

Pre-emphasis and de-emphasis on the DSP4000

Pre-emphasis is a scheme used to extend the dynamic range of a process (such as, but not exclusively, A-D conversion) by applying a controlled boost to the high frequencies before the process, and the inverse characteristic after it. This means that any high frequency noise or distortion products introduced during the process will be reduced by the amount of the boost initially applied. The effectiveness of this approach relies upon the fact that in audio, high frequency components are usually of lower amplitude than lower frequency signals, and can thus take a fair amount of frequency-selective boost without overloading.

Pre-emphasis is not a uniquely digital technique, as many, if not all, noise reduction systems used on analog tape recorders are based on similar principles.

Since any A-D conversion process may or may not use pre-emphasis, it is necessary to tag digital signals accordingly. Thus, an AES/EBU signal carries a flag to show whether or not it has been pre-emphasized.

The DSP4000 uses pre-emphasis during the A/D conversion process in order to increase its dynamic range, with a corresponding de-emphasis applied in the D-A process. This gives a useful increase in dynamic range, and causes few problems as long as the user remains strictly analog or strictly digital.

However, more and more users are making use of the DSP4000's power as a front-end to an all-digital system, and thus find that they are sending an emphasised digital signal to the rest of their processing chain, which can cause problems with equipment not able to handle (or, in many cases, even recognize) it.

There are various ways to deal with this problem:

- 1) The pre-emphasis on the input can be removed by changing jumpers J5 and J6 (some systems will also need small PCB mods). This will lose the increased dynamic range provided by the pre-emphasis.
- 2) The pre-emphasis on the input can be removed digitally by patching in a *de-emphasis* module. This will retain the increased dynamic range.

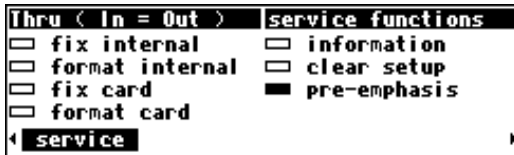
Both the above have two disadvantages:

- The AES/EBU pre-emphasis flag will still be set, even though the signal is now not emphasised.
- De-emphasis will still be applied on analog outputs, causing a noticeable high frequency roll-off.

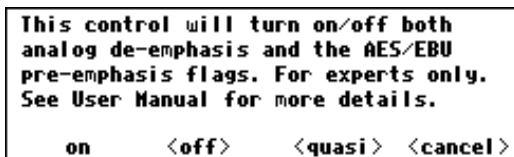
Version 2.112 of 4000 series software, which will be available shortly, has a facility to turn off the analog de-emphasis, as well as the AES/EBU flag, which will largely resolve these problems.

Interim User Manual Update for V2.112 Pre-emphasis feature

A pre-emphasis trigger has been added to the SETUP/SERVICE menu. This gives the user the ability to directly control the AES/EBU (and SPDIF) emphasis flag as well as the analog de-emphasis of the 4000 series.



When [SELECT] is hit, this brings up a further menu:



The user is invited to select one of three modes, or <cancel> to leave things unchanged. The current setting is indicated by a plain text softkey label - the other options have <angle brackets> to mark them.

There are three operating modes:

on (factory default):

In this mode, when using analog input and digital output, the output signal is emphasised, and the output AES/SPDIF flag is set to show this. J5/J6 (see below) should use default settings.

quasi:

This mode should be used when J5/J6 (see below) are at the default settings, and the *deemphasis* module is in the signal path. When using analog input and digital output, the output signal is not then emphasised, and the output AES/SPDIF flag is clear to show this.

off:

This mode should be used when J5/J6 (see below) are at the non-default settings, and the *deemphasis* module not used. When using analog input and digital output, the output signal is not then emphasised, and the output AES/SPDIF flag is clear to show this.

Differences between the three preemphasis mods

	<i>on</i> (default)	<i>quasi</i>	<i>off</i>
type of audio on digital output when using analog input	emphasised		not emphasised
type of audio on analog output when using analog input if <i>deemphasis</i> module not used	not emphasised	emphasised	not emphasised
emphasis flag on the AES/SPDIF output when using analog input.	set always	clear always	
emphasis flag on the AES/SPDIF output when using digital input.	same as emphasis flag on the AES/SPDIF input		
<i>deemphasis</i> module operation when using analog input.	active		disabled
<i>deemphasis</i> module operation when using digital input.	active when emphasis flag on the AES/SPDIF input is set		
J5/J6 setting	factory default		non-default

Motherboard Jumper settings to enable/disable analog pre-emphasis:

The diagram below shows the location of J5 and J6, with the jumpers in the default positions (emphasis applied).

Note that some 4000's are *etch-jumpered*, that is to say that no jumpers are installed and the connection is made by a trace on the underside of the printed circuit board. In this case, the trace must be carefully cut with a sharp knife. The jumpers at JP5,6 only then need to be installed if it is desired to *reintroduce* preemphasis. This modification should only be made by those with experience of such work.

