 2K1 | 9K2 |
| 390 | 3K8 | 2K | 9K |
| 470 | 3K2 | 1K8 | 8K3 |
| 560 | 2K7 | 1K7 | 7K9 |
| 680 | 2K3 | 1K6 | 7K1 |
| 820 | 1K8 | 1K5 | 6K7 |
| 1K | 1K5 | 1K3 | 6K |
| 1K2 | 1K3 | 1K2 | 5K3 |
| 1K5 | 1K | 1K1 | 4K7 |
| 1K8 | 820 | 920 | 4K1 |
| 2K2 | 680 | 800 | 3K7 |
| 2K7 | 550 | 700 | 3K1 |
| 3K3 | 450 | 600 | 2K8 |
| 3K9 | 380 | 510 | 2K3 |
| 4K7 | 315 | 440 | 2K |
| 5K6 | 270 | 380 | 1K7 |
| 6K8 | 220 | 320 | 1K45 |
| 8K2 | 175 | 270 | 1K25 |
| 10K | 145 | 225 | 1K |
| 12K | 120 | 185 | 850 |
| 15K | 92 | 150 | 700 |
| 18K | 78 | 130 | 580 |
| 22K | 60 | 110 | 490 |

**table 1** SIP resistor values for setting cutoff frequencies and EQs

resistor values in Ohm (Ω).

frequency in Hertz (Hz).

These values noted in three numbers: The first and second show the resitor value, the third shows the numbers of zeros to be added:

Example: 222: 2200 Ω = 2,2 kΩ

153: 15000 Ω = 15 kΩ

| Switch | | | | | Threshold | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S1 | S2 | S3 | S4 | S5 | U | P16 | P8 | P4 | P2 |
| OFF | OFF | OFF | OFF | OFF | 12 | 9 | 18 | 36 | 72 |
| **ON** | OFF | OFF | OFF | OFF | 15 | 14 | 28 | 56 | 113 |
| OFF | **ON** | OFF | OFF | OFF | 18 | 20 | 41 | 81 | 162 |
| **ON** | **ON** | OFF | OFF | OFF | 21 | 28 | 55 | 110 | 221 |
| OFF | OFF | **ON** | OFF | OFF | 24 | 36 | 72 | 144 | 288 |
| **ON** | OFF | **ON** | OFF | OFF | 28 | 49 | 98 | 196 | 392 |
| OFF | **ON** | **ON** | OFF | OFF | 32 | 64 | 128 | 256 | 512 |
| **ON** | **ON** | **ON** | OFF | OFF | 36 | 81 | 162 | 324 | 648 |
| OFF | OFF | OFF | **ON** | OFF | 40 | 100 | 200 | 400 | 800 |
| **ON** | OFF | OFF | **ON** | OFF | 44 | 121 | 242 | 484 | 968 |
| **ON** | **ON** | OFF | **ON** | OFF | 48 | 144 | 288 | 576 | 1152 |
| OFF | OFF | **ON** | **ON** | OFF | 52 | 169 | 338 | 676 | 1352 |
| **ON** | OFF | **ON** | **ON** | OFF | 56 | 196 | 392 | 784 | 1568 |
| OFF | **ON** | **ON** | **ON** | OFF | 60 | 225 | 450 | 900 | 1800 |
| **ON** | **ON** | **ON** | **ON** | OFF | 64 | 256 | 512 | 1024 | 2048 |
| OFF | OFF | OFF | OFF | **ON** | 68 | 289 | 578 | 1156 | 2312 |
| **ON** | OFF | OFF | OFF | **ON** | 72 | 324 | 648 | 1296 | 2592 |
| OFF | **ON** | OFF | OFF | **ON** | 76 | 361 | 722 | 1444 | 2888 |
| **ON** | **ON** | OFF | OFF | **ON** | 80 | 400 | 800 | 1600 | 3200 |
| OFF | OFF | **ON** | OFF | **ON** | 84 | 441 | 882 | 1764 | 3528 |
| **ON** | OFF | **ON** | OFF | **ON** | 88 | 484 | 968 | 1936 | 3872 |
| OFF | **ON** | **ON** | OFF | **ON** | 92 | 529 | 1058 | 2116 | 4232 |
| **ON** | **ON** | **ON** | OFF | **ON** | 96 | 576 | 1152 | 2304 | 4608 |
| OFF | OFF | OFF | **ON** | **ON** | 100 | 625 | 1250 | 2500 | 5000 |
| **ON** | OFF | OFF | **ON** | **ON** | 104 | 676 | 1352 | 2704 | 5408 |
| OFF | **ON** | OFF | **ON** | **ON** | 108 | 729 | 1458 | 2916 | 5832 |
| **ON** | **ON** | OFF | **ON** | **ON** | 112 | 784 | 1568 | 3136 | 6272 |
| OFF | OFF | **ON** | **ON** | **ON** | 116 | 841 | 1682 | 3364 | 6728 |
| **ON** | OFF | **ON** | **ON** | **ON** | 120 | 900 | 1800 | 3600 | 7200 |
| OFF | **ON** | **ON** | **ON** | **ON** | 124 | 961 | 1922 | 3844 | 7688 |
| **ON** | **ON** | **ON** | **ON** | **ON** | 128 | 1024 | 2048 | 4096 | 8192 |

**table 2** DIP-switch settings for limiter levels

U in Volt
P 16 in Watt at 16 Ω impedance
P 8 in Watt at 8 Ω impedance
P 4 in Watt at 4 Ω impedance
P 2 in Watt at 2 Ω impedance

## 4.2 Note - Chart for SP2.5-configurations

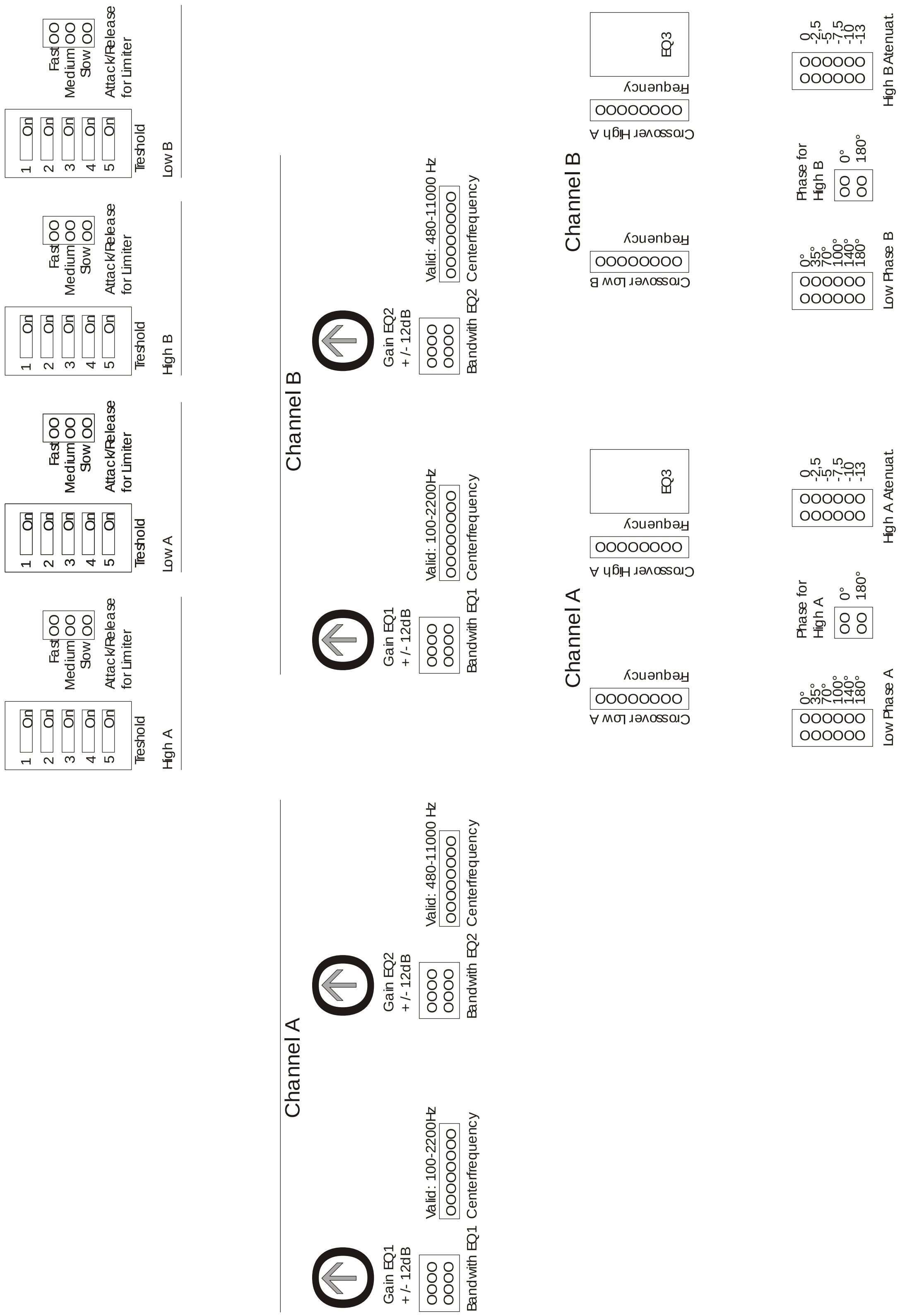


**fig 11** note chart to archive controller-settings

## 4.3 Factory Settings

If your SP2.5 was not ordered for a specific SEEBURG acoustic line system, it will be delivered with the following standard preset:

| | | |
|---|---|---|
| Crossover: | Cutoff frequency (SIP): | 120 Hz (12 kΩ) |
| | Phase HighMid and Woofer: | 0° |
| | Attenuation HighMid: | 0 dB |
| EQ 1: | Center-frequency (SIP): | 440 Hz (4,7 kΩ) |
| | Bandwidth: | Normal (mid position) |
| | Gain: | 0 dB (mid position) |
| EQ 2: | Center-frequency (SIP): | 2 kHz (4,7 kΩ) |
| | Bandwidth: | Normal (mid position) |
| EQ 3 | Center-frequency: | 2500 Hz, Q = 1 (fixed) |

Limiter: All limiters are set to transmit a power of 400W to a 8 Ohm transducer.

## 4.4 Technical Specifications SP2.5

| | |
|---|---|
| Signal-To-Noise-Ratio (@ 6 dB): | > 103 dB |
| Total Harmonic Distortion (THD) (@ 6 dB): | < 0,04 % |
| Maximum Input Level (Headroom): | 22 dBU |
| Subsonic/Ultrasonicfilter: | -3 dB points @ 35 Hz and 20 kHz |
| | -18 dB/octave slopes |
| Output impedance (Signal to Amp): | 600 Ω |
| Input impedance (Audio In): | 40 kΩ |
| Mains: | 230 Volt/AC/10 VA |
| Dimensions (W x H x D): | 482 x 440 x 230 mm |
| Weight: | 3,4 kg |

Equalizer function:

| | |
|---|---|
| cut/boost: | ±12 dB |
| Range EQ1: | 110 - 2100 Hz |
| EQ2: | 490 - 11000 Hz |
| EQ3: | 2500 Hz Q = 1 |

In keeping with our policy of continued improvement, SEEBURG acoustic line reserves the right to alter specifications without prior notice.

## 4.5 Glossary

- **compression ratio:** A compressor limits the level of an audio signal, as soon as it exceeds a certain adjustable value (threshold). Below the threshold the slope is 1 (a ratio of 1:1), which means output value is equal to input value. At the threshold the characteristic changes to a less steep slope, depending on the compression ratio. COMPRESSION RATIO determines the ratio of change on output signal to changes in input level for all signals that exceed the threshold. A limiter has a compression ratio of 1:∞, meaning no increase of output level no matter how much the input level increases (after exceeding the threshold level!).

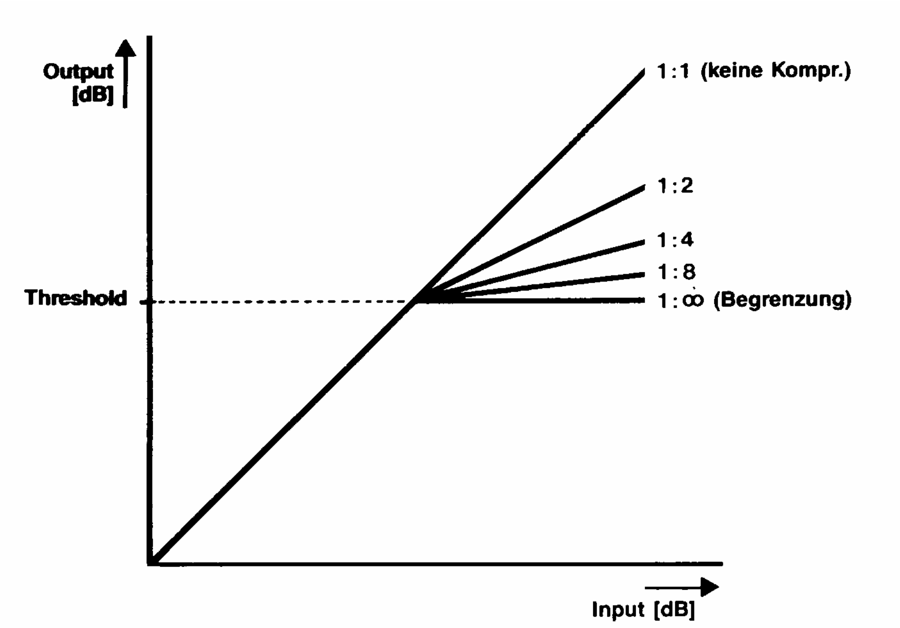


**fig 12** compression ratio

- **Level (Dezibel, dB):** In audio we have a to care a lot about levels. A level can mean a voltage or power and often a sound pressure in relation to a reference voltage, reference power or reference sound pressure. This scale used is logarithmetic, and the unit used is Bel, for matters of size mostly used is dezi-Bel, or short dB.

For power level the definition is

$$\frac{L_P}{dB} = 10 \cdot \log(\frac{P}{P_0})$$

With a known impedance a level can also refer to a voltage:

$$\frac{L_u}{dB} = 20 \cdot \log(\frac{U}{U_0})$$

In our part of the audio world the reference voltage $U_0$ is 0,775V.

The reference power $P_0$ is defined at 1mW, resulting in a voltage of 0,775 V over a 600 Ω resistor.

- **Phase shift:** If two waves with the same frequency and same zero crossing overlay (they are **in phase**), they will add to a new wave with exact doubled amplitude (**fig 13a**). If these waves are shifted by 180°, they will cancel each other ( **fig 13b**). The time shift between two waves is called phase shift. Depending on size of this phase shift, there will be more or less amplification or cancellation. This will also happen with two waves of different amplitudes, it will then not result in total cancellation at 180°.

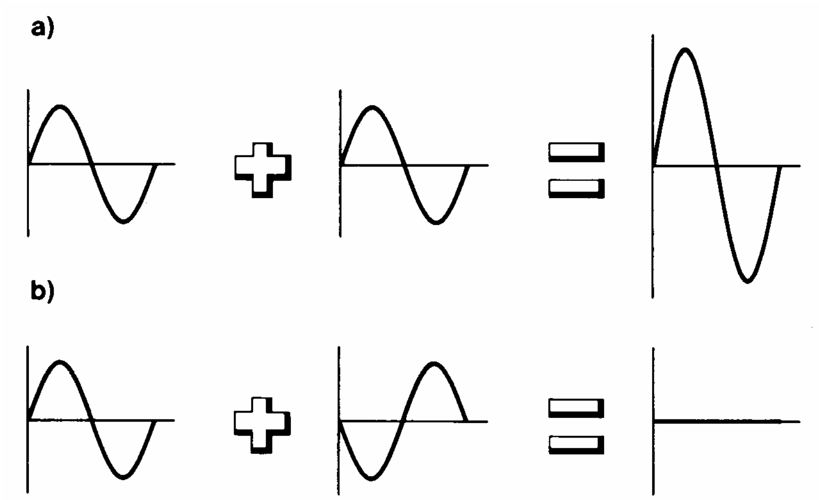


**fig 13** two waves, same amplitude, frequency and phase (**a)**) add to a new wave with doubled amplitude

- **Q-factor:** The Q-factor (or Q) ist the width of the slope produced by a filter circuit. Every EQ is a electronic filter (resonant circuit). A EQ with a small Q will alter neighbor frequencies of the cutoff frequency more than a EQ with a large Q. If you want to very perecisly alter one single frequency, you will need a very high Q. Sometimes you´ll want to effect a broader band, i.e. lower band of a complete P.A. system (50 to 150 Hz), in that case you need a filter with a low Q.

For you slope freaks out there: The Q for electric resonant circuits is:

$$Q = \frac{f_0}{B}$$

B Bandwidth: B = fa-fb (fa is the upper 3dB frequency, fb the lower)

fo Resonance frequency: fo = √(fa x fb)

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