

# DPR-402

## User Manual

This equipment has been tested and found to comply with the following European and international Standards for Electromagnetic Compatibility and Electrical Safety:

Radiated Emissions (EU):	EN55013	(1990) Associated Equipment
RF Immunity (EU):	EN50082/1	(1992) RF Immunity, Fast Transients ESD
Mains Disturbance (EU):	EN61000/3/2	(1995)
Electrical Safety (EU):	EN60065	(1993)
Radiated Emissions (USA):	FCC part 15 Class B	
Electrical Safety (USA):	UL813/ETL	(1996) Commercial Audio Equipment
Electrical Safety (CAN):	UL813/ETLc	(1996) Commercial Audio Equipment

### IMPORTANT SAFETY INFORMATION

**DO NOT REMOVE COVERS. NO USER SERVICEABLE PARTS INSIDE, REFER SERVICING TO QUALIFIED SERVICE PERSONNEL. THIS EQUIPMENT MUST BE EARTHED. IT SHOULD NOT BE NECESSARY TO REMOVE ANY PROTECTIVE EARTH OR SIGNAL CABLE SHIELD CONNECTIONS TO PREVENT GROUND LOOPS. ANY SUCH DISCONNECTIONS ARE OUTSIDE THE RECOMMENDED PRACTISE OF BSS AUDIO AND WILL RENDER ANY EMC OR SAFETY CERTIFICATION VOID.**

For continued compliance with international EMC legislation ensure that all input and output cables are wired with the cable screen connected to Pin 1 of the XLR connectors. The input XLR Pin 1 is connected to the chassis via a low value capacitor, providing high immunity from ground loops whilst ensuring good EMC performance.

We have written this manual with the aim of helping installers and sound engineers to get to grips with the **DPR-402** and obtain its maximum capability. If you are new to BSS products, we recommend that you begin at the start of the manual.

We welcome any comments or questions regarding the **DPR-402** or other BSS products, and you may contact us at the address or World Wide Web site given in the warranty section.

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# 1 Compressors and Limiters

## 1.1 The need for Gain Control

The human ear excels in its ability to detect an extremely wide range of sound levels. These can range from the quietest whisper to the roar of a jet aircraft. When we attempt to reproduce this large range (dynamic range) of sounds with amplifiers, tape recorders or radio transmitters, we run into one of the fundamental limitations of electronic or acoustic equipment. In some cases, such as amplifiers, the dynamic range available is quite good. However, equipment such as tape recorders and radio transmitters have a restricted usable dynamic range.

What limits the available dynamic range of this equipment is its inherent noise floor at the bottom end, and the maximum input signal resulting in an acceptable amount of distortion at the upper end. The usable dynamic range sits in between these two limits, and it is common practice to operate a piece of equipment at a level that is somewhat below the upper distortion point, leaving a margin of safety for the unexpected transient loudness peaks present in program material. The safety margin is known as headroom, and is generally in the range of 10 to 20dB. Lowering the standard operating level to increase headroom helps distortion, but moves the average program level nearer to the noise floor, thereby compromising the signal to noise performance.

It therefore becomes apparent that to get the most out of an audio system, the standard operating level must be kept as high as possible without risking distortion.

One solution to this problem is for the operator of the equipment to be continuously monitoring the program, and manually adjusting the gain to suit the moment. When the program is quiet, the gain can be increased, and when the program is loud the gain can be reduced. However, in most types of program there are instantaneous short duration level peaks or transients, which would be difficult to anticipate and impossible to respond to in the required time. Even a sound engineer with the quickest reflexes could not bring the gain knob or fader down quickly enough.

The need therefore arises for a fast acting automatic gain controlling device which will track the program material constantly, and which will always adjust the gain to maximise the signal to noise performance without incurring distortion. This device is called a compressor or limiter, and is one part of the **DPR-402**.

## 1.2 Compressors and Limiters

Compressors and limiters have closely related effects, and in general a limiter will reduce gain very strongly once a certain level has been reached, whereas a compressor will act gently, but over a much wider range of volume levels.

A limiter will continuously monitor program levels, but only commence to reduce gain once the level has exceeded a preset amount. This point is called the threshold level. Any program level in excess of the threshold will immediately be reduced to this threshold level.

A compressor will also continuously monitor the program and has a threshold level. However, program signals in excess of this threshold will be progressively reduced by an amount (ratio) depending on the degree to which it initially exceeds the threshold. Generally, threshold levels for compressors are set below the normal operating level to allow them to reduce the dynamic range of the signal gradually, so that they are acceptable to following equipment. For limiters, the threshold point will be set above the operating level in order to provide a maximum level for signals to following equipment.

## 2 The effect of Compression on sound

### 2.1 Compression

Consider an input signal which is applied to two units, one having its threshold point set 10dB higher than the other (*See figures 2.1 a/b*). Since the compressor only affects signals that exceed the threshold level, that in figure 2.1a will be more affected than that in figure 2.1b.

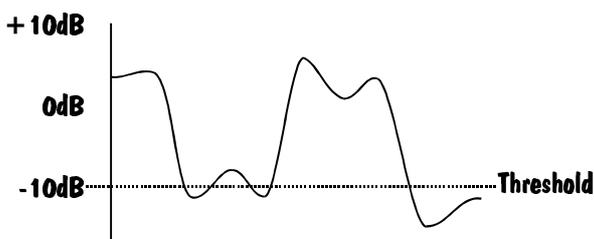


Figure 2.1a

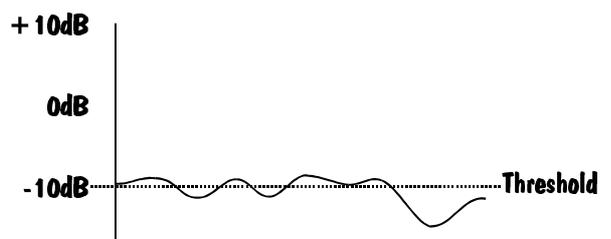


Figure 2.1b

Assuming that all other controls on both channels are set identically with gains equalised, the processing effect on these signals is shown below.

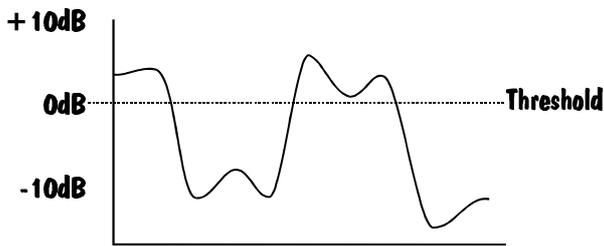


Figure 2.2a

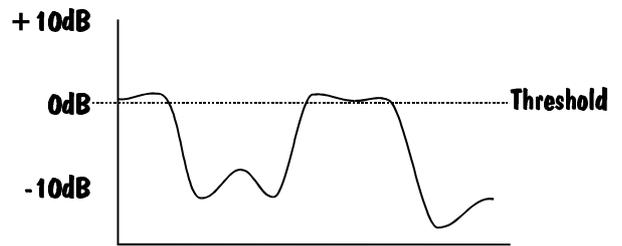


Figure 2.2b

It is immediately apparent that there is a large difference between these two signals in relation to their dynamic range, and the signal processed in figure 2.2a is said to have been compressed, whereas the signal in figure 2.2b is said to have been limited. Furthermore, it is interesting to note that by comparing the input and output waveforms for the compressed mode, the quietest portions of the input signal have been effectively raised in level, whereas the loudest portions have been effectively decreased in level. The net effect, therefore, is for both ends of the dynamic spectrum to be pushed (or squeezed) towards each other. This squeezing effect of compression is important to remember, and provides a major difference between compression and limiting.

Compression and limiting differ further in one other important aspect, that of the dynamic time settings for attack and release. For compressors a slow attack and release time is generally used in order to keep the overall output signal within a specified dynamic range, whereas for limiting purposes where transient peaks are to be kept clear of the headroom limits, a faster attack and release time is required.

The range provided by the **DPR-402** on its time controls is sufficient to allow its use either as a compressor or limiter, and the AUTO facility is scaled primarily for compression use.

## 2.2 Attack, Release and Ratio

Attack is the amount of time that elapses before the compressor begins to attenuate the output level after the threshold point has been exceeded. For sounds such as a snare drum or hand clap, fast attack is desirable so that the compressor responds in time to control the peaks.

Release is the amount of time taken for the compressor to return to normal gain after the input signal has fallen BELOW the threshold point.

Ratio determines the ratio of change on output level to changes in input level for all signals that exceed the threshold. **Returning to section 1.1; The need for Gain Control** where the idea of manual controlling the level of the program was

discussed, the operator would reach over and turn down the volume if signal levels were approaching distortion. At this point he now has an option: Either reduce the level so that there is nothing exceeding his desired maximum level, or reduce the level by a small amount so that his output is slightly greater than that of his preferred maximum but not as loud as it would have been if no action had been taken. This action is known as the ratio. A ratio of 1:1 indicates that the output will linearly track the input level of the threshold. i.e. For every 1dB of input over the threshold point, there will be 1dB of output. A ratio of 2:1 indicates that for every 2dB of input level above the threshold, there will be a corresponding increase of 1dB in the output level. A ratio of 10:1 indicates that for every increase of 10dB of input level, there will be a corresponding increase of 1dB in the output level, and so on. A ratio of infinity:1 indicates that no matter how loud the input signal goes above the threshold, the output will remain constant at the threshold point. It is worth noting that a hard or infinite ratio limit has applications in some specialised situations, but in general it is neither appropriate nor necessary, and is likely to cause noticeable side effects in the sound.

### 3 De-essing and Peak Limiting

A common problem encountered when amplifying the human voice is the large amount of High Frequency energy, heard as the sibilant 'sss' sound. These high frequency or sibilant sounds can reach levels considerably greater than the normal voice level, and will result in signal break-up or distortion. It is possible to control these sounds independently of the normal program by making the normal compressor sensitive only to these high frequencies. Selective high frequency compression is generally called de-essing, as it removes the 'sss' content from the program.

**Referring to section 2.2; Attack, Release and Ratio**, attack time was defined as the time taken for the compressor to respond to program levels which have exceeded its threshold level. It is also found that for relatively low frequencies a longer attack time is required than for high frequencies, to avoid any unpleasant dynamic distortions. When compressing a program mix that includes a wide range of frequencies, some compromise must be made to the setting of the attack time, and this will inevitably result in a setting that suits the lowest frequency components present. For general dynamic range controlling using a compression mode, this is of no serious consequence. However, in a limiting mode, where the peaks of the signal are being restricted to a maximum operating level to avoid distortions in following equipment, it is essential to have the attack times as fast as possible for all frequency components. Operating the compressor in a limiting mode, with a high ratio, high threshold and dynamic settings to suit the low frequency components, will result in very fast high frequency signal transients passing through without causing gain reduction. These transients can then cause distortions in following equipment, such as tape recorders and radio transmitters.

It should be remembered that the **DPR-402** is a peak limiter, designed to be used in conjunction with the main compressor section. If it is used exclusively on its own, then dynamic distortions will generally result on program signals having anything other than high frequency content.

## 4 The BSS DPR-402

The BSS **DPR-402** compressor, de-esser and peak limiter has been designed in response to the demand for a versatile, compact stereo unit which provides the three most commonly used dynamic functions in a single 1 unit rack space. The internal architecture, including two independent insert accessible side chains per channel, allows unprecedented flexibility and scope for the creative operator. In its normal mode, however, this complexity remains totally invisible for the user who required a conventional system with operational simplicity.

The dedicated de-esser control and associated variable filter allow wide band sibilance control simultaneously with compression and peak limiting. For highly critical de-essing application, the compressor section can be switched to operate at high frequencies only, i.e.: as a dynamically controlled tunable HF filter.

The compressor section allows you full control over all the normal parameters, and offers 'auto' time constants for general purpose use. The control and subtract side chain insertion points allow numerous applications for the patching of the units own, or external, filters to provide dynamic tonal modification. The calibrated peak limiter allows absolute control without having to compromise the dynamics setting of the compressor, potentially resulting in less dynamic distortion for an equivalent amount of compression.

The **DPR-402s** user friendliness is well demonstrated by the sophisticated yet uncluttered LED metering and monitoring facilities. The full compressor operating range is displayed on a two part meter, indicating both signals below threshold and actual gain reduction. The arrangement of these two meters, together with the full scale 'bright-up' feature, ensures that operation will always be within the permitted VCA window, making it virtually impossible to exceed the systems parameters unintentionally.

The output is continuously monitored on the output level meter, which also incorporates the full scale 'bright-up' facility. The bypass switch, in conjunction with the meter input switch, provides a powerful aid for initially setting up the unit. The straight signal and the processed signal may be monitored on the output level meter without affecting the output from the unit, thus enabling system gains to be equalised while in the bypass mode.

Like all BSS Audio equipment, the **DPR-402** has been designed to withstand harsh treatment on the road, yet has a specification to satisfy the most stringent studio and broadcast work.

## 5 Earthing Requirements

### **WARNING! THIS APPLIANCE MUST BE EARTHED.**

IMPORTANT: The wires in the mains lead are colour coded in accordance with the following code.

Green and Yellow.....Earth

Blue.....Neutral

Brown.....Live

As the colours of the wires in the mains lead may not correspond with the markings identifying the terminals in your plug, proceed as follows.

- The wire which is coloured Green and Yellow or Green must be connected to the terminal which is marked with the letter 'E' or by the Earth signal or which is coloured Green and Yellow or Green.
- The wire which is coloured Blue must be connected to the terminal labelled 'N' or coloured Black or Blue.
- The wire which is coloured Brown must be connected to the terminal labelled 'L' or coloured Red or Brown.

Those units supplied to the North American market will have an integral moulded 3 pin connector which is provided to satisfy required local standards.

The mains voltage selector switch provides a simple external adjustment to allow operation on all international AC power standards. The allowable ranges for the supply voltage are:

90VAC up to 132VAC on the 115V position and

190VAC up to 264VAC on the 230V position.

Outside these ranges the unit will not work satisfactorily, if at all. Voltages in excess of the maximum will probably cause damage. Voltages below the minimum will cause the power supplies to drop out of regulation, degrading the performance of the system.

## 6 Unpacking

As part of BSS' system of quality control, this product is carefully inspected before packing to ensure flawless appearance.

After unpacking the unit, please inspect for any physical damage and retain the shipping carton and ALL relevant packing materials for use should the unit need returning.

In the event that damage has occurred, please notify your dealer **immediately**, so that a written claim to cover the damages can be initiated.

## 7 Mechanical Installation

A vertical rack space of 1U (1¾" / 10½mm) deep is required. Ventilation gaps are unnecessary.

If the **DPR-402** is likely to undergo extreme vibration through extensive road trucking and touring, it is advisable to support the unit at the rear and/or sides to lessen the stress on the front mounting flange. The necessary support can generally be bought ready-built, as a rack tray. As with any low-level signal processing electronics, it is best to avoid mounting the unit next to a strong source of magnetic radiation, (for example, a high power amplifier), to help keep residual noise levels in the system to a minimum.

## 8 Mains Power Connection

**Voltage:** The **DPR-402** operates on either 120 or 240 volt supplies. Use the voltage selector switch to choose the required voltage setting.

**Frequency:** Both 60Hz and 50Hz are acceptable.

**Grounding:** The **DPR-402** must always be connected to a 3-wire grounded ('earthed') AC outlet. The rack framework is assumed to be connected to the same grounding circuit. The unit must NOT be operated unless the power cables ground ('earth') wire is properly terminated - it is important for personal safety, as well as for proper control over the system grounding.

**AC Power Fusing:** The incoming line power passes through an anti-surge ('T') fuse, accessible from the rear panel. If the fuse blows without good reason, *refer to section XX*. Always replace with an identical 20mm x 5mm 'T' fuse, rated at either 250mA or 200mA for 240V or 120V settings respectively, for continued protection from equipment damage and fire.

**Power ON:** This is indicated the green 'ON' LED located under the CH 'IN' switches. If this LED is not lit when power is connected and the 'POWER' switch is depressed.

## 9 Input and Output Connections - Rear Panel Facilities

### 9.1 Inputs

The input is a 10K ohm balanced type on a standard 3 pin female XLR which will accept levels up to +20dBv. The '+' or in-phase connection is to pin 3 and the '-' or out-of-phase connection is to pin 2. There is no connection to pin 1, and input cable shielding should be derived from the equipment which is providing the input signal. When feeding the **DPR-402** from unbalanced sources, connect the signal 'hot' to pin 3, and the signal ground to pin 2.

## 9.2 Outputs

The output connection is a standard 3 pin male XLR. Output impedance is less than 1 ohm, unbalanced, and full headroom is available into any load 600 ohms or greater. The signal 'hot' is connected to pin 3, and the ground to pin 2 and pin 1.

For rack mounted unbalanced audio systems, the case (power) ground can be isolated from the signal by removing an internal wire link associated with channel one output.

## 9.3 Stereo Link

This facility enables the two channels of the **DPR-402** to be used in a stereo system, with the result that there is no image shifting under comparison on either channel. This switch actually couples the detector outputs from both channels together, so that either one responds to the largest signal present. When in stereo mode, the front panel 'LINK' LED will illuminate, and care should be taken to ensure that both channels have their controls set equally. For other methods of multiple channel coupling, *refer to section 14; Operation and Applications.*

## 9.4 Barrier Strip

This interface facility provides various input and output signals to the unit, allowing other dynamic controlling features to be realised. This strip also includes the two insertion points for external equipment connections, and in the absence of these, the two indicated shorting links must be made to allow normal operation of the unit. *Please refer to section 14; Operation and Applications for examples of possible uses.*

## 9.5 Peak Limiter Switch

This fast/slow selector changes the dynamic response of the peak limiter section to best suit the particular program material. *Please refer to section 12.4; Peak Limiting for applications and usage.*

## 10 Compression Controls

### 10.1 Threshold

In the **DPR-402**, the gain reduction is achieved using a Voltage Controlled Attenuator with a range or operational 'window' of 30dB. This means that it is capable of reducing the input signal by up to 30dB or 30 times (the **GAIN REDUCTION METER** displays this window showing how much of it is being used). The voltage level corresponding to the lower boundary of this window is called the threshold, and input signals below this level cannot cause gain reduction. When the input level enters the window by exceeding the threshold, gain reduction can occur (the amount of gain reduction or 'compression' produced being directly proportional to the amount by which input signal level exceeds the threshold). The upper boundary of the VCA window is set by the circuitry at a level 30dB above the threshold. The **THRESHOLD** control adjusts the threshold relative to the input signal in order to set the compressor to the required amount of gain reduction. For example, if the average input is +12dBv and the **THRESHOLD** control is set to -10dBv, then the top 22dB [ $12 - (-10) = 22\text{dB}$ ] of the signal can be compressed. The **THRESHOLD** control is adjustable from -30dBv to over +20dBv.

It should be noted that when the **THRESHOLD** control is set fully clockwise to the position marked **OUT**, this corresponds to a threshold level above +20dBv, so that no matter how high the input level stage will clip before the threshold is reached, the signal will reach the output uncompressed.

How the compressor performs on the signal once inside the window is controlled by the **RATIO**, **ATTACK**, and **RELEASE** controls.

### 10.2 Ratio

The effect of the ratio control can be shown on a graph which plots input level, and clearly shows that below threshold the **DPR-402** acts purely as a linear amplifier.

In applications where gentle compression is required, it is advantageous to change from the linear to compression region in a very gradual manner, rather than the more conventional abrupt manner, as shown in the diagram. The **DPR-402** has been configured so that for low settings of the ratio control and low levels of compression, the transfer is soft, and for increasing ratio settings and high levels of compression the transfer becomes harder. This 'progressive knee' gives inaudible compression for low levels of ratio and gain reduction, whilst allowing harder compression for extreme control when required.

### 10.3 Attack Time

The response of the **DPR-402** compressor to signals above the threshold point is further defined by the ATTACK TIME control.

The **DPR-402** ATTACK TIME control has 11 calibrated positions from 50 microseconds to 100 milliseconds, and determines how quickly the compressor responds to signals once the threshold is exceeded.

As explained earlier, for fast transients, a fast attack time is desirable. For other types of program material a slower time will be more useful. It is always preferable to start with a slower time, and progressively speed up the response as necessary, since too fast a time may cause distortion of the sound.

### 10.4 Release time

Another parameter which affects the compressor performance is the RELEASE TIME control.

The release time control has 10 calibrated positions from 5 milliseconds to 5 seconds, and determines how quickly the compressor returns to normal gain following a transient in excess of the threshold. The setting of the release time is very much dependant on program type, and the setting of a wrong speed will result in either of two conditions:

If set too fast; the overall volume level will jump up and down, exactly following the peaks above threshold, and this will produce an objectional and unsettling effect.

If set too slow; quiet parts of the program immediately following loud transients will be subjected to 'breathing' or 'pumping' effects caused by the VCA releasing its attenuation (or effectively the system gain) during the quiet program period, when it is not required.

### 10.5 AUTO TIME

This feature of the **DPR-402** is provided to overcome some of the settling problems associated with the attack and release time control features. It is accessed by switching the released time control to the 'AUTO' position, whereupon the circuit automatically adjusts itself to provide the required attack and release time settings, depending on the program type.

The circuitry combines a program related attack time setting and a two part program related release time setting. The two part program dependant release provides:

A fast release to restore below threshold gain as soon as the transient has passed.

A much longer following release to avoid rapid gain change effects.

**Note that once AUTO time has been selected, the attack control becomes inoperative.**

## 10.6 GAIN control

Because compression is a gain reducing process, the output signal level can often be lost. The GAIN control is provided to restore this output to normal operating point, and provides a calibrated range of  $\pm 20\text{dB}$ .

The facility of gain loss provided by this control can be used, when required, to restore the compression to a point lower than the input signal (For example, when connecting this output to a high sensitivity input on a following piece of equipment).

## 10.7 BYPASS switch

The BYPASS switch enables you to bypass quickly all functions of the **DPR-402** by connecting the output directly to the input. When the switch is pressed, and the light is on, all **DPR-402** functions are present on the output signal. When the switch is out, all facilities are bypassed.

It should be noted that in the bypass mode, the input is still connected to all of the **DPR-402** circuitry, so that all of the required facilities can be selected and set up. This, in conjunction with the OUTPUT METER and INPUT SWITCH, provides a powerful tool for comparing processed signals prior to operating the bypass switch and going 'on-air'.

A further feature of this illuminated switch is to allow coding of each particular channel with a specific number or letter. By removing the lens-cap with a small screwdriver or your fingernail, an appropriate symbol can be fitted. This will have particular advantages in situations where more than one **DPR-402** is fitted into a control rack.

## 10.8 MODE switch

This control switch reconfigures the compressor to insert the built-in filters into its side chains, so that gain reduction only occurs when certain frequencies are present in the input signal.

For normal compression, this switch will always be in the 'compress' position.

**Please refer to sections 12.2; *Broadband De-essing and controls* and 12.3; *HF Only De-essing and Controls* for a full explanation of this, and the applications of de-essing.**

## 11 Compression meters

### 11.1 Below Threshold and Gain Reduction Meter

Referring back to *section 10.1; Threshold*, where we discussed the VCA window of operation, the five LEDs of the BELOW THRESHOLD meter will give you an indication of the input signal in relation to this window.

You will notice that the LED marked 'TH' is half-on all the time. This point represents the threshold point as set by the THRESHOLD control, and any signal level that exceeds this LED will start the compressor operating. Rotating the threshold control anticlockwise effectively lowers the window of the VCA, allowing it to sit at the right point on the input signal. Observation of this meter during program will give an instant picture of how much of the input signal is being processed, or how near the peaks are to being processed. This will provide valuable information at all times during use, especially for live concert work, where signal levels tend to increase during the course of the show.

Once the input signal has exceeded the threshold point on scale, the compressor starts to operate, and gain reduction will occur. The amount of gain reduction being used is displayed on the GAIN REDUCTION meter.

Gain reduction is a useful way of expressing compressor action. We have seen that the output level of a compressor is less than the input level by some amount that depends on the threshold, ratio, attack and release time settings. If, for example, a particular signal transient exceeds the threshold point by 10dB and the ratio knob is set to 2:1, then we would expect the output to have only increased by 5dB (providing the time controls are set accordingly). Assuming the gain control is at 0dB, the difference between the input and output levels of 5dB then represent the amount of gain reduction which has occurred and will be displayed on the gain reduction meter as 5dB.

The range of the gain reduction meter is set to display the 27dB operating window. In practice, over 30dB of range is available before noticeable distortion occurs.

Another piece of information also displayed by these meters is the amount of gain reduction still available from the VCAs window of operation. If you consider that the input signal is of such a level that 15dB of gain reduction is occurring (i.e.: the 15dB LED on the gain reduction meter is on), then the length of GAIN REDUCTION meter display remaining unlit is an accurate visual indication of how much headroom still exists within the circuitry. Observing this information will ensure that the output signal is unlikely to incur distortion as a consequence of overloading the VCA.

A further operational feature of this meter is its ability to intensify brightness when the VCA window is in danger of being exceeded and distortion is likely to occur. Input signals causing an excess of 30dB of gain reduction will initiate the 'bright-up' and the display will appear to flash to alert attention. This feature is especially

useful when a rack of equipment contains a number of **DPR-402** units; the ability to immediately pick out the particular channel that is in danger of distortion will be much appreciated.

## 11.2 Output Level Meter and Meter Input Switch

This meter monitors the signal level at the output of the **DPR-402**, and gives an absolute reading of its level.

This meter also incorporates the 'bright-up' feature, which will occur when the output signal level reaches +20dBv.

The METER INPUT switch is used in conjunction with the OUTPUT LEVEL meter to allow the input signal to be displayed. The switch has a momentary action to ensure that the meter is not inadvertently left showing input level.

This facility becomes extremely useful when used in conjunction with the BYPASS switch. During initial setting up of routines and prior to going 'on-air', the signal output level will be different from the input. Utilising this meter input switch will enable the input and output levels to be compared on the same display, and adjustments can then be made accordingly with the GAIN control to ensure that the input and output levels are similar (the GAIN control will only affect the output signal level). Once satisfied of this condition, operation of the BYPASS switch will ensure an unnoticeable 'drop-in'.

## 11.3 MON S.C. switch

This switch will change the output connector of the **DPR-402** from the normal compressor output, and connect it to the return of the control side chain insertion point. This will allow monitoring of any external equipment which is connected to the unit to assist in its setting up. For applications and a description of side chain insertions please *refer to sections 13; Rear Barrier Strip and 14; Operation and Applications*.

## 12 De-essing and Peak Limiting

### 12.1 De-essing

*In section 3; De-essing and Peak Limiting*, the problems with high frequency energy, also known as sibilance, were discussed. The **DPR-402** provides for this facility in either of two distinct ways: Broadband de-essing and HF only de-essing.

Under program conditions, once the detector detects excessive amounts of frequency, it will start to gain reduce the program level as in normal compression. Because compression then occurs over the whole frequency range of the program, it is called Broadband de-essing. To make the compressor sensitive only to high frequencies, a high pass filter is inserted into the CONTROL side chain insertion

point, with the result that frequencies below the filter cut-off point are excluded. Once excessive amounts of frequency are detected compression will commence, but only on those high frequencies program components that initially caused the compressor to act.

The type of de-essing to be used in a particular situation will depend largely on the program type and whether the input to the compressor is a mix of sibilant sounds and other program material, or exclusively the sibilant sound. HF only de-essing will generally be used when processing a mix of program, whereas broadband de-essing will be acceptable when processing only the sibilant sound.

It should be realised that this technique is very different from simple equalisation, since equalising a sibilant vocal by cutting high frequencies would result in loss of high frequency content at all times. De-essing has no effect whatsoever on the signal, except at the moment of sibilance, and then the effect is only of overall level change. There is no change in the general frequency response, yet sibilance is controlled.

## 12.2 Broadband De-essing and controls

Broadband de-essing can be achieved either simultaneously with normal compression on the same channel of the **DPR-402**, utilising DE-ESS and FREQ controls, or exclusively on the one channel by setting the MODE switch to DE-ESS WIDE, and utilising the compressor section controls.

In utilising the controls no other compressor controls will be required. If no compression is being used, the ratio or threshold controls should be set to OUT. The frequency control should be set to coincide with the lowest frequency of the sibilance, and the de-ess control be used to give the required amount of gain reduction. The maximum amount of reduction available in this mode is 20dB. The dynamic settings for this compression are set automatically by the unit, and are optimised for general vocal work.

The green and orange LEDs above the de-ess control provide a simple indication of the degree of de-essing, with the green LED indicating the start of the operation and the orange LED indicating approximately 15dB of gain reduction.

Having only a frequency and level control for this broadband de-essing function provides a very simple and effective way of treating general sibilant vocal signals, when processed on their own.

Should the need for more comprehensive control of the de-essing function arise, then the main compressor section can be configured to operate as a dedicated de-esser by operating the mode switch. The amount of gain reduction can then be extended down to 30dB if required, and this gives full control over the dynamic settings, as in normal compression.

## 12.3 HF Only De-essing and Controls

To achieve this mode of operation, the main compressor must be utilised as an exclusive de-esser by operation of the MODE switch to DE-ESS HF.

Gain reduction at high frequencies only is achieved by inserting an internal high pass filter into the subtract side chain so that only these high frequencies are available to the subtractor. The front panel FREQ control adjusts both this filter and the control side chain filter simultaneously, to provide a de-essing range from 700Hz to 20kHz. HF only de-essing is achieved by operating the compressor controls as for normal compression (*refer to section 10; Compression Controls*), and utilising the FREQ control to allow only the sibilant frequencies to cause gain reduction. If general compression is required simultaneously, then channel 2 of the unit can be used by connecting the two channels in series. It should be remembered that in this mode, the DE-ESS and PEAK LIM controls must be set to OUT, as they cannot be used simultaneously with the compressor switched to dedicated de-ess mode.

To aid the correct setting of the FREQ control in relation to the audible sibilance, the source program can be listened to through the internal de-ess filter by depressing the MON S.C. switch. This replaces the normal signal at the output connector with the output of the de-ess filter.

## 12.4 Peak Limiting

Referring back to *section 3; De-essing and Peak Limiting*, the problems with high frequency transients causing distortion further down the equipment line were discussed. The peak limiter of the **DPR-402** provides an extra stage of gain reduction, with dynamics specifically set for these fast transients. It is used in conjunction with the main compressor section and provides an output limiting function to control the fast transients which would generally be missed by the slower dynamic settings of the compressor. The attack and release times are set internally to suit the limiting application, with a choice of FAST or SLOW response selected by a switch on the rear panel (*refer to section 9; Input and Output Connections - Rear Panel Facilities*). It is preferable to use the FAST response setting, providing this does not cause audible distortion, otherwise the SLOW response should be used.

The peak limiter threshold is unaffected by the GAIN control, and is set by the PEAK LIM control, which is scaled directly in dBv. The ratio is set internally to 20:1. A green LED is provided to indicate when limiting begins, and a red LED indicates when heavy limiting occurs (above 10dB). This red LED indicates that more than optimum peak limiting is being used, and the output gain control should therefore be backed off, so that it only flashes on occasional peaks.

## 13 Rear Barrier Strip

The **DPR-402s** rear barrier strip provides an interface with the main compressor section, allowing for various configurations which utilise the internal facilities as well as external equipment. For correct operation of the unit, make sure that both the SUBTRACT and CONTROL side chain points are closed, either by links or by externally connected equipment. Connections to the subtract side chain will be phase conscious, whereas those to the control will not be. Any externally connected equipment should operate at unity gain, and be capable of handling signal levels up to +20dBv.

### Rear Barrier Strip Designations

Pin	Function
A	Ground
B	Insert Return: Control Side Chain
C	Insert Send: Reversed Phase
D	Insert Send: Normal Phase
E	Insert Send: L.F. Re-emphasised
F	Insert Send: H.F. Re-emphasised
G	Insert Return: Subtract Side Chain
H	Insert Return: Subtract Side Chain Gain Link (Expand or over infinity mode)
J	Ground
K	Insert Send: Subtract LP Filter
L	Insert Send: Control LP Filter
M	Stereo Link

## 14 Operation and Applications

### 14.1 Compression

Barrier strip linking B-C and D-G (as factory set).

Initial settings.

Controls	Position
MODE SWITCH	Compress
THRESHOLD	Out
RATIO	4
ATTACK	-
RELEASE	Auto
GAIN	0dB
CHN BYPASS	In (Illuminated)
DE-ESS THRSILD	Out
FREQ	-
PK LIM THRSILD	Out

Rotate the THRESHOLD control anticlockwise until the BELOW THRESHOLD meter is fully illuminated and an appropriate amount of gain is indicated on the GAIN REDUCTION meter. This operation will be accompanied with a drop in output level, as indicated by the OUTPUT METER. The output GAIN CONTROL should now be adjusted to reinstate the output level. The levels of the uncompressed input signal and the compressed output signal can now be compared on the output meter by operating the METER INPUT switch.

Final adjustments of the controls can then be made to suit particular requirements, including the RATIO, ATTACK, and RELEASE controls. The 'auto' position of the release control provides for a program related operation of the dynamics of the unit, and will be accepted for most general purpose applications. Should a tighter or looser requirement be necessary, then both the attack and release controls can be set individually to suit.

The experienced engineer will be able to set the compressor controls to near optimum position for any source material with the BYPASS switch out, so that the compressor can be 'dropped' into a live performance without disturbance.

### 14.2 De-essing

The DPR-402 has three modes of de-essing available, de-ess wide with simultaneous compression, de-ess wide with full dynamic control, and de-ess HF

with full dynamic control. De-ess wide attenuates with whole frequency spectrum, and although acceptable for most vocal sources, it may cause undesirable side effects on a mixed program source (*refer to section 12.2; Broadband De-essing and controls and 12.3; HF Only De-essing and Controls*). De-ess HF only attenuates the high frequencies and therefore produces superior results in all cases, which is essential when de-essing a mixed program source.

If simultaneous de-ess HF and compression are required, the separate channels must be used for each function.

### 14.3 De-essing Wide with Simultaneous Compression

Barrier strip linking B-C and D-G (as factory set).

Initial settings.

Set all compressor controls as required (*refer to section 14.1; Compression*). For optimum de-essing effect, no more than 10-15dB of compression should be used. If compression is not required, then set THRESHOLD to OUT.

<b>Controls</b>	<b>Position</b>
DE-ESS THRESHLD	OUT
FREQ	4kHz
PK LIM THRESHLD	OUT

Under program control, gradually rotate the DE-ESS THRESHOLD control anticlockwise until the required effect is achieved. The FREQ control can also be adjusted to ensure that frequencies lower than those causing concern do not initiate de-essing. It should be remembered that this de-essing is wideband and may cause distortion or pumping effects if the source program contains significant low frequencies.

## 14.4 De-ess Wide with Full Dynamic Control

Barrier strip linking B-C and D-G (as factory set).

Initial settings.

Controls	Position
MODE SWITCH	De-ess wide
THRESHOLD	Out
RATIO	Infinity
ATTACK	50 microseconds
RELEASE	100 milliseconds
GAIN	0dB
CHN BYPASS	In (Illuminated)
DE-ESS THRSILD	Out
FREQ	4kHz
PK LIM THRSILD	Out

Rotate the THRESHOLD control anticlockwise until the BELOW THRESHOLD meter is fully illuminated and an appropriate amount of gain reduction is indicated on the GAIN REDUCTION meter. The FREQ control and THRESHOLD control can now be fine tuned to achieve the desired effect whilst listening to the program. Gain compensation will not normally be required when de-essing. Although fast attack and release times are most appropriate, they should be adjusted to achieve the best results. The 'auto' position should **NOT** be used.

To aid the correct setting of the FREQ control in relation to the audible sibilance, the source program can be listened to through the internal de-ess filter by depressing the MON S.C. switch. This replaces the normal signal at the output connector with the output of the de-ess filter.

The peak limiter can be used simultaneously with wide band de-essing, should it be required.

## 14.5 De-ess HF with Full Dynamic Control

Barrier strip linking B-C and D-G (as factory set).

Initial settings.

Controls	Position
MODE SWITCH	De-ess wide
THRESHOLD	Out
RATIO	Infinity
ATTACK	50 microseconds
RELEASE	100 milliseconds
GAIN	0dB
CHN BYPASS	In (Illuminated)
DE-ESS THRSILD	Out
FREQ	4kHz
PK LIM THRSILD	Out

Rotate the THRESHOLD control anticlockwise until the BELOW THRESHOLD meter is fully illuminated and an appropriate amount of gain reduction is indicated on the GAIN REDUCTION meter. The FREQ control and THRESHOLD control can now be fine tuned to achieve the desired effect whilst listening to the program. Gain compensation will not normally be required when de-essing. Although fast attack and release times are most appropriate, they should be adjusted to achieve the best results. The 'auto' position should **NOT** be used.

To aid the correct setting of the FREQ control in relation to the audible sibilance, the source program can be listened to through the internal de-ess filter by depressing the MON S.C. switch. This replaces the normal signal at the output connector with the output of the de-ess filter.

The peak limiter should **NOT** be used in the HF mode.

## 14.6 Peak Limiting

The peak limiter is designed to be used in conjunction with compression and/or any wide band de-essing. It should not be used simultaneously with HF de-essing or when external filters are patched into the SUBTRACT side chain (Terminal G).

Barrier strip linking : D-G (other links to suit functions as required).

Initial settings.

Controls	Position
PK LIM THRESHLD	As required
FAST/SLOW switch	FAST on rear panel

The PEAK LIMITER control is calibrated in dBv (ref 0.775v), and is set to suit the headroom of following equipment. Should the red LED indicator remain on other than for occasional peaks, the GAIN control should be backed off to reduce the signal to the peak limiter. If this produces an unwanted decrease in overall output level, then the amount of compression should be increased either by reducing the compressor threshold, or by increasing the compressor ratio and then reinstating the gain.

## 15 Applications using the Barrier Strip

### 15.1 Patching of External Equipment

#### Control Side Chain

A very common requirement is to make the threshold of the compressor frequency conscious by inserting a graphic or parametric equaliser into the control side chain. The input of the external equipment should be connected to one of the send outputs of the unit, and the output of the external equipment connected to one of the return inputs, as required. Care should be taken to avoid introducing earth loops when the external equipment is mains powered, as all inputs and outputs on the barrier strip are unbalanced. A signal 0v ground is provided at pins A and J for connection to the screens of one or both of the connecting cables, as necessary.

All external equipment should be capable of operating at general line levels (Max +20dBv), have unity gain, and have high input impedance (>10k) and a low output impedance (>1k).

In order to preserve the THRESHOLD control calibration, it is essential that unwanted frequencies are attenuated rather than wanted frequencies boosted by the external filter. For example, if compression is to be controlled by a narrow mid-band of frequencies, then the low frequency and high frequency sliders should be pulled down, and the mid-band sliders left at 0dB.

## Subtracting Side Chain

Inserting an external equaliser into the subtract side chain has the effect of modifying the tonal balance of the processed signal by adding or subtracting a specific band of frequencies. The external equipment should meet all the requirements specified in the control side chain section (above) and be operated in a similar manner. The adding or subtracting process requires that all signals are appropriately phased and the gain be unity. Any errors may lead to unexpected results.

For the units DE-ESS HF function, the internal filters have been phase and amplitude corrected to achieve the required response.

## 15.2 Repatching of the Barrier Strip for other uses and Special Effects

The following table lists many of the possible uses of the **DPR-402**. This is not an exhaustive list, and other combinations may be tried. To obtain the full benefits of its versatility, a simple understanding of how it works is required (*refer to section 13; Rear Barrier Strip*).

MODE	SUBTRACT S/C LINK	CONTROL S/C LINK
NORMAL COMPRESSION Compression occurs equally at all frequencies.	D-G	C-B
H.F. RE-EMPHASISED COMPRESSION Compression is higher at LOW frequencies. This arrangement will make heavily compressed signals sound brighter as it lessens the effect of heavy low frequencies modulating the treble.	D-G	F-B
H.F. RE-EMPHASISED COMPRESSION As above, but more pronounced.	F-G	F-B
L.F. RE-EMPHASISED COMPRESSION Compression is higher at HIGH frequencies. This is useful for controlling harsh or shrill components of a signal, allowing faster ATTACK and DECAY to be used before LF distortion becomes a problem.	D-G	E-B
L.F. RE-EMPHASISED COMPRESSION Compression is higher at HIGH frequencies. This is useful for controlling harsh or shrill components of a signal, allowing faster ATTACK and DECAY to be used before LF distortion becomes a problem.	E-G	E-B

MODE	SUBTRACT S/C LINK	CONTROL S/C LINK
<p>WIDE BAND L.F. CONTROL COMPRESSION</p> <p>This mode compress the entire audio spectrum under control of the frequencies below that set by the FREQ control. The modulation of H.F. signals by the L.F. signals is an effect which may be desired.</p>	D-G	L-B
<p>NARROW L.F. CONTROL COMPRESSION</p> <p>Only frequencies below that set on the FREQ control are compressed. Low frequencies are compressed without modulating the high frequencies, which pass unattenuated. The PEAK LIMITER and DE-ESSER should not normally be used in this mode.</p>	K-G	L-B
<p>EXPANDER - WIDE BAND</p> <p>When input signals exceed the set threshold, expansion occurs, since the subtract side chain signal is added to the main signal. The DE-ESSER should not normally be used in this mode. The PEAK LIMITER may be used for effect.</p>	C-G H-J	D-B
<p>EXPANDER - L.F. ONLY</p> <p>As above, but only those frequencies below that set by the FREQ control are expanded.</p>	K-H	L-B
<p>EXPANDER - L.F. CONTROL. (MODE switch to COMPRESS)</p> <p>EXPANDER - H.F. CONTROL. (MODE switch to DE-ESS WIDE)</p> <p>As in wide band, expansion occurs over the entire audio bandwidth. However, it is under the control of either low or high frequencies, as set by the links and FREQ control.</p>	D-H D-H	L-B C-B
<p>EXTERNAL GAIN CONTROL</p> <p>By driving the control s/c with an external signal, the amplitude of the main signal will be modulated by the envelope of the external control signal. By choosing links on the subtract s/c, modulation can be wide band or L.F. only. DE-ESS and PEAK LIMITER should not be used in this mode.</p>	D-G K-G	EXT SIG

MODE	SUBTRACT S/C LINK	CONTROL S/C LINK
<b>AMPLITUDE CONTROLLED MIXING (1)</b> In this mode, an external signal will be summed with the main signal and appear on the compressor, under control of the amplitude of the main signal. Wide band link C-B, L.F. only link K-B, H.F. only link C-B and MODE switch to DE-ESS WIDE.	EXT SIG to G	C-B K-B
<b>AMPLITUDE CONTROLLED MIXING (2)</b> As above, but the external signal will be summed with the main signal, but this time under control of the same, or another, external control input.	EXT SIG to G (sum)	EXT SIG to B (control)

These two modes may be used to good effect when the external signal is an echo return or delayed signal. For example, a single voice can be automatically chorused above the set threshold.

### 15.3 Stereo Linking

When stereo signals are compressed, it is necessary for the gain of both channels of the compressor to be identical at any moment in time, otherwise the stereo image will move around the sound picture as the relative levels of the left and right hand signals vary. Stereo linking couples together the compressor control signals, so that the VCAs in both channels work together, as in a stereo fader.

It should be noted however that, when in stereo linked mode, the standard DE-ESS and PEAK LIMITER functions continue to operate independently for each channel, and are not part of the stereo linking.

There are three possible ways to stereo link of the **DPR-402**:

#### Stereo Link Switch

When the rear panel STEREO LINK switch is ON, both channels are coupled together, and the LINK LED illuminates on the front panel.

In this mode, it is important that the compressor controls are set identically for both channels.

#### Hard Wired Stereo and Multiple Channel Linking

The stereo coupling point is available at connection M on the BARRIER STRIP, and up to four channels may be coupled together by simply strapping these pins together. Screened cable will not normally be required if the wiring is short, unless there are strong local interference fields present.

In this mode, it is important that the compressor controls are set identically for all channels.

### **Improved Stereo Coupling**

In this mode, only the controls on Channel 1 compressor will be required to control both channels, as the control signal for channel 1s VCA is used to drive that on channel 2. This gives excellent stereo matching without the need to adjust both sets of compressor controls. Two 10k ohm, ¼ watt, 1% resistors are required to sum the left and right signals into channel 1 CONTROL S/C RETURN input.

## 16 Warranty Information

When sold to an end user by BSS Audio or a BSS Audio Authorised Reseller, this unit is warranted by the seller to the purchaser against defects in workmanship and the materials used in its manufacture for a period of one year from the date of sale.

Faults arising from misuse, unauthorised modifications or accidents are not covered under this warranty. No other warranty is expressed or implied.

If the unit is faulty it should be sent to the seller of the equipment, in its original packaging with shipping prepaid. The unit will be returned to you when the repair has been completed. If the unit was purchased in the European Union, you may, as an alternative, return the unit to any other BSS distributor in the European Union.

You should include a statement listing the faults found. The unit's serial number must be quoted in all correspondence relating to a claim.

We recommend that you record your purchase information here for future reference.

Dealer Name: \_\_\_\_\_

Dealer Address: \_\_\_\_\_

Post/Zip Code: \_\_\_\_\_

Dealer Phone No.: \_\_\_\_\_

Dealer Contact Name: \_\_\_\_\_

Invoice/Receipt No.: \_\_\_\_\_

Date of Purchase: \_\_\_\_\_

Unit Serial Number: \_\_\_\_\_

In keeping with our policy of continued improvement, BSS Audio reserves the right to alter specifications without prior notice.

The **DPR-402** was designed and developed by BSS Audio, Hertfordshire, England.

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World Wide Web address: <http://www.bss.co.uk>

## 17 Specifications

### 17.1 General

<b>Input Impedance:</b>	10k ohm balanced or unbalanced.
<b>Input Headroom:</b>	>+20dBv.
<b>Input CMMR:</b>	Better than -50dB 30Hz-20kHz. Typically -65dB at 1kHz.
<b>Output level:</b>	>+20dBv into 600 ohms or greater.
<b>Output Impedance:</b>	<1 ohm unbalanced.
<b>Output Gain:</b>	±20dB continuously variable.
<b>Frequency Response:</b>	±1dB 25Hz to 20kHz. Ultrasonic filter -3dB at 30kHz.
<b>Noise:</b>	Equivalent input noise <-86dBv 22Hz to 22kHz <-82dBv CCIR weighted.
<b>Distortion:</b>	Unity Gain +10dBm output, below threshold. THD. <0.03% 20Hz-20kHz. Typically 0.002% at 1kHz. IMD. <0.01% SMPTE. Typically 0.003%.10dB compression. Threshold 0dB. 1kHz, 5sec rel. Time (see note 1). 2nd Harmonic <0.15%. 3rd Harmonic <0.05%. IMD (SMPTE) <0.25%.
<b>Cross Talk:</b>	Better than -85dB 20Hz to 20kHz, any settings.

### 17.2 Compressor

<b>Threshold Range:</b>	-30dBv to 20dBv continuously variable.
<b>Compressor Ratio:</b>	1:1 to infinity:1 continuously variable. Over infinity available by Barrier strip re-linking.
<b>Maximum VCA Range:</b>	>30dB.
<b>Attack Time:</b>	50 microseconds to 80 milliseconds in 11 switched steps (see note 2).
<b>Release Time:</b>	5 milliseconds to 5 seconds in 10 switched steps and AUTO (see note 2).
<b>AUTO TIME Constant:</b>	A two part program dependant time constant. Attack time is typically 200 microseconds on fast transient overdrives. Release is typically 10 milliseconds for

63% recovery from a 10dB 4 millisecond overdrive, and 1 second for a 10dB 40 millisecond overdrive.

### 17.3 De-esser

**Threshold Range:** -30dBv to 20dBv continually variable.  
**Ratio:** Infinite, at and above twice the set frequency.  
**Frequency Range:** 700Hz to 20kHz continuously variable (see note 3).

### 17.4 Peak limiter

**Threshold Range:** +4dBv to +20dBv continuously variable.  
**Ratio:** >20:1.  
**Attack Time:** 150 microseconds, fast setting.  
750 microseconds, slow setting.  
**Release Time:** 100 milliseconds, fast setting.  
500 milliseconds, slow setting.

### 17.5 Notes

**Note 1:** Harmonic distortion will increase with reduced frequency and shorter time constants, which is inherent in this type of equipment.

**Note 2:** Attack times are those as measured to achieve 63% of final gain reduction with a step signal of 8dB above threshold. Release times are those as measured to achieve 63% recovery of open gain or removal of a signal of 8dB above threshold.

**Note 3:** The frequency is that at which 3dB of gain reduction occurs for 10dB of signal overdrive above threshold. 10dB of gain reduction will occur at and above twice this frequency.

### 17.6 Facilities

**Mode Switch:** 3 position switch to select:  
**Bypass Switch:** Normal mode to allow simultaneous wide band de-essing, compressing and peak limiting.  
**MON S.C. Switch:** Wide band de-ess mode utilising compressor side chain.  
**Meter Input Switch:** HF de-ess mode utilising compressor side chain.

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	<p>Bypasses all functions of the unit at unity gain, allowing all parameters to be adjusted and levels checked whilst 'on air'.</p> <p>Momentarily connects the control side chain to the output of the unit to allow monitoring of control insert return.</p> <p>Momentarily connects the input signal to the output level meter to allow comparison of input and output levels prior to operating the bypass switch.</p>
<b>Metering:</b>	<p>BELOW THRESHOLD: 5 LEDs to indicate side chain level from 18dB to 0dB ref the set threshold.</p> <p>GAIN REDUCTION: 9 LEDs to indicate the amount of gain reduction from 3dB to 27dB. Display 'bright-up' at 30dB of reduction.</p> <p>OUTPUT: 12 LEDs to indicate output level from -24dBm to +18dBm. Display 'bright-up' at +21dBm (clip).</p> <p>DE-ESS: 2 LEDs to indicate normal and hard de-essing.</p> <p>PEAK LIMITING: 2 LEDs to indicate normal and hard peak limiting.</p>
<b>Stereo Switch (Rear Panel):</b>	<p>Couples channel 1 and channel 2 control signals for stereo operation. Indicated on the front panel by an LED.</p>
<b>Rear Connections:</b>	<p>INPUT: XLR 3-31 or equivalent (Balanced)</p> <p>OUTPUT: XLR 3-32 or equivalent (Unbalanced)</p> <p>ACCESS POINTS: Barrier strip, providing control and subtract side chain insertion points including HP and LP filter sends, pre-emphasis and de-emphasis network sends; inverse phase sends for expander mode; and control side chain DC access point for stereo, quad etc., coupling and gating.</p>
<b>Power:</b>	<p>Switch selectable 120V or 240V, 50/60Hz, 15VA. AC fuses on the rear of the unit. DC fuses located inside the unit.</p>
<b>Mounting requirements:</b>	<p>(Ht x W x D) 44.5mm x 483mm x 229mm 1U/1¾" x 19 x 9"</p>
<b>Weight:</b>	<p>4.5kg (Packed)</p>

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