MERIDIAN 518 USER MANUAL

BOOTHROYD STUART
MERIDIAN

Contents

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Acknowledgements

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Testers

The processing in 518 has been beta tested in a 618 version over some three years. Thanks in particular to Tony Faulkner (*Green Room Productions*), David Chesky (*Chesky Records*), Tom Jung (*DMP Recording*), David Smith (*Sony Classical*), Peter McGrath (*Audiophon, HM*) and John Atkinson (*Stereophile Magazine*).

A list of their current 618 recordings is available from Meridian Audio on request.

Designers

The 518 design team included Phil Boddy, Richard Hollinshead, Duncan Smith, Bob Stuart and Rhonda Wilson.

Author: J R Stuart

Introduction

The Meridian 518 Digital Audio Processor is part of the 500 Series of advanced high-fidelity equipment.

In purchasing a Meridian 518 Digital Audio Processor, you have acquired a refined piece of equipment that will continue to bring you listening pleasure for many years. This manual will enable you to get the most from it.

About this manual

Because the 518 is such a flexible item, we have divided this manual into three parts.

Part 1 gives an overview of 518 and gives 'how to use' information for the two common 'consumer' applications of Control Unit and Resolution Enhancement.

Part 2 is more technical and describes how to use 518 as a Mastering or Multimedia Processor.

Part 3 gives more technical information in Appendices.

Conventions used in this manual

506. A number such as 506 refers to a component in the *Meridian* 500 Series of audio equipment.

Display. Whenever a key name is printed in **bold** typeface, it means that you should press this key. If the key name is not in bold type, it indicates that the course of action is not required at present, e.g. 'if you want to change the display, press Display' means you can do this, but it is not essential as part of the operation currently being discussed.

Standby Italic form normally refers to the state of the 518. In some instances, a key and the status of the equipment share the same name, e.g. the Standby key and the *Standby* state.

Radio	54

Displays are illustrated in this form.

1. Sequences of actions are given in numbered lists.

About the 500 Series

The Meridian 500 Series is a unique system of digital, analogue and video components designed to meet the demand for absolute quality, ease of use and lasting value.

The flexibility of the Meridian 500 Series is such that you can assemble a system as simple or as complex as you need, perfectly suited to your requirements, and with the ability to add to it or change it at a later date should those requirements change.

The Meridian 500 Series includes a sophisticated communications link, to ensure that any configuration of units will work together as a fully integrated system. The 500 Series communications system allows you to control any combination of units using a single handset, and ensures that your commands from the handset are interpreted unambiguously. Any unit can be designated as the controller for the system, allowing you to position the other units out of range from the handset beam if desired. It also allows all the units to be switched off from the front panel of any unit in the system.

Part 1

Unpacking the 518

On opening the carton, you should have found the following parts:

- Meridian 518 Digital Audio Processor
- Power cord
- This manual
- 500 Series communications lead

If any of these items is missing, please contact your dealer. We suggest that you retain the packing carefully as it provides maximum protection for the unit in transit.

Installing your 518

General precautions

Before carrying out any installation, you should ensure that the 518 is marked with the correct voltage for your local AC supply. Should this not be the case, do not proceed – but contact your dealer.

As a general rule, you should not make any connections to the 518, or to any other component in your system, whilst the AC power supply is connected and switched on.

Connections

There are three types of connection that need to be made to the 518:

- power
- digital audio
- communications.

Audio connections need to be made to other components in your system. Communication connections have to be made to most of the other *Meridian* components in your system in order for them to act as one system. The connections to your 518 are very important and care should be taken in deciding which connections to make.

Connection details are described following page 29.

Siting

We recommend the following guidelines for location.

- The 518 should not be placed on top of a power amplifier.
- Avoid sites where it would be subjected to direct sunlight or where it is near a heat source, e.g. a central heating radiator
- Avoid sites where the 518 could be subjected to strong magnetic radiation, like near a power amplifier.
- Not too close to a television, or where connecting cables may be subject to, or cause, interference.

Tip In common with all digital products, the 518 emits some radio-frequency signals. For this reason, try to keep all power cables and network leads away from audio, antenna and loudspeaker cables. Some time spent laying out the cables carefully will repay you with the best possible performance later.

Planning setup of 518

Firstly, the 518 is a product for enthusiasts! We designed it for audio and multimedia enthusiasts, keen listeners and those with enthusiasm for the best sound.

However, 518 is something of a chameleon. What do we mean by that? This is best explained by seeing what it does: 518 fulfils four very different functions in one box.

We have categorised uses (applications) of 518 into four broad headings, as follows:

- A simple 'preamp' or *Control Unit* for a purist digital audio system. (Type 0) – see below.

- A *Resolution Enhancement* processor in a high-quality audio system. (Type 1) – see the overviews on pages 10 and 49.

- A *Mastering Processor*, used in any recording, editing, mastering or dubbing process. (Type 2) – see the overview on page 12.

- A peri-computer *Multimedia Processor*. (Type 2) – see the overview on page 12.

What's inside a 518?
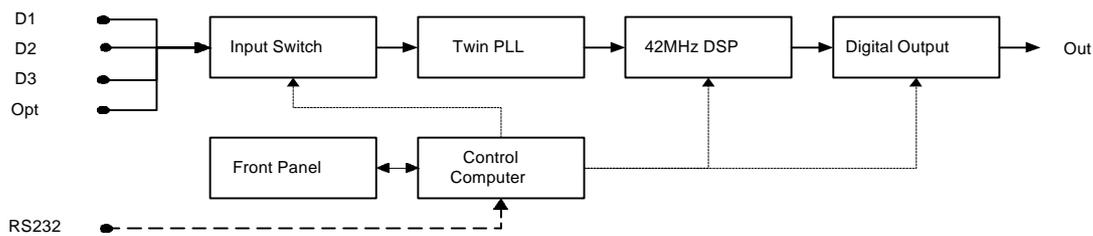
Internal block diagram for 518

518 is a 2-channel digital audio computer with four inputs – see the diagram above. The selected input is de-jittered with a proprietary Meridian twin phase-lock-loop that acts as a 'big flywheel' to regulate the audio stream. By using this twin PLL we ensure that the outgoing digital audio has very precise timing allowing the final output device (e.g. DAC) to achieve its maximum sonic potential.[1]

Following the twin PLL is a fast (42MHz) 24-bit Digital Signal Processor, which runs the user programs in 518. The DSP functions are all controlled by an internal computer which co-ordinates the front-panel keys, remote control sensor and display as well as RS232 control.

All software for 518 – control and DSP is held in a socketed EPROM. This allows the potential of upgrades or new applications being issued later.

Following the DSP is a multistandard digital output.

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[1] For the technically interested, Figure 1 on page 49 shows the performance of the twin PLL.

Overview as Preamp (Type 0)

Conventional analogue systems use a 'preamp' or control unit to gather together the various sources and to control the level of signal fed to the power amplifier so you can adjust volume.

Purists know that no matter how well a piece of analogue audio electronics is designed, there will always be unwanted and irreversible degradation, due to the addition of noise and distortion. Preamps are by no means immune from this.

For this reason, Meridian have for many years been developing an all-digital system where digital audio is handled by a digital controller (like 562) instead of a preamp. In these systems the signal is kept in the digital domain right into the DSP loudspeakers. Apart from sophisticated loudspeaker technology, the digital signal processing (DSP) in the speakers also replaces the volume control.

Some quality-concious audiophiles (who still don't have DSP speakers) prefer to use very simple replacements for the analogue preamp, placing a passive volume control between an analogue source such as a CD player or DAC and the power amp. This architecture gives very high sound quality, but has a number of disadvantages – like it requires a very sensitive power amp and has difficulties with impedance matching, hum, noise and frequency response in the passive control.

The Meridian 518 can provide an enormous improvement in the sound quality of some systems, by allowing you to dispense with the analogue preamp altogether – providing you have a good enough digital–analogue converter (DAC) and can route all signals in digital form.

For these applications – where a DAC can be connected directly to a power amp – then 518 provides a radical upgrade by removing the troublesome passive control.
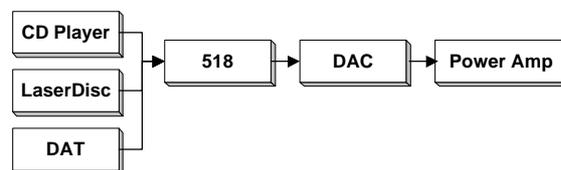
Using 518 as a 'preamp'

The system is illustrated above. Up to four digital sources – like CD, DAT or LaserDisc (often using the optical input) – are connected to the 518. 518 is then configured as Type 0 (see page 21) which makes it a system controller with a fully-operational volume control.

The output of 518 is taken to a DAC (or digital power amp); the output of the DAC is directly connected to the power amplifier.

The 518 performs more functions than switching and volume control. In summary, it:

- smooths the sound by de-jittering the incoming data stream,

- performs resolution enhancement by word-length matching, shaped dither DAC enhancement and the option of pre-emphasising the DAC. For an overview of Resolution Enhancement see page 49.

Warning! Systems like this can sound *incredibly* good!

What about analogue sources?

Using 518 with a 562
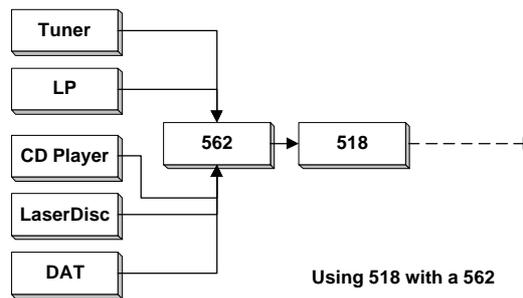
Analogue sources need to be converted to digital before passing through 518. Meridian make the 562 and 562V digital controllers, both of which have very high quality delta-sigma analogue–digital converters.

By adding a 562 to the system you will be able to feed 7 analogue sources (like radio, tape, even LP) in addition to 5 digital sources. A 562 also provides full tape copy and 2-room facilities.

518 and 562 work together seamlessly through the Meridian 500 Comms system.[2]

What else do I need to know?

This is a high-performance system, and to be successful, there are a few things to consider.

- Use a high-quality DAC. Preferably look for at least 18 bit precision. The Meridian 563 is an 18 bit converter and is a very good choice. Of course, 16 bit DACs will work, and the sound quality improvements from 518 will be evident: the drawback is that 16 bit DACs *may* give an audible background hiss when connected directly to a power amplifier. The extent of this noise depends on the sensitivity of the power amplifier and speaker used – and of course will be no more than the noise the DAC currently gives you at high listening levels. If the power amp has some adjustment, set its gain to the lowest value that also allows 518 to give you the loudest result you need. As a guideline, an 18 bit DAC should be quiet enough for a system where the DAC maximum output (normally 2V) is well matched to the power amp sensitivity.

- Make sure that the maximum output of the DAC (normally around 2V) suits the maximum input level of the power amp. Your dealer will advise on this.

- As there is no volume control between the DAC and power amp, it is important that either the DAC you use does not have a serious turn-on/off thump, or that you always turn the power amp on last and off first.

- Preferably, the DAC will use analogue de-emphasis.

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[2] Setup details: set 518 to Type 0, set 562 to Type 1. Either can be the system controller. *Autoconfigure* (see page 30) makes 562 the controller. Make 518 the controller if you want to use the Menu keys on MSR.

Overview as Resolution Enhancement Processor (Type 1)

There are a wide number of applications for this mode of 518: three examples are described.

CD or LaserDisc playback improvement

Many installations use the 2-box CD player format of CD transport + DAC. The CD transport provides a digital output, and of course may be a normal CD player where the digital output is used to drive an outboard DAC to improve the quality.

This CD playback system may then have its analogue output connected to a preamp or integrated amplifier in the usual way.
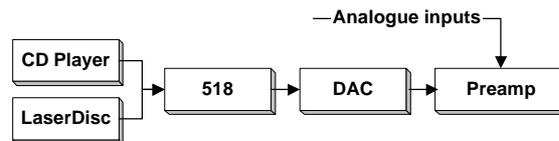
Using 518 as part of CD playback

The diagram above illustrates how 518 is added to such a system. The picture shows that the source could be a CD transport, a LaserDisc player or both.[3]

The 518 provides two resolution enhancement methods: de-jittering via the twin PLL and DAC optimisation through DSP. These are explained in 'Overview of Resolution Enhancement' – page 49.

The de-jittering element is of great importance to some CD players, and of enormous significance to any LaserDisc player as they tend to have relatively high-jitter output. If you want to use a LaserDisc player for serious CD listening, then the de-jittering in 518 is absolutely necessary.

The DSP DAC optimisation uses the techniques described in Appendix 4. One function the 518 provides is matching the wordlength of the source to the capability of the DAC, so for example, it can match LaserDisc or CD (both 16 bits) to an 18 or 20 bit DAC.

Normally in this mode, the 518 is not used as a volume control. Optimum performance for a disc will come, either from using unity-gain (i.e. 0dB gain) or possibly a few dB boost to optimise the disc.

Meridian DSP speaker improvement

The Meridian DSP loudspeakers, provide the most advanced performance and highest-resolution sound available today. The DSP speakers only accept a digital input and in order to use analogue sources a Meridian 562 or 562V is often added. The 562 provides input handling for up to seven analogue signals using its in-built 16 bit delta-sigma analogue-to-digital converter (ADC).

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[3] Setup details: set 518 to Type 1. Adjust **Out** to match DAC.
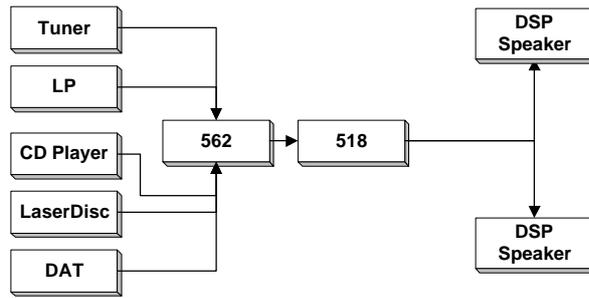
Using 518 with DSP Loudspeakers

As the diagram shows, a 518 can be placed between the 562 and the Meridian DSP speakers. In this case, the 518 is used – very much as it is for the earlier CD example – to provide further de-jittering and resolution enhancement. The Meridian DSP speakers can read 22 bits on the input and have analogue de-emphasis, so 518 can significantly improve the sound of this system.[4]

Because 518 does not pass on subcode, the time display feature on DSP5000 or DSP6000 becomes disabled. However the Meridian Comms system keeps the speaker updated on the current track number.

Meridian Surround improvement

The Meridian 565 is a world-beating surround decoder. One of its unusual features is the ability to accept digital signals directly to the DSP decoding. This means, for example, that the signal from a LaserDisc can be passed without the distortion of in-built (and often inferior) DACs and results in a substantially improved sound.

The Meridian 565 can drive DSP, active or conventional loudspeakers in any combination.
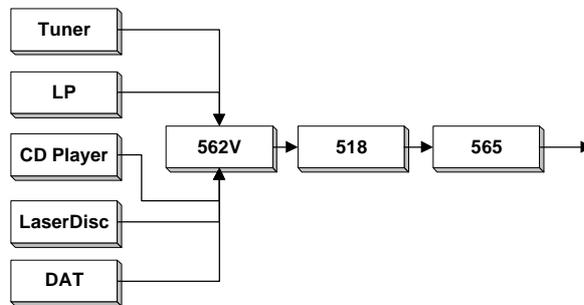
Using 518 with a 565 Digital Surround Processor

Whatever the output configuration, the 518 should be placed before the 565 Digital Surround Processor – so that the precision of the inputs (normally 16 bit) can be matched to the 20 bit input capability of 565.[5]

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[4] Setup details: set 518 to Type 1. Set **Out** to 22 C.

[5] Setup details: set 518 to Type 1. Set **Out** to 20 C.

Overview as Mastering Processor (Type 2)
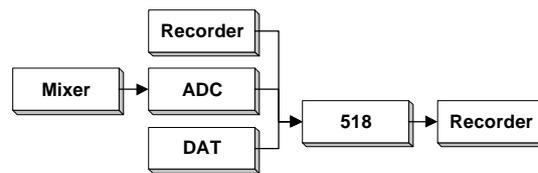
Using 518 as a Mastering Processor

The 518 is closely related to the highly respected Meridian 618 Mastering Processor; in fact 518 uses identical DSP to the 618 in this mode.

The Meridian 618 has been used for over three years by some of the world's most experienced recording engineers and there is a long and growing list of superior CDs that have used 618 in their production. See page 4.

A mastering processor is used during recording, editing and transfer processes. In the course of making a CD for example, the music may pass through 518 two, three or four times.

The diagram shows 518 between a recorder – which may be DAT, reel–reel, CDR, MO or hard disk – and a source which may be also a recorder or an analogue-to-digital converter (ADC).

The Mastering processor provides these important functions at each stage:

- de-jittering
- matching wordlengths output to input
- translating between consumer and professional serial interface modes
- stripping subcode and some flags
- level-shifting to optimise dynamic range
- fading during edits
- multiple re-dithering options
- DSP application of pre-emphasis or de-emphasis
- RS232 control

Overview as Multimedia Processor (Type 2)
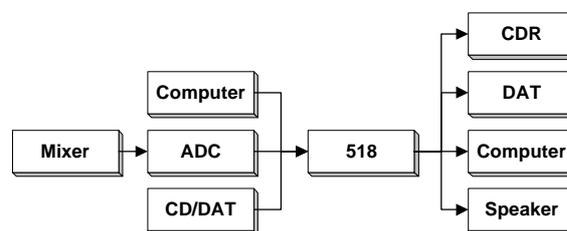
Using 518 as a Multimedia Processor

The Multimedia application of 518 is somewhat similar to the Mastering Processor just described.

Inevitably a PC is a very unfriendly place for high-quality sound for a number of reasons. The nature of the electrical environment, the block (i.e. 'jerky') access of hard-disc data and severe electrical noise combine to seriously limit the jitter performance of digital audio functions and the analogue performance of sound cards.

The principle benefits of using 518 in multimedia systems are:

- De-jittering. This is vital to getting good sound when recording or playing back from a computer-based sound storage system.

- Matching wordlengths input to output. Hard disc storage systems tend to use 16 or 24 bits. While 16 bit storage is quite adequate for simple transfer, it does not allow any headroom for manipulation of the signals – without degrading noise. 518 can be used to ensure that all the headroom in the disc storage is used by boosting the incoming signals to full code. 518 is also ideally suited to translating 24 bit storage to a downstream 16 bit recording medium like DAT or CDR. In fact, the noise-shaping options of 518 allow most of the subjective dynamic range of a 20 bit master to be retained in the 16 bit storage device.

- Accurate DSP. The quality of signal processing used in 518 is substantially higher than that normally found in PC editors or sound API functions. For example, 518 uses the most sophisticated re-dithering technology combined with 72 bit internal processing to ensure that any level changes or equalisations are made truly transparent to the listener. Much of this technology is proprietary to Meridian.

- RS232 control. The 518 supports direct RS232 control from a PC– effectively turning it into a 2-channel DSP peripheral.

Customising features

As the previous sections illustrate, the 518 is very flexible. You have the opportunity to significantly customise its functions to give you the functionality that exactly suits your application.

The section 'Customising 518, an overview' on page 37 describes the options in detail.

We recommend that you first get to know the 518 using one of the standard setups, and by working through this manual. Do not be afraid later to experiment with customising – we have given you a simple way to get back to where you started! (See page 23).

518 as provided has three standard configurations that we call *Type* settings. Each *Type* gives a different set of options; this feature is described fully on page 23.

Note By selecting a *Type* you automatically reset all custom settings for 518 to that default.

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518 has four operating modes (not to be confused with setup *Types*):
- *Normal*
- *Standby*
- *Type*
- *Config*

Normal and *Standby* are the everyday operating modes: the basic operating instructions refer to these.

Type, and *Config* are used to make choices about the way 518 works. These are described later in the section: 'Configuring 518, an overview' on page 37.

Starting off with 518

Checking

Before turning on the power, check once again that you have made all the connections correctly.

The 518 is designed to be left connected to AC power at all times and can be run continuously.

Switching on

The power switch is located directly next to the power inlet on the right-rear of 518.

1. Turn on the power switch at the rear of the unit. A small point on the display should now be illuminated.

.

If there is no display

Check the integrity of the power connections, including any fuses in the supply. If the display is still not illuminated, contact your dealer for help.

Memory

The 518 stores your latest settings for each Source in non-volatile EEPROM memory and automatically returns to these settings either when you come back to that Source, or on power-up.

The settings which are remembered for each Source are:

*   Gain (not volume in Control Unit mode)

*   DSP

*   Dither

*   In

*   Out

Standby

The entire 500 Series is designed to be left connected to AC power at all times.

This *Standby* state ensures that the components operate at maximum efficiency from the moment you start listening. It is perfectly safe and consumes a negligible amount of power. However, when you are not going to use your system for an extended period of time, e.g. when you are going on holiday, we would advise you to disconnect it from the AC power supply.

Basic operation of 518

The majority of functions are available from the front panel controls. When used as a preamplifier (Type 0), more functions are available using the Meridian System Remote control. See ' Advanced operation using the Remote Control' on page 15.

This section describes the front-panel operation for those controls that are common to all applications.

The following sections describe differences when operating 518 as a Control unit, as a Resolution Enhancer and as a Mastering processor.

> **Note** **518** can be used with or without other *Meridian* equipment. When it is used as the main system control unit it is normally the 'System Controller' and operates exactly as described below. Systems including other *Meridian* control units like 562 or 565 or DSP speakers will always elect for 518 not to be System Controller and there are some functional differences.

Operating 518 as a Control Unit (Type 0)

> **Note** Do not use 518 as a Control Unit if the system has a Meridian 565 or DSP loudspeaker. (Use Type 1)

Selecting a source

1. press **Source** until the input you require is indicated
2. release **Source**

   or

   press a Source key on the Remote

Selecting a source will bring 518 out of *Standby*.

Adjusting the volume

To increase the volume

1. press ▲, the right-hand volume key on the 518

   or

   press the top red key on the Remote

To decrease the volume

1. press ▼, the left hand volume key on the 518

   or

   press the bottom red key on the Remote Control

As you adjust the volume setting, the display will change to show the current source and volume number. For example:

| CD   65 | would indicate that you were listening to a Compact Disc at a volume setting of 65. The volume level dis- |

played will count up or down and ranges from 1 to 99. Each step is 1dB.

Subjectively a volume increase of 9dB is equivalent to a doubling of loudness. Each volume number represents about a 11% change in loudness; nine steps to double loudness. In a traditional analogue preamplifier using a rotary volume control the mid-way position usually offers approximately unity gain – with full volume corresponding to around +20dBgain.
In 518 the unity-gain i.e. 0dB setting is at volume number 87. For normal to high-level listening you should expect volume numbers in the region 60 to 90. For this reason 518 starts at power-up with volume number 87.

Out

1. Press **Out** to cycle between the output word options.

The **Out** key is used to set the number of output bits. It is also used to set consumer or professional channel-status output format. The choices are:

     16C, 18C, 20C, 22C, 24C, 16P, 18P, 20P, 22P, 24P

The numbers indicate the number of output bits. C and P represent the choice of consumer and professional channel status formats respectively.

Information: 24 audio data bits are always written to the left and right output words but the least significant bits, below the number of output bits chosen, are set to zero.

e.g. for **16 C**

16 data bits

| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

e.g. for **18 C**

18 data bits

| | | 0 | 0 | 0 | 0 | 0 | 0 |

In

1.   Press **In** to cycle between the input word options.

The **In** key sets the number of input bits to be read from each input word. The least significant bits below the number of input bits are masked (i.e. ignored).

Note It is extremely important that the number of input bits is equal to or greater than the number of data bits available on the input. If input is from a device which is known to use some of the 24 data bits for non-audio data or status[1], the number of input bits must be equal to the number of input audio data bits.

Both professional and consumer channel status input signals are acceptable to the 518.

Dither

1.   Press **Dither** to cycle between the dither options.

Appendix 1 shows the frequency shapes of these dithers.

| **Flat** |

Flat uses additive, white-spectrum, triangular probability-distribution (TPDF) dither.

1.   Press **Dither** again to choose between the dither options.

| **HP** |

HP (high-pass) uses additive, high-pass, TPDF dither.

| **Shape A** |

Shape A uses flat dither and a 2nd-order shaper optimised to MAF. [2]

| **Shape B** |

Shape B uses flat dither and a 9th-order shaper optimised to MAP. [3]

| **Shape C** |

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[1]For example, some A/D converters based on *Crystal Semiconductor* ™ converters may have level information embedded below the LSB.

[2]MAF, Minimum Audible Field, is the appropriate threshold curve for human listeners with normal stereo loudspeakers.

Shape C uses flat dither and a 9th-order shaper optimised to MAF.

> **Shape D**

Shape D uses high-pass dither and a 9th-order shaper optimised to MAF.

> **Shape E**

Shape E uses high-pass dither and a 2nd-order shaper optimised to MAF.

DSP

1. Press **DSP** to select the primary processing mode.

The display will show:

> **Gain   87**

Gain has a flat frequency response, but the level of the signal level is adjusted using a precision dithered multiplication. All the front panel keys are available to specify processing.

1. Press **DSP** again.

The display will show:

> **Emph   87**

Emphasis ensures that the output of 518 is always pre-emphasised according to the 50/15µs CD standard. 518 uses precision DSP to pre-emphasis the signal *providing* the incoming signal is not already pre-emphasised. If the incoming signal is pre-emphasised the red **Emph** light indicates this.

Emphasis is the recommended mode for most program material providing the DAC system is correctly designed and uses analogue de-emphasis.

or:

> **De-Emph 87**

De-Emph provides the CD de-emphasis function to very high precision when the incoming signal is pre-emphasised. You would use this *only* if you have a DAC which provides digital de-emphasis. This adaptive mode ensures that the output of 518 is never pre-emphasised.

Note Gain functions in Emphasis and De-Emphasis, in fact all the front panel keys are available to specify processing.

Display

1. Press **Display** key to select between the following display formats

> **Emph   67**

Pre-emphasis option and gain setting, *or*

> **ShpB   67**

Dither mode and gain setting, *or*

> **CD   67**

Source and gain setting, *or*

---

[3]MAP, Minimum Audible Pressure, is the appropriate threshold curve for human listeners using headphones.

20C16	67

Input/output choice and gain setting, (This example indicates 20 bits of input and 16 bits of output in consumer format), *or*

44k1	67

Sampling frequency and gain. If there is no input signal the display would indicate no lock as follows:

N.L.	67

Emphasis Light

There is a light on the front panel **Emph** which indicates when the channel status suggests that the incoming audio is pre-emphasised. It is not affected by the user's settings on the 518 itself.

Clip Display

Some of the processing modes in 518 deliberately allow you to increase the overall level of the signal. If the output signal exceeds full scale, the 518:

- clips (saturates) at full code (normally sounding benign on short overloads), and
- displays a clip message like:

ClipL	89

The clip message will indicate whether the overload occurred on Left, Right or both.

Clipping in DSP has nothing like the bad sonic consequences of clipping analogue systems. Normally small amounts of clipping cannot be heard.

Software version

In *Standby*:

1. Press and hold **Display**.

   The display will show the version number of the microcontroller software, followed by the DSP version e.g.:

DSP	1.5

Advanced operation using the Remote Control

Putting the 518 in *Standby*

1. press **Standby** on the Remote Control

   or

   put another *Meridian* component into *Standby*.

Coming out of *Standby*

To start up the 518 from *Standby*

1. Select a source from the front panel or the Remote Control (MSR).

   or

   If the 518 is part of a *Meridian* system, bring any component out of *Standby*. For example start up a *Meridian* CD-player.

Muting the sound

The mute facility cuts off the sound by setting the volume level to zero.

To mute the sound

1. Press **Mute** on the Remote Control. The output will mute and the display will change to:

> | **Muted** |

To restore the sound

1. Press **Mute** a second time.

   The volume level and display will be restored.

Menu Keys

When the 518 is used as a control unit *and* it is the system controller, then the four menu keys on the MSR can be used to access the **DSP**, **Dither, In** and **Out** menu functions.

To access a menu

1. Press **w** or **e** on the remote.

   The menu will be displayed.

To change a menu

1. Press **n** or **s** on the remote.

Operating 518 as Resolution Enhancer (Type 1)

> **Note** Do not use Resolution Enhancement mode if you want the 518 to provide the volume control. (Use Type 0)

Volume control

The 518 does not provide the main system volume control in Resolution enhancement (Type 1) mode.

If 518 is used with other *Meridian* controllers like 565 or DSP loudspeakers, they will provide the volume function and the normal *Meridian* 0–99 volume number display.

In Resolution Enhancement mode, 518 does provide a secondary gain control which allows you to maximise the resolution of down-stream processors and DACs by raising each piece to full digital code.

This function is called 'Gain' and does not follow the system volume control.

Gain control

Gain control is provided in one decibel steps from +12 dB down to -99 dB.

1. Press ▲

The gain will increase in 1dB increments, and the display will show the gain in dBs, something like:

> | **CD   +2** |

1. Press ▼, to decrease the gain.
2.

Memory

In Resolution Enhancement mode, 518 maintains a continuous memory of the **DSP, Dither, Gain, In** and **Out** settings for each source.

So, if you had determined that, e.g. CD should always use Gain 0dB but that Radio could always use Emphasis and +2dB, then 518 will remember these and automatically reconfigure itself for each source.

DSP

In addition to the DSP modes offered in Control Unit (see page 15), Resolution Enhancement adds **Bypass**.

Bypass transmits all 24 bits on the input to the output without any processing.

Note When **Bypass** is chosen, all the other front panel keys are disabled.

Operation summary

On the 518 front panel

Key	Action
Source	Selects Source or input
Display	Cycle the display through:
	Processing option with gain in dB
	Dither option with gain in dB
	Input/output choices with gain in dB
	Sampling frequency and gain in dB
	Blank
DSP	Select main processing method: Bypass, Gain, Emphasis, De-emphasis.
Dither	Select dither or noise shaper to be used
In	Set number of input bits
Out	Set number of output bits and consumer or professional use of channel status
s	Decrease volume/gain
n	Increase volume/gain

With the Remote Control

Source keys	Selects input depending on customisation.
Standby	Puts the 518 into the *Standby* state.
Clear	Autoconfigure (in *Standby*)
w e	Access the Menus
n s	Change the Menus
Fn + Display	Change 518 Display
Red n and s	Change the primary volume.
Mute	Mutes output**.**

Customising 518, an overview

518 is a very sophisticated device with a huge number of options to allow you to set up exactly the system you need or to experiment with new possibilities.

Programming 518 is a straightforward process and you should not be timid about experimenting. Although the setup is stored in non-volatile memory called EEPROM, the EPROM (which you cannot change) contains default *Type* settings and you can return to these at any time.

Restoring default settings

1. Switch off any power amplifiers that are connected to 518.
2. Switch off the 518 using the power switch on the back.
3. While pressing the **Source** key on the 518 front panel, switch the power on again. The display will read:

Type   1

4. Release the **Source** key

   At this stage you can change the *Type* from 0 – 2 using the **n** and **s** Volume keys.

5. Switch off the 518 using the power switch on the back.
6. After half a second, switch the 518 power on again.

Caution Some power amplifiers are very susceptible to small surges that may result from the process of switching a preamplifier on and off. Some – like the *Meridian* 205, 555 or 605 incorporate DC-offset protection that may be triggered by this process. *Meridian* active or digital loudspeakers are inherently proof against these surges and need not be switched off. In general digital products like power amplifiers, recorders etc. will be unpredictable when they have the digital signal interrupted.

---

518 has two setup options; *Type* and *Config*. These together with *Normal* and *Standby* give the 518 four operating states. The following sections give an overview.

Type: an overview

Type just described, restores one of the default settings. No further actions are possible.

Config: an overview

Config mode is used for setting fundamentals of options and control. Consequently in *Config* the outputs of 518 are muted while you make the necessary choices. The choices available in *Config* are outlined in the following sections.

Config: control settings

In *Config* you can make selections that effect the way 518 responds to certain keys. The main choices of this kind are:

- whether the 518 is to auto-configure, or you will determine the controller in the system.
- The 'address' of the product.
- whether or not *Standby* is permitted.[1]

---

[1] *Standby* is not recommended for 'Pro' or Mastering situations

- whether or not the **Bypass** DSP option is available.[2]
- whether or not a blank display option is allowed.
- whether or not the **Emphasis** DSP option is adaptive – i.e. reacts to the incoming emphasis status.
- choices on how the volume control operates and displays.

Details of these are described in the next section.

Config: sources and inputs

In *Config* you can also make selections to do with sources, e.g.

- how many inputs will be active
- which sources you can select
- which *key* on the remote control selects which source
- the *Logo* for that input on the 518 display
- the physical *input* connection to 518.
- the Comms type of the source, i.e. whether it is a Meridian controllable source like CD or Radio
- the address for that source product

How to customise 518

The 518 comes configured in Resolution Enhancement mode (Type 1) and needs no customising to become operational.

There are a very large number of different configurations possible. This section tells you how to change the configuration.

Customising, general procedure

518 has four operating modes (not to be confused with setup *Types*):

- *Normal*
- *Standby*
- *Type*
- *Config*

Normal and *Standby* are the everyday operating modes: the operating instructions refer to these.

Type and *Config* are used to make choices about the way 518 works. These are described in the section: 'Configuring 518, an overview' on page 37.

How to change to *Type* or *Config*

To change to *Type* or *Config* you use the same basic procedure.

1. Switch off any power amplifiers that are connected to the system.
2. Switch off the 518 using the power switch on the back.
3. While pressing the specific key for the operating mode you want on the 518 front panel, switch the power on again.

   518 will display a message to inform you which mode it is in.
4. Release the key

   At this stage you can make the adjustments required.

In step 3, the front panel key is:

- *Type* – press and hold **Source**.
- *Config* – press and hold **Display**.
- *Normal* – do not use any key!

_____

[2] Bypass is not available if the 518 is the system volume control!

Caution Some power amplifiers are very susceptible to small surges that may result from the process of switching a preamplifier on and off. Some – like the *Meridian* 205 or 605 incorporate DC-offset protection that may be triggered by this process. *Meridian* active or digital loudspeakers are inherently proof against these surges and need not be switched off. In general digital products like power amplifiers, recorders etc. will be unpredictable when they have the digital signal interrupted.

How to change back to *Normal*

To revert to *Normal* .

1. Switch off the 518 using the power switch on the back.
2. After half a second, switch the 518 power on again.

Making changes to an existing setup

Config is a configuration editing mode, it does not reset on entry. *Type* however performs a full reset of all parameters.

To make any changes to your custom configuration:

1. Change to *Config*,
2. make the changes you want,
3. change back to *Normal*.

Customising using Type

Type is a mode used specifically to setup 518 into one of three factory-preset configurations.

- *Type* resets the following for all three *Types.*

Setting	Type 0	Type 1	Type 2
Controller	Auto	Auto	N.Con
System Address	1	1	1
Product Address	1	1	1
Standby	Y	Y	N
Bypass	N	Y	Y
Blank	Y	Y	N
***Emph**	N	N	N
Volume	M	N	N
Volume	##	dB	dB

- Source-Logo-input mapping as shown below.

Source	Logo	Type 0 Input	Type 1 Input	Type 2 Input	Comms type
CD	CD	D1	D1	D1	1
Radio	RD	D1	D1	N	2
LP	LP	D1	D1	N	–
TV	TV	D1	D1	N	–
Tape1	T1	D2	D1	D2	–
Tape2	T2	D3	D1	D3	–
CDR	CR	D1	D1	N	–
Cable	Cb	D1	D1	N	–
Text	Tx	D1	D1	N	–
VCR1	V1	D1	D1	N	–
VCR2	V2	D1	D1	N	–
LD	LD	OP	D1	OP	–

Selecting *Types*
1. Switch off any power amplifiers that are connected to the system.
2. Switch off the 518 using the power switch on the back.
3. While pressing the **Off** key on the 518 front panel, switch the power on again. The display will read:

> **Type   1**

4. Release the **Off** key
5. Use the front-panel ▲ and ▼ **Volume** keys to move the selection between *Types* 0 – 2.
6. When you have the *Type* you want displayed, wait one second for 518 to action the choice.
7. Switch off the 518 using the power switch on the back.
8. After half a second, switch the 518 power on again to restore *Normal* mode.

Customising using *Config*

In *Config* you can review and change settings to do with communications, control and the hardware options you have. In *Config* you also make choices about the number and types of sources, what the display shows when you select them etc. The 518 is initially programmed to *Type 1* and all *Types* set up the source configuration as shown in the previous Tables.

How to use *Config*
1. Switch off any power amplifiers that are connected to the system.
2. Switch off the 518 using the power switch on the back.
3. While pressing the **Display** key on the 518 front panel, switch the power on again. The display will read:

> **Config**

4. Release the **Display** key, the display will show:

> ```
> Auto
> ```

Selecting the controller mode

In *Config* mode:

1. Press **Display** until you see a display like:

> ```
> Auto
> ```

2. Use the ▲ and ▼, **Volume** keys to choose between:
   - Auto, meaning configuring can be automatic
   - Cont, meaning the 518 will be the system controller
   - N.Con, meaning the 518 will not be the controller

Setting the system address for 518

In *Config* mode:

1. Press **Display** until you see a display like:

> ```
> SA=1
> ```

This means the system address is 1. The *Meridian* 500 Comms system allows for up to eight systems operating on the same network. Unless you are setting up a *Multiroom* system, or are advised to do so by *Meridian* support personnel, we suggest you leave this on address 1.

Setting the product address for 518

In *Config* mode:

1. Press **Display** until you see a display like:

> ```
> PA=1
> ```

This means the product address is 1. The *Meridian* 500 Comms system allows for up to eight products of the same type operating on the network. Unless you are setting up a *Multiroom* system, or are advised to do so by *Meridian* support personnel, we suggest you leave this on address 1.

Note When customisation is complete, switch the power off and then on again to restore *Normal* mode and to save what you have done.

Setting the Standby mode for 518

In *Config* mode:

1. Press **Display** until you see a display like:

> ```
> Stby        Y
> ```

This means that *Standby* mode is available. To prevent *Standby* chose N.

2. Use the ▲ and ▼, **Volume** keys to choose between Yes or No.

Setting the Bypass option for 518

In *Config* mode:

1. Press **Display** until you see a display like:

> ```
> Bypass    Y
> ```

This means that **Bypass** is available. **Bypass** prevents the 518 operating as a volume control and is therefore it is highly undesirable to access it by mistake if you are using 518 to control volume.

2. Use the ▲ and ▼, **Volume** keys to choose between Yes or No.

Setting the Blank display option for 518

In *Config* mode:

1. Press **Display** until you see a display like:

> | **Blank   Y** |

This means that a blank display is one of the options offered by the Display key. To remove this option chose N.

2. Use the ▲ and ▼, **Volume** keys to choose between Yes or No.

Setting the Emphasis option for 518

In *Config* mode:

1. Press **Display** until you see a display like:

> | ***Emph   N** |

*Emph Y means that pre-emphasis will be 'forced' on the output signal irrespective of the incoming channel status (displayed with the **Emph** light). Normally Emphasis is an adaptive setting that guarantees pre-emphasis on the output. There may be requirements in mastering where pre-emphasis needs to be applied even though incoming emphasis is indicated.

'*Emph N' means use the adaptive method.

2. Use the ▲ and ▼, **Volume** keys to choose between Yes or No.
Chose 'Y' to over-ride the incoming emphasis flag[1].
If in doubt chose 'N'. '*Emph Y' is not needed in normal use.

Setting the Volume mode for 518

In *Config* mode:

1. Press **Display** until you see a display like:

> | **Vol.   N** |

In the 500 Comms system there is provision for two volume controls, main and secondary.

2. Use the ▲ and ▼, **Volume** keys to choose between:
   - N. No means that the gain control in 518 is independent of any other *Meridian* components in the system and is stored by Source.
   - M. Volume Main means that the volume control in 518 will follow the main *Meridian* system and respond to the red keys on the remote.
   - S. Volume secondary means that the volume control in 518 will follow the second volume control in the system and respond to the shifted volume command on the remote. (Fn + Volume)

For further details on shifted commands see the manual supplied with the remote control.

If in doubt choose VolM for a preamp and N for Resolution Enhancement.

Setting the Volume display

In *Config* mode:

1. Press **Display** until you see a display like:

---

[1] **Note.** *Emph also allows De-emphasis of a signal *not* shown to be emphasised.

> **Vol.   dB**

The gain of 518 can either be displayed in absolute dB in the range -99dB to +12dB, or as a *Meridian* volume number 0 to 99 – where 87 corresponds to 0dB.

2. Use the ▲ and ▼, **Volume** keys to choose dB or ##.

Setting up sources

For each of the twelve source selection keys on the Remote control you choose a display *Logo* and a physical input connection.

Normally as shown, we set the CD key to give a **CD** display with the D1 (Digital 1) input selected. You may however wish to display CD1 for your main CD player and to connect it to D2.

A full list of possible logos and their meanings is:

Source	Logo	Source	Logo	Source	Logo
CD	CD	S-VHS	SV	DAB	DAB
Radio	RD	Betamax	βm	Dig. Sat	DSat
LP	LP	Camera	Ca	ADC	ADC
Tape 1	T1	Video 8	V8	R-Reel	Reel
Tape 2	T2	CD-V	CD-V	FM tuner	FMTun
CDR	Cr	CD-I	CD-I	AM tuner	AMTun
Cable	Cb	CD-T	CD-T	MW tuner	MWRad
Teletext	TX	CD Photo	CD Photo	SW tuner	SWRad
VCR 1	V1	CD Lib	CD Li	LW tuner	LWRad
VCR 2	V2	CD Jbox	CD Jbox	Line	Line
Laserdisc	LD	CD-ROM	CD-ROM	Mic.	Mic
Satellite	SA	DAT	DAT	Aux	Aux
CDX	C2	DCC	DCC	Mixer	Mixer
78 rpm	78 rpm	Phono	Phono	Simul.	Simul
VHS	VH	Minidisc	Mdisc	Computer	PC

Choosing source logos

Note at any time in the source configuring process you can use the front-panel **Display** key or the handset **Mute** key to return to the root menu with a display like 'Auto'.

In *Config* mode:

1. Press **Source** until you see a Remote-key (source) + logo display like

> **CD   CD**

2. Press **Source** until the Remote key name for the source you wish to configure is displayed.

3. Use the ▲ and ▼ **Volume** keys until the correct logo is indicated – see the list above.
4. Make changes for all the source options.

Note If you select the logo '**N**' the 518 will ignore that key on the Remote control and that source will not be offered in the *Normal* source menu.

Changing the input for a source

In *Config* mode:

1. Press **Source** until you see a Remote-key (source) + logo display like

CD	CD

2. Press **Source** until the Remote key name for the source you wish to configure is displayed.
3. Press **DSP.**

you should see the display change to one like:

CD	D1

The Remote control key you are setting up is the source name and it is indicated on the left as before. Now the letters on the right indicate which of the four physical input connectors will be selected.

To change the physical inputs:

1. Use the ▲ and ▼ **Volume** keys until the correct one is indicated
2. Make changes for all the source options by pressing **Source**.

Note When customisation is complete, switch the power off and then on again to restore *Normal* mode and to save what you have done.

Choosing the Comms type for a source product

This setting currently only applies to a source which is a *Meridian* CD player or Radio tuner.

In *Config* mode:

1. Press **Source** until you see a Remote-key (source) + logo display like

CD	CD

2. Press **Source** until the Remote key name for the source you wish to configure is displayed.
3. Press **DSP** until you see a display like:

CD	1C

4. Use the ▲ and ▼ **Volume** keys to chose the Comms type.

CD players are always 1C, tuners are always 2C. NC means the source is not Meridian.

5. Make changes for all the source options by pressing **Source**.

Choosing the address of a source product

In *Config* mode:

1. Press **DSP** until you see a display like:

CD	1A

2. Use the ▲ and ▼ **Volume** keys to choose the product address
3. Make changes for all the source options by pressing **Source**.

Connections

There are three types of connection that need to be made to the 518.

- power, see page 14.
- digital audio, see page 40.
- communications, see page 30.

Digital audio connections

Digital connections are made:

- from the digital outputs of 518 to your digital power amplifiers, digital loudspeakers, digital recording devices, editors.
- to the digital input of 518 from sources like CD, A/D converters, mixers, digital recording devices, editors.

Digital connections should be made with either:

- high-quality 75Ω screened cable on SPDIF
- high-quality 110Ω balanced screened cable on AES/EBU.

For advice on the type of cable we suggest you consult your dealer and the manual supplied with the source equipment.

Meridian has a range of suitable digital interconnects available as accessories. We recommend you do not use cables intended for analogue connection since these do not usually have the degree of shielding or an impedance of 75Ω. Cable intended for UHF applications like antenna down-lead is also unsuitable since it does not shield adequately in the 1–30MHz region.

Warning. We strongly recommend the use of well-screened precision coaxial cable. Certain 'audiophile' cables are not screened. Screened cable will minimise RF interaction with your system. Unscreened cables for digital connections may cause illegal levels of RF interference.

Digital input connections

1. Make digital connections from each of your digital sources to an appropriate digital input on 518. The digital inputs on 518 are labelled:

- **D1** to **D3** for the three cable inputs, and
- **OP** for the optical input.

These inputs are identical in performance and are assigned in *Config*.

D1 also has an AES/EBU connection. Only one can be used at a time, i.e. **D1** is either SPDIF or AES/EBU *not both*.

Digital output connection

1. Make digital connections from the output to the equipment you have chosen to follow it.

You can use both the SPDIF and AES/EBU output connections at the same time.

Communications connections

Communications connections are only made to other *Meridian* equipment. The following sections describe the major points.

To connect to other Meridian 500 Series equipment

1. Connect one of the COMMS sockets on the rear panel of the 518 to one of the COMMS sockets on another 500 Series unit, using the 500 Comms lead supplied.
2. Connect all the 500 Series products together in this way to form a chain (not a loop). The order in which they are connected is not important.

If the system is to operate in 500 mode, then, configure the units with the following automatic setup procedure.

1. Switch all the units to *Standby*.
2. Press **Clear** on the handset.

Each unit will display:

Auto

One unit will then be designated as the controller and display:

Con

All the other units will be configured as non-controllers and display:

NCon

The system is now set up and ready to use.

If for any reason the automatic setup does not give the configuration you want, you can restore the default operation by selecting a *Type* or by setting the controller status in *Config* as described on page 21.

Connecting to Meridian Digital speakers

1. Connect the phono plug on the end of the M-lead to the digital output of the 518.
4. Connect one of the two DIN plugs on one end of the M-lead to one of the COMMS sockets on the back of 518.

Note There are usually two DIN plugs on an **M-lead**. Take care to chose the correct one and do not force the plug. The second plug is used to connect to any 200 Series products in the range.

Part 2

Mastering Processor

The Meridian 518 Digital Audio Processor has been designed to allow the making of better recordings, and in particular to enable the production of high-quality, enhanced-definition CDs.

The predominantly available channels for delivering high-quality sound to consumers is stereo, linear-encoded 16 bit PCM. There is also no realistic prospect of a widely-available improvement on this capability. While CD is limited to 16 bits, we now have A/D converters, recorders and editors operating with anywhere between 16 and 24 bit words.

The Meridian 518 provides the very best quality and combination of signal-processing functions for use when preparing material for issue on media like CD. In fact, using the unique signal processing in 518, CDs can be produced with up to 19-bit subjective dynamic range.

The functions of 518 have been optimised for use in three stages of the production process, namely:

- on location, processing the signal between the A/D converter and recorder,

- during transfer of a recording to an editor,

- during transfer from editor to production master.

In each such step, the word-size can be different, and 518 can make these processes optimal.

The signal-processing used is based on an extensive programme of research, and is implemented in DSP with an internal precision of 72 bits to ensure exceptional transparency. For a very full technical background, please see the papers referred to below: copies may be obtained from Meridian. [1] [2] [3] [4]

518 also finds applications in professional or consumer replay situations. Here the precision gain control and pre/de-emphasis processing can replace the system preamp and enhance the dynamic range of a D/A converter – see the earlier sections of this manual.

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[1]J.R. Stuart and R.J. Wilson, "A Search for Efficient Dither for DSP Applications", 92nd AES Convention, Vienna 1991, Preprint #3334

[2]J.R. Stuart, "Noise: Methods for estimating Detectability and Threshold", 94th AES Convention, Berlin 1993, Preprint #3477

[3]M.A. Gerzon, P.G. Craven, J.R. Stuart, R.J. Wilson, "Psychoacoustic Noise-Shaped Improvements to CD and other Linear Digital Media", 94th AES Convention, Berlin 1993, Preprint #3501

[4]J.R. Stuart and R.J. Wilson, "Dynamic Range Enhancement Using Noise-Shaped Dither Applied to Signals With and Without Pre-emphasis", In preparation for AES Convention, Amsterdam 1994.

Description

The Meridian 518 Digital Audio Processor is a general-purpose digital-domain DSP engine that operates on or between consumer or professional interfaces at sampling frequencies between 32–50kHz and with up to 24 bit input and output.

The supplied user programmes are intended for use in recording, editing, mastering and replay situations.

The primary functions of 518 permit the correct signal processing when moving between carriers or channels of different word size. Options are also offered – in the form of noise-shaping, gain control and precision pre and de-emphasis – to maximise the subjective dynamic range of the final carrier or channel. Typical applications would be to use 518 at all stages, i.e. between an A/D converter and a recorder; then between the recorder and any editor; and finally between the editor and the final carrier.

518 has been extensively beta-tested, there are many highly-regarded commercially-available CDs that have used its processes.

518 as a Mastering or Multimedia Processor (Type 2)

This section covers unusual features of 518 operation when used in mastering or Multimedia processor mode (Type 2). Please refer to the normal operating instructions on page 15 for more details.

Meridian 500 Comms warning

We strongly recommend that you do not connect anything to the Comms sockets in Type 2. The behaviour of the 518 may be unpredictable.

If you want to use 518 as a Mastering or Multimedia Processor along with other *Meridian* equipment, we suggest you start from Type 1 and build the appropriate functionality in *Config*.

Emphasis Light

There is an **Emph** light on the front panel which indicates when the channel status *suggests* that the incoming audio is pre-emphasised. It is not affected by the user's settings on the 518 itself. Obviously in this circumstance, it is not advisable to pre-emphasise again using 518! Routinely 518 prevents you from making this mistake, however, against the possibility that the incoming channel-status may be wrong, you can over-ride this protection, see *Emph on page 26.

Selecting a source

1. press **Source** until the input you require is indicated
2. release **Source**

Gain control

Gain control is provided in one decibel steps from +12 dB down to -99 dB.

1. Press ▲

The gain will increase in 1dB increments, and the display will show the gain in dBs, something like:

D1	+2

1. Press ▼, to decrease the gain.

Memory

In Mastering Processor mode, 518 maintains a continuous memory of the **DSP, Dither, Gain, In** and **Out** settings for each source.

So, if you had determined that, e.g. D1 is an 18 bit source that should always use Gain 0dB but that D2 is 16 bit and can always use Emphasis and +2dB, then 518 will remember these and automatically reconfigure itself for each source as you switch between them.

DSP

1. Press **DSP** to select the primary processing mode.

The display will show:

Bypass   0

Bypass transmits all 24 bits on the input to the output without any processing.

Note When **Bypass** is chosen, all the other front panel keys are disabled.

---

1. Press **DSP** again.

The display will show:

Gain   0

Gain has a flat frequency response, but the level of the signal level is adjusted using a precision dithered multiplication. All the front panel keys are available to specify processing.

1. Press **DSP** again.

The display will show:

Emph   0

Emphasis ensures that the output of 518 is always pre-emphasised according to the 50/15μs CD standard. 518 uses precision DSP to pre-emphasis the signal *providing* the incoming signal is not already pre-emphasised. If the incoming signal is pre-emphasised the red **Emph** light indicates this.

or:

De-Emph   0

De-Emph provides the CD de-emphasis function to very high precision – providing the incoming signal is emphasised (**Emph** light on).

Note Gain functions in Emphasis and De-Emphasis, and all the front panel keys are available to specify processing.

Display

1. Press **Display** key to select between the following display formats

Emph   +2

Pre-emphasis option and gain setting, *or*

ShpB   +2

Dither mode and gain setting, *or*

CD   +2

Source and gain setting, *or*

20C16 +2

Input/output choice and gain setting, (This example indicates 20 bits of input and 16 bits of output in consumer format), *or*

44k1 +2

Sampling frequency and gain. If there is no input signal the display would indicate no lock as follows:

N.L. +2

Clip Display

Some of the processing modes in 518 deliberately allow you to increase the overall level of the signal. If the output signal exceeds full scale, the 518:

- clips (saturates) at full code (normally sounding benign on short overloads), and
- displays a clip message like:

ClipL +10

The clip message will indicate whether the overload occurred on Left, Right or both.

Clipping in DSP has nothing like the bad sonic consequences of clipping analogue systems. Normally small amounts of clipping cannot be detected.

Making Recordings

Case 1. The recording is made to the final carrier, DAT or CDR at 16 bits

a) 16-bit A/D – 518 – CDR, use **Bypass**.
b) 20-bit A/D – 518 – CDR.

use **Emphasis** (if the material has sufficient headroom at high frequencies), or:

use **Gain** (on the maximum setting which does not cause clipping) with:

- **Shape B, C** or **D**.
- **In** set to **20**.
- **Out** set to **16 C** (possibly **16 P)**.

Case 2. The recording will be further processed: carrier and A/D converter have the same word size

In this case use **Bypass**.

Case 3. The recording will be further processed: carrier has more bits than the A/D converter

In this case use **Bypass**.

Case 4. The recording will be further processed: the carrier has fewer bits than the A/D converter

Use Emphasis if the material has sufficient headroom at high frequencies, or:

use **Gain** on the maximum setting which does not cause clipping.

In both cases, also select:

- **Flat** or **H.P. dither.** You may also use **Shape A.**
- **In** set to the number of bits in the *A/D converter.*

- **Out** set to the number of bits in the *recorder.*

Transfer to editor

Case 5. The recording and editor are the same word size

In this case use Bypass.

Case 6. The recording has fewer bits than the editor

In this case use Bypass.

Case 7. The recording has more bits than the editor

In this case use Emphasis (if the recording is not already pre-emphasised) and if there is sufficient headroom at high frequencies, *or*:

use **Gain** on the maximum setting which does not cause clipping.

In both cases, also select:
- **Flat** or **H.P. dither.** You may also use **Shape A.**
- **In** set to number of bits on the *recording.*
- **Out** set to the number of bits used in the *editor.*

Transfer to the final carrier

Case 8. Editor and final carrier have same word size.

In this case use Bypass.

Case 9 Editor has fewer bits than final carrier

In this case use Bypass.

Case 10 Editor has more bits than final carrier

In this case use **Emphasis** (if the recording is not already pre-emphasised) and if there is sufficient headroom at high frequencies, *or*:

use **Gain** on the maximum setting which does not cause clipping.

In both cases, also select:
- **Shape A, B, C or D**.
- **In** set to number of bits on the *output of the editor.*
- **Out** set to the number of bits on the *final carrier.*

Note In this circumstance, the editor should be set to put out the maximum number of bits it can to preserve linearity.

Noise shaper characteristics

Each noise shaper presents a different degree of subjective noise reduction – we call that its 'advantage' – compared with normal dithering using white TPDF dither. Each shaper also has a different degree of HF boost. The parameters are summarised in the table below.

Shaper	Advantage			
	44.1kHz		48kHz	
	Normal	**Pre-emphasis**	**Normal**	**Pre-emphasis**
Flat TPDF	0.0dB	3.4dB	0.0dB	3.4dB
High-pass	3.5dB	7.0dB	3.5dB	7.0dB
Shape A	6.4dB	12.2dB	6.4dB	12.2dB
Shape B	19dB	22.6dB	19.6	23.6dB
Shape C	15.1dB	17.9dB	18.6dB	21.4dB
Shape D	15.3dB	21.5dB	19.9dB	23.5dB

518 Operating Background

Transparency in digital systems

Digital audio gives a unique opportunity to deliver exceptional sound quality in a recording or broadcast. In the first decade of this technology, considerable progress was made developing the gateways – i.e. A/D and D/A conversion. The promise of digital audio is only deliverable if the digital audio signal is handled with complete integrity.

It is has been a common misconception among practising engineers that the signal is robust once it is in the digital domain. This combined with a general misunderstanding about dither, has led to working practises that degrade the potential of the recording. Obviously, it is necessary to understand the signal processes, and to have a way to process the signal optimally.

The 518 allows you to achieve a transparent channel with the maximum subjective dynamic range. This section explains the technical background.

Digital Audio and Quantisation

Digital audio is used because it is possible to transmit the data through space (broadcast) or time (recording) without any loss of information or generation degradation. This property of digital audio makes it extremely attractive. The major development in digital audio has been in extending our comprehension of the processes of digitisation and reconstruction of the original analogue signal.

Dither

Dither is an essential lubricant if a digital audio channel that includes processing is to remain transparent.

Transparency in a digital channel is the result of maintaining linearity at both high and low levels and not falling prey to signal-processing distortions like, for example, noise modulation.

It is well established that in order for linearity to be maintained, dither must be applied at every non-trivial signal processing stage. By non-trivial, we include all operations that modify a sample. With very few exceptions, arithmetic operations that modify a sample result in an increase in the number of bits representing the output result; in a fixed size channel, this can therefore lead to truncation or quantisation effects.

In a recording process, the typical non-trivial operations will be:
- Truncation and requantisation if the A/D converter has a larger word size than the recorder.
- Truncation and requantisation if the recorder has a larger word size than the editor.
- Truncation, requantisation and many potential signal-processing errors in the editor itself.
- Truncation and requantisation if the editor has a larger word size than the final carrier.
- Truncation and requantisation mastering house processes the material (e.g. gain shift, dc filtering etc.).

It is well established that applying dither with triangular probability distribution of ± 1 LSB to a quantisation process results in perfect linearity, contributes no noise modulation and permits resolution of signal elements below the LSB. It is therefore the ideal tool to achieve transparent processing.

Unfortunately, although this process is generally understood, it is not common practise to employ correct dithering procedures at these stages. In fact, practising engineers are often under the misapprehension that dither is only needed once in a system, or that if there is sufficient noise in a recording then further dither will not be needed*.* This is an important ***misunderstanding*** that has so often led to lost quality in recordings.

518 provides two additive triangular probability-distribution dither forms – flat and high-pass. The essential difference between them is that H.P. dither has a lower subjective noise-floor, being about 3.5dB less audible than additive white dither.

Both spectra are illustrated in Appendix 1.

Noise Shaping with dither

Noise-shaping is a technique in which a filtered version of the quantisation error plus dither is fed back and subtracted from the quantiser input. By this technique, the total noise can be redistributed, moving the noise from spectral regions where the listener is sensitive to other regions where they are less audible.

In 518 we provide four different shapers; they are carefully selected for their different properties, each optimised for a different application.

Dynamic Range

The dynamic range of a digital channel is defined by the maximum level – often referred to as full-scale or 0dBFS – and by the quantisation noise floor which is itself determined by the sample word-length. A normal TPDF dithered quantisation introduces a benign uncorrelated addition to the noise-floor.

A background to this and a method of calculating dynamic range is given in the paper [2] referred to on page 31 of this manual.

From a users point of view, the noise-floor is determined by the number of bits; the subjective noise-floor is determined by the spectrum of the noise, i.e. the shaper used.

The most important application where maximising subjective dynamic-range occurs is in a word-size reduction. Here the correct strategy for maximising dynamic range is to use the **Gain** feature of 518 to raise the overall recording so that it nearly reaches full-scale. (This can be done by playing the recording and monitoring with a peak-hold indicator the maximum level; then replay increasing the gain sufficient to raise the peak to say -1dBFS).

Further maximising of the subjective dynamic-range can occur by minimising the impact of the added noise using a shaper. For example, if a 20-bit original recording achieved a peak level of -4dBFS, then transferring it to a CD using **Gain** +3dB and **Shape B** could result in a 19-bit subjective dynamic range on the CD. Transferring it without 518, i.e. by truncation, will reduce the recording to 15 bit with unpleasant low-level artefacts.

Pre and De-emphasis

The use of pre and de-emphasis as signal-processing means of optimising the subjective dynamic range of analogue channels, should be quite familiar ideas to audio engineers. In particular, pre and de-emphasis have been used in channels where the analogue noise level showed an increasing level with frequency, e.g. magnetic tape, shellac or vinyl grooves and Frequency Modulation. In all these cases, a well-documented property of music and speech is exploited, namely that for material microphoned at normal listening positions, and of acoustic

source, the average and peak spectrum level declines with frequency above a few kHz. Best use is therefore made of the channel by pre-emphasising high-frequency signals to an extent where they are more likely to occupy the capacity of the channel. De-emphasis is applied on replay or reception and has the dual benefit of reducing noise and distortion from the preceding chain.

So far, all linear PCM standards used for digital audio permit the use of pre and de-emphasis; the universal characteristic being 50/15uS. Probably this standard came into play originally because it helped to alleviate the very real problems of linearity in early A/D and D/A converters.

More recently, the use of pre-emphasis has been neglected in digital audio. The main reasons for this being:

- prejudice based on the very considerable difficulty of designing a transparent analogue pre-emphasis module in a microphone preamplifier.

- the much-improved quality of A/D and D/A converters.

- the availability of A/D conversion with more significant bits than the distribution channel (e.g. CD 16 bits).

This trend is mistaken, and for suitable material and conditions, a very real benefit can be obtained using pre-emphasis. The improvements with 518 are unique since the noise-shaping is *designed for that circumstance* and the pre-emphasis is effected in the DSP.

If we used pre-emphasis on the example of the previous section, the resulting CD could have a subjective dynamic range of 20 bits.

Simple rules for using 518

This section lays out some simple rules for using 518 in three different circumstances.

A step-down in sample word size

A step-down in sample word size while applying noise-shaping to give the channel a subjective dynamic range as close as possible to the input data. Such applications include transferring e.g. 20 bit masters to a 16 bit carrier like CD. In these cases:

- Use Gain to bring peak level as close to full-scale as possible

- If the programme material permits, use pre-emphasis

- Use **Shape B, C** or **D** unless there is to be significant subsequent editing – in which case use either **Shape A** or high-pass dither.

No change in sample size

Modification of a signal in a channel where the same number of bits are used to define the input and output data. In this case we should be concerned with minimising the impact on the subjective dynamic range of the output signal. In these cases:

- Use Gain to bring peak level as close to full-scale as possible

- If the programme material permits, use pre-emphasis

- Use **Shape A** or high-pass dither.

Step up in dynamic range

Shifting incoming data to allow the output to have potential for a subjective dynamic range that exceeds the input data without increasing

the dynamic range of the signal itself. A typical application may be a full-range DSP volume control, where e.g. a 16 bit input is modified by a gain control function and passed out to a DAC of 18 or 20 bits. In these cases:

- If the programme material permits, use pre-emphasis

- Use **Shape A** or high-pass dither.

Additional technical information

Specification

Inputs	3 cable and one TOSLINK optical. Digital serial interface to AES/EBU or SPDIF 2 channels up to 24 significant bits
Outputs	Digital serial interface to AES/EBU or SPDIF 2 channels up to 24 significant bits.
Sampling Frequency	32kHz – 48kHz.
Twin PLL	Second phase-lock loop minimises jitter at 44.1kHz to approx. 3pS rms.
Input word selection	16, 18, 20, 22, 24 bits
Output word selection	16, 18, 20, 22, 24 bits
Channel status	Output selectable professional or consumer
Dither options	Additive white spectrum TPDF Additive high-pass spectrum TPDF
Noise shapers	5 specific types offered, optimised for each sampling frequency, with and without pre-emphasis and for MAF and MAP hearing thresholds.
Processing	Gain control in 1dB steps from +12 to –99dB Digital-domain pre-emphasis Digital-domain de-emphasis
Accuracy	72 bit internal precision
Display	Gain, processing mode, dither, incoming emphasis, clipping.
Digital Subcode	Channel status only
Controls	Source, Display, DSP, Dither, In, Out, Gain
Dimensions	325 x 100 x 320mm, (12.9 x 3.9 x 12.6")
Weight	5 kg (10 lb.)

Help!

Standby point not lit

Check the following:

1. There is AC power connected to the socket on the rear of the 518
2. The power switch on the rear panel of the 518 is turned on

If the 518 will still not illuminate, check any fuses in your power supply and the fuse in the inlet of the 518. If these are all intact, contact your dealer.

Audible hiss at high volume settings

The input dynamic range of any recordings you have are at maximum 16 bit. The reason for this is that CD and other consumer sources use a 16 bit standard. The analogue sources you have cannot achieve this kind of range. For comparison, analogue sources are likely to be of the order of:

*   FM Radio, 13 bits
*   Reel-reel tape, 13 bits
*   Cassette tape, 12 bits
*   LP, 11 bits.

Note that there may be a difference between the dynamic-range of the source channel when it is operating, and the noise you hear in *Standby*. For example LP normally has lower noise when the stylus is not in the groove; similarly tape will be quieter when it is stopped. CD may also be quieter when it is stopped, producing so-called 'digital silence'.

The 518 has a 16 bit capability from input to output on analogue sources. When the volume is turned up high you may hear this dither as a hiss when the sources are stopped. This hiss is lower than the background noise of your recordings and is of no consequence.

No output with Meridian 565, DSP speaker or DAC

Many consumer products will mute when fed a signal in Professional format. If you have no sound – try setting Out to C.

No time display with Meridian DSP speaker

518 removes unnecessary subcode as a method of reducing jitter and therefore improving sound quality.

Because 518 does not pass on subcode, the time display feature on DSP5000 or DSP6000 becomes disabled. However the Meridian Comms system keeps the speaker updated on the current track number.

Communications not working between 518 and other Meridian products.

If you have this problem check the connections carefully.

Are you using a mix of 200 and 500 mode units?

Radio interference

NOTE 518 is a digital audio and computing device which has been de-signed to very high standards of electromagnetic compatibility.

FCC WARNING: This equipment generates and can radiate radio frequency energy and if not installed and used correctly in accordance with our instructions may cause interference to radio communications or radio and television reception. It has been type-tested and complies with the limits set out in Subpart J, Part 15 of FCC rules for a Class B computing device. These limits are intended to provide reasonable protection against such interference in home installations.

If this equipment does cause or suffer from interference to/from radio or television reception then the following measures should be tried:

1. Reorient the receiving aerial (or antenna) or route the antenna cable of the receiver as far as possible from the 518 and its cabling.
2. Ensure that the receiver uses well-screened antenna cable.
3. Relocate the receiver with respect to the 518.
4. Connect the receiver and this product to different AC outlets.
5. If the problem persists contact your dealer.

EEC This product has been designed to comply with the limits set out in EN55013 and EN55020C.

REMEMBER to switch all units off before changing any connections.

Cleaning

When cleaning the 518 bear in mind that the front of the unit is plastic, and the display panel and top surface are glass.

Disconnect the power cord before cleaning the unit.

Note Do not use abrasive cleaners on any part of the 518.

Maintenance & Service

The *Meridian* 500 Series of hi-fi components have been carefully designed to give years of untroubled service, and there are no user-serviceable parts inside the case, nor do the units require any form of maintenance.

In the unlikely event that your 518 fails to function correctly, it should be returned, in its original packing, to your *Meridian* dealer. In case of difficulty within the UK or USA please contact our sales and service offices shown on page 4.

Outside the UK: contact the importing agent for the territory. A list of *Meridian* agents abroad is available from the above address.

No responsibility can be accepted for the 518 whilst in transit to the factory or an agent and customers are, therefore, advised to insure the unit.

Part 3

Appendix 1 – Noise Shapes

The graphs in this appendix show the relative noise spectra in dB for the different shapers, compared with the flat-spectrum dither level for the same word-size.
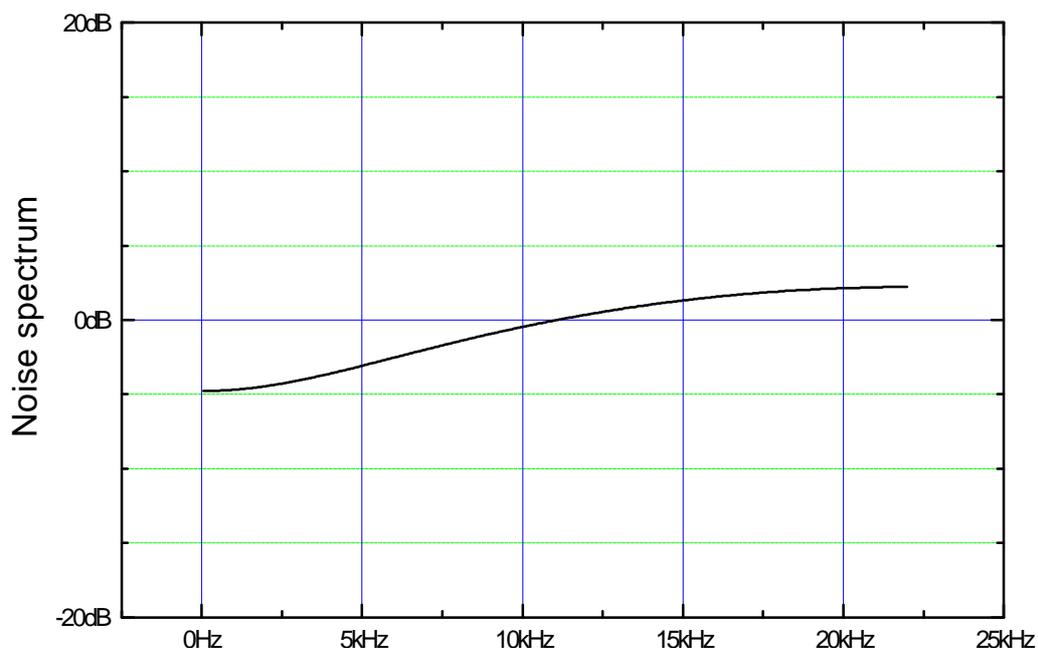
Above: noise spectrum using High-Pass additive TPDF dither at 44.1kHz
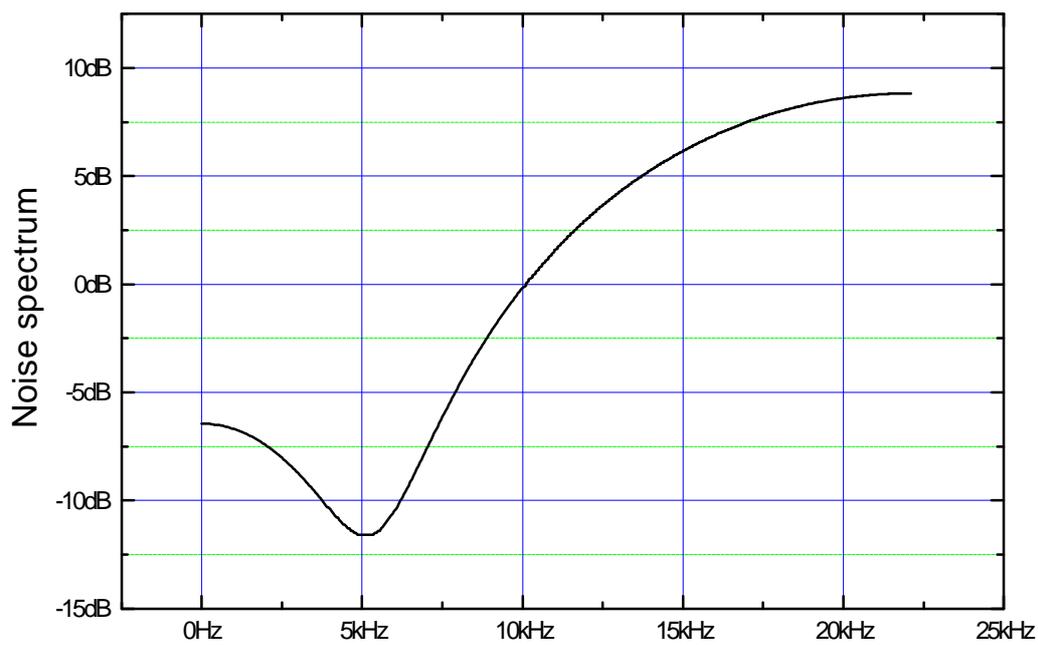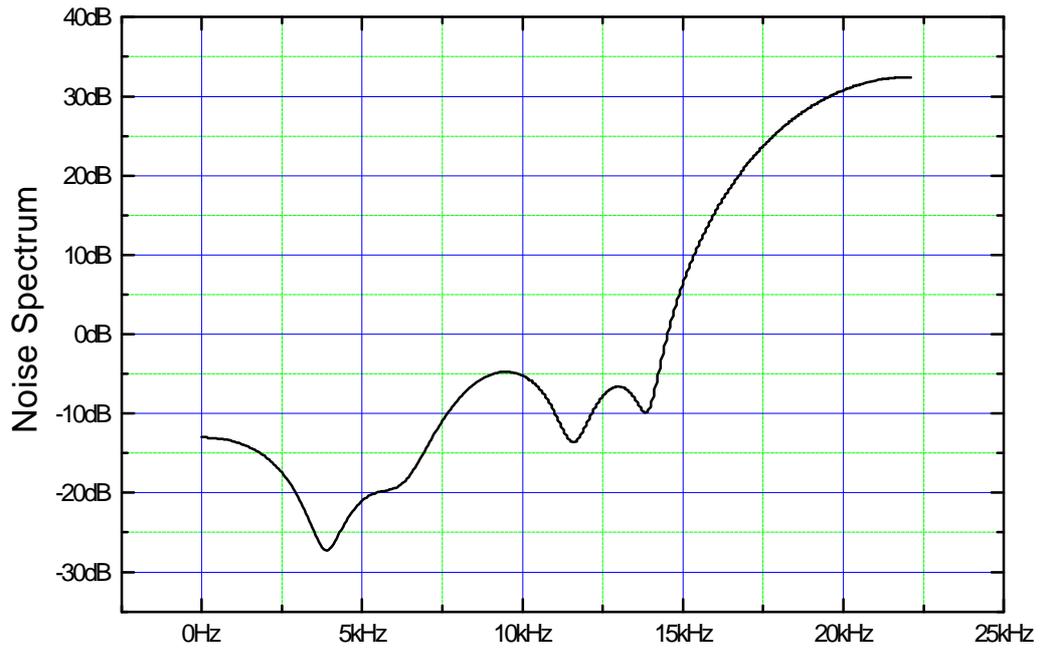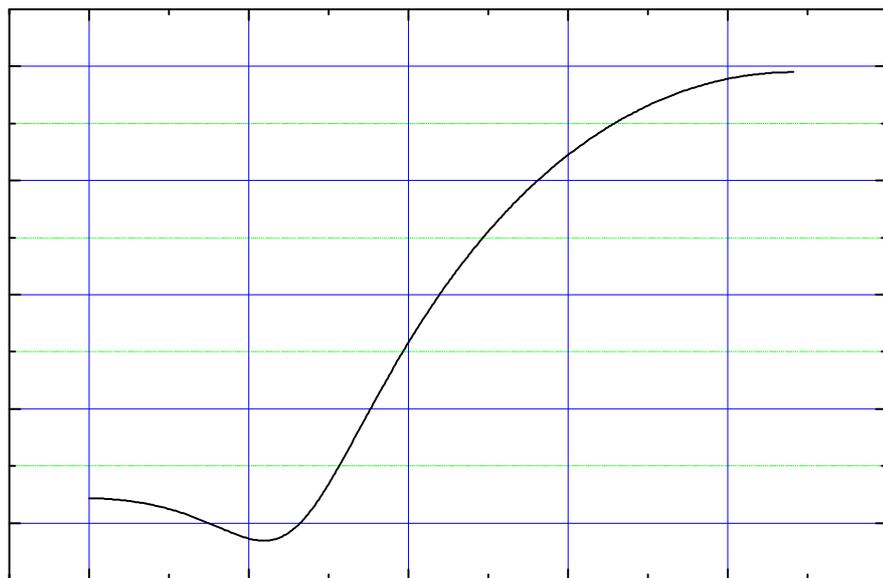

Above: noise spectrum for Shape A at 44.1kHz.
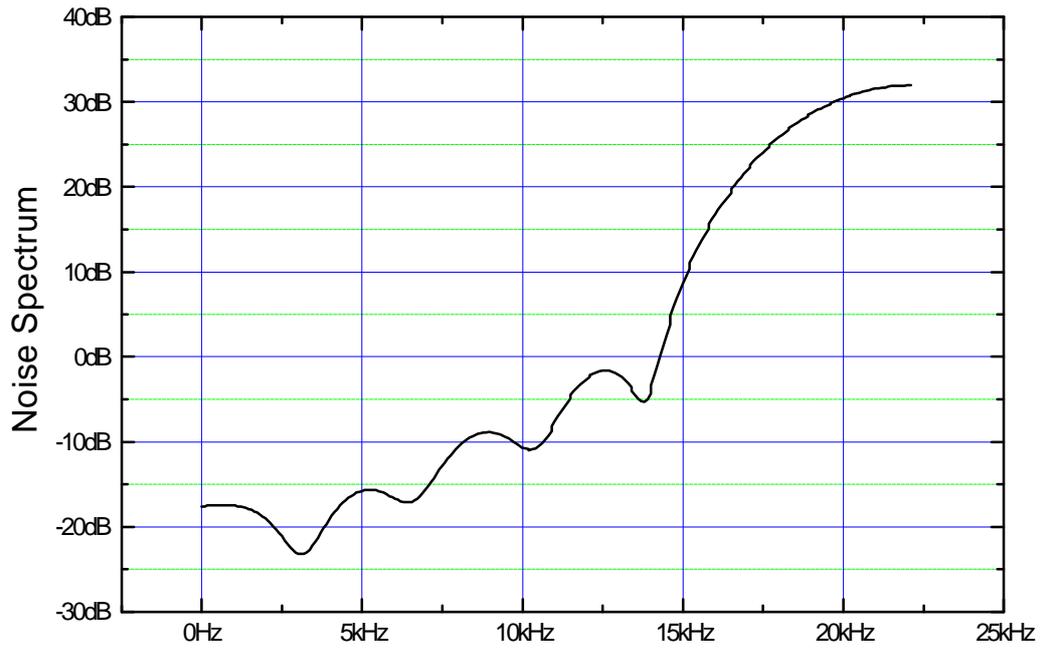
Above: noise spectrum for Shape B at 44.1kHz

Above: noise spectrum for Shape C at 44.1kHz

Above: noise spectrum of shape D at 44.1kHz.

Above: noise spectrum of shape E at 44.1kHz.

Appendix 2 – Hints on Mastering with noise-shaping

There are a few difficulties associated with employing noise-shaping schemes to maximise the subjective dynamic-range of a digital audio channel. These are now reviewed.

Vulnerability of the signal

The available dynamic range in a channel is only as wide as the narrowest step. No matter how much care is taken with a recording, or to maintain the maximum word-size right up to a noise-shaped dithered truncation to e.g. 16 bits, the whole benefit can be thrown away if at that stage a non-dithered signal process is carried out on the material. This is not unheard of, a mastering house may e.g. choose to pass the signal through an undithered dc filter!

This caution simply says that every process on the signal leading up to delivery to the customer has to be reviewed for its impact on the noise-floor and transparency. Such errors will be cumulative, but just one will destroy any dynamic-range enhancements.

Audible results of digital errors and editing

Normal digital channels have provision for error detection and correction. In sophisticated apparatus, short bursts of erroneous samples are interpolated to reduce the audible effect. It is becoming more common in CD replay systems, that the only error handling is a first-order hold; that is when the system detects an erroneous sample, the previous valid sample is output in its place.

This trend has partly been a response to the fact that errors on CD tend to be single missing samples at an acceptably low rate. There are however marked variations in this performance between players.

On normal music this strategy results in a minor modification to the waveform and it usually passes unnoticed. The introduced sample is of similar size to the signal, and is therefore readily incorporated or masked. On normal material we also notice that errors occurring in silent passages result in near-zero additions which tend to be inaudible.

Let us now consider the circumstance where a signal has been passed through a noise-shaper with a function like **Shape D**. In loud passages errors will be masked just as the normal circumstance. However channel errors occurring in quiet or silent passages will tend to result in an audible click (since the HF noise is boosted) with little or no material to mask it.

A similar problem pertains to editing 'shaped' material in quiet passages. The requirement exists to maintain apparent continuity in the shaped noise. We have observed clicks due to replay errors when shaped material is re-played on cheap CD players, but no difficulty at all on reasonable or up-market units.

Requirements for D/A conversion

Noise-shaping can be used to extend the audible dynamic range of a channel beyond that which would be expected for a normal digital channel of the same word-size. The essential principle by which this is achieved is representing numbers below the LSB as an average of successive bracketing numbers. For this system to work, the channel must exhibit *differential* linearity equal to the resolution required.

We can illustrate this best by example. Let us assume that a signal has been encoded with 20-bit precision and that a shaper type D has been used to convey this signal onto a 16 bit CD channel. Measurement in the digital domain shows very clearly the success with which the subjective

dynamic range is extended. Implicit in this theory is the fact that the digital channel has near-infinite differential linearity, i.e. each bit has a magnitude precisely twice or half the magnitude of the next.

When this signal is applied to a D/A converter some problems may arise. First the D/A process may be associated with an oversampling digital filter. Commonly these parts take no precautions with regard to dither and introduce a quantisation noise-floor themselves at the approximate level of the LSB in the filter, thereby obliterating lower-level information in the signal. Secondly the D/A converter will not have perfect differential linearity – there is no longer any reason why successive bits will maintain a precise 2:1 ratio. The effect of this is also equivalent to quantisation at the linearity level of the converter.

In summary therefore, the wide subjective dynamic range inherent in the recording cannot be reproduced unless the replay D/A system has both a word-size (in terms of associated oversampling filters) and a differential linearity equivalent to the original material, which in this example was 20 bit. The result would be further improved by the correct use of dither and noise-shaping in the digital filter.

That a subjective channel dynamic range of approaching 20 bit can be conveyed on a 16 bit channel is quite remarkable. On reflection, it should not be surprising that to realise this benefit, both the A/D and D/A sub-systems must have the required 20-bit precision.

Appendix 3 – RS232

The 518 may be operated via its RS232 interface.

Set the communication settings as follows:

- Baud rate 9600
- Data bits 8
- Stop bit 1
- Parity none

The 518 is operated by sending short command strings on the RS232 interface. Each command is terminated by a <return> (dec. 13). No echo is implemented. Any subsequent <return> on its own repeats the last command.

518 returns useful strings acknowledging the command and giving status information.

Handset Functions

The following commands emulate the MSR remote control keys.

Sources send one of: CD, RD, LP, TV, T1, T2, CR, CB, TX, V1, V2, LD

Numbers send one of: N1, N2, N3, N4, N5, N6, N7, N8, N9, N0, DP (decimal point)

Menus send one of: ML, MR, MP, MM (for **w**, **e**, **n**, **s**.)

Source send one of: PR (previous), PL (play), NE (next), PS (pause), FB (fast back), ST (stop), FF (fast forward), RC (record), RP (repeat)

Memory: SR (store), CL (clear)

Status: DI (display), SB (standby)

Volume: VP (up), VM (down), MU (mute)

GoTo Functions

There are direct access functions that use two-character codes that may be followed by additional numbers or parameters.

VN##	Goto volume number
GN±##	Goto gain number
BP	Goto DSP Bypass
GA	Goto DSP Gain
EM	Goto DSP Emphasis
DE	Goto DSP De-emphasis
DT#	Goto dither # (0=flat, 1= HP, ...6=ShapeE)
IN##	Goto input bits ##
OU##C	Goto output bits ## (Consumer format)
OU##P	Goto output bits ## (Professional format)

Appendix 4 –Resolution Enhancement

Resolution enhancement in 518 depends on six techniques.

1. De-jittering
2. Dynamic-range optimisation with **Gain**
3. Dynamic-range optimisation with **Pre-emphasis**.
4. Dynamic-range optimisation with Noise-shaped **Dither**.
5. DAC enhancement by using high-frequency dither.
6. DAC or channel enhancement by word-length matching.

Jitter and de-jittering

Digital audio works by representing the acoustic waveform by a series of evenly-spaced sample words. In digital-audio systems, it is quite possible – in fact usual – for the data to pass without error. Unfortunately, where the data is passed from process to process, the exact even timing of the samples may become disturbed so that the samples arrive occasionally slightly early or late. inaccuracy in the timing of the incoming stream is called 'jitter' – and Meridian have been skilled at dealing with this since 1983.

When a jittered digital stream is fed to a DAC, the sound is degraded – typically a listener will describe it as 'harsh', 'glassy' or 'bright' or lacking in 'spaciousness'.

The de-jittering element is of great importance to some CD players, and of enormous significance to any LaserDisc player as they tend to have relatively high-jitter output. If you want to use a LaserDisc player for serious CD listening, then the de-jittering in 518 is absolutely necessary.

Another interesting aspect of jitter is that the current AES/EBU and SPDIF interfaces use coding that causes some signal-dependent jitter to be introduced. So, we can de-jitter a stream, but if it is then passed through a series of digital interfaces then it will almost certainly benefit from de-jittering again. Now, jitter does no harm in the digital domain: it is *only* important that the stream be correct going into the final converter – which in a Meridian system may be a DAC like 563, a Surround Processor like 565 or a DSP loudspeaker.
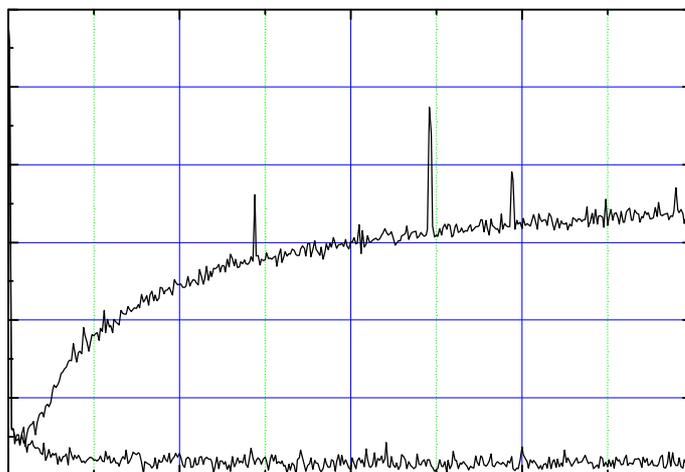
Figure 1. Showing jitter spectrum of twin PLL.

The block diagram on page 7 shows the twin phase-lock-loop which 518 uses to smooth out the digital sample stream. Each loop acts as a progressive 'flywheel' – following the average sample rate exactly – but removing short-term speed unevenness.

Dynamic-range

The dynamic range of a channel or system is determined by the ratio between the loudest signal it will carry without distortion and the background noise.

For digital signals the loudest signal – full output of the channel – is called full-scale and this level uses all the available bits.

In a system using digital components, the background noise may be determined by:

- the analogue input signal

- the analogue output components like DAC, preamp or power amp

- the smallest word-size in the digital chain.

For digital systems to be transparent, dither is needed – this is described on page 37. Whether the dither is added at the analogue–digital conversion stage or later, it produces a defined noise-floor.
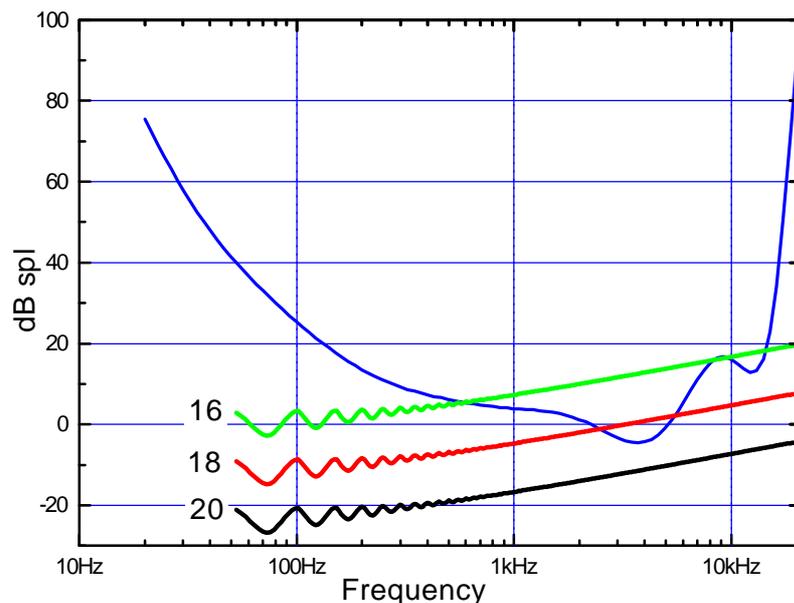
Figure 2. Showing audibility of noise in dithered channels of different wordsize at very high listening levels.

In the diagram above, an audio system has been modelled for the loudest reasonable listening circumstance – where peak levels reach 120dB spl. The 'U'-shaped curve is the threshold of human hearing – sounds below this are inaudible. The three curves show the human-audible-significance of the dither level in 16, 18 and 20 bit channels. The diagram shows that for a digital audio system to reproduce the whole scope of human hearing without noise – 19 bits are needed.

For interest and comparison, the diagram below compares this circumstance with LP records where the playback is set for 115dB maximum.
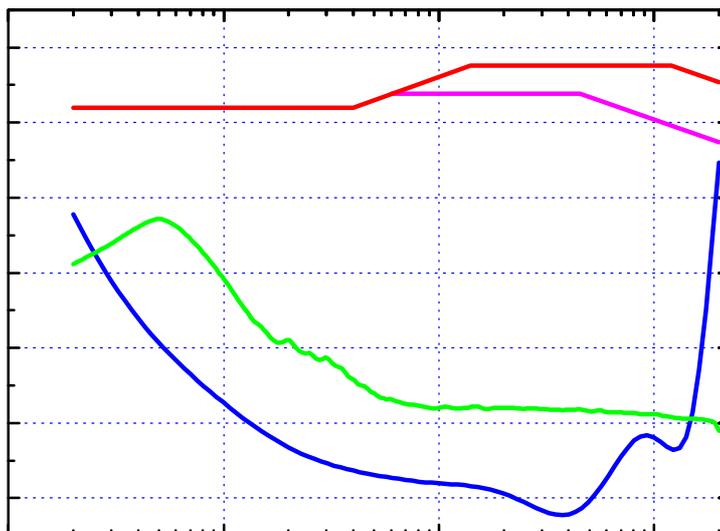
Figure 3. Showing the audibility of noise in the LP system for comparison with digital channels.

Dynamic-range optimisation with Gain

The noise-floor of a digital system is determined absolutely by the lowest preceding wordsize. For nearly all commercial material this is 16 bits.

518 allows you to get the best out of whatever comes next, by making sure that the full output capability is used. **Gain** can be used in Resolution Enhancement and Mastering to boost the level of the signal to fill the available capacity.

For some reason, many CDs are recorded well below maximum level. By boosting these we are able to reduce the audible effect of noise in subsequent processing, or digital filters in DACs, or in the analogue electronics.

Getting this right is easy – 518 immediately tells you if had to 'clip' the output because you asked for too much. See page 18.

Dynamic-range optimisation with Pre-emphasis

Real-world music and speech signals do not have equal energy at all frequencies. Typically the loudest sounds happen in the mid-range and peak levels are much reduced above 5kHz.

This fact has been exploited extensively in audio systems over the years, with a system known as pre-emphasis.

Using Pre-emphasis and de-emphasis to improve channel performance

The diagram above shows the general pre-emphasis method. To take best advantage of the channel – which could be an AM or FM radio link, an LP record, a tape recording, a CD or a DAC – high-frequency signals

are boosted. This boost process is called pre-emphasis. Now, in the channel, the energy is more evenly distributed with frequency, and any high-frequency noise and distortion in the channel is further below the signal. In other words we get a better distortion and noise result in the channel.

Before playing back the signal, we need to de-emphasise it to bring the overall frequency response back to where it should have been. By cutting the high-frequencies back, we also reduce the noise and distortion introduced in the channel.

This process is used everyday for FM broadcast, tape and cassette recording, for LP (RIAA pre- and de-emphasis) and for some CDs.

Now, boosting high frequencies is possible only when the program does not have too much high-frequency content. Obviously anything that has been through a pre- and de-emphasis process has the required spectrum.

The diagram below shows the pre-emphasis and de-emphasis curves for CD – which are the curves used by 518. You can see that the highest frequencies are boosted by nearly 10dB in the channel (on the disc).
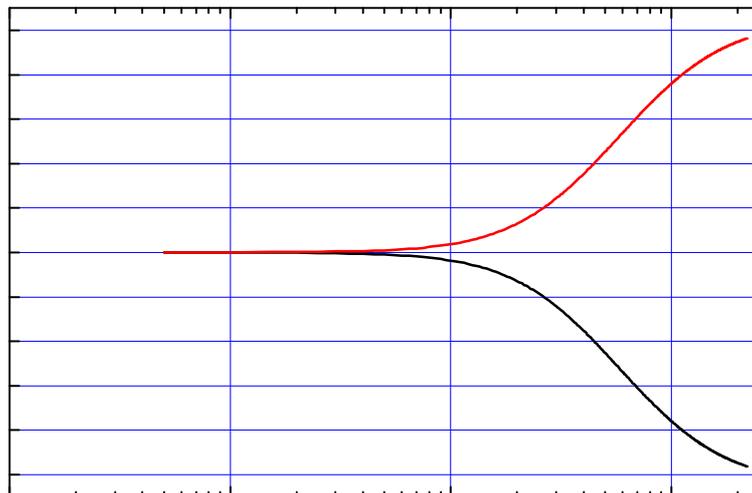
Figure 4. Showing CD pre- and de-emphasis curves.

The 518 obtains resolution enhancement in making CD recordings by using this pre-emphasis. All CD players know how to de-emphasise this signal and recognise the pre-emphasis flag. When a signal coming in to 518 is pre-emphasised, the **Emph** light comes on. When 518 adds pre-emphasis to a signal, the digital audio output stream carries an industry-standard indication of pre-emphasis to tell downstream devices how to handle this signal.

The 518 obtains resolution enhancement in playback systems by boosting the high-frequency signals as it travels through signal processing or the digital filters and conversion parts of a DAC. In the above diagram 'Channel' can be the digital and conversion part of an outboard converter. The last block, 'De-emphasis' is normally in the final analogue sections of the converter.

Well-designed converters use analogue de-emphasis so that all the noise of the digital filters and converter are reduced. There are some cheap implementations around that use digital-de-emphasis. This is bad design and the benefits of this type of resolution enhancement are reduced if

such converters are used. Meridian has always used correct analogue de-emphasis in its designs.

By wrapping 72-bit precision pre-emphasis and analogue de-emphasis around a DAC, it effectively gains:

- one bit noise reduction

- two-bit increase in high-frequency resolution

- more than ten-fold (20dB) reduction of converter noise.

These are substantial gains and are clearly audible on a good system.

On some material, using pre-emphasis will raise the overall signal level to give 'clip' messages. It is still a great step forward to use pre-emphasis with some overall gain reduction. In other words, if using pre-emphasis on a piece of music causes clipping, try using **Emphasis** with the gain reduced to –2 or –3dB. You are still winning on resolution with most DACs up to –6dB.
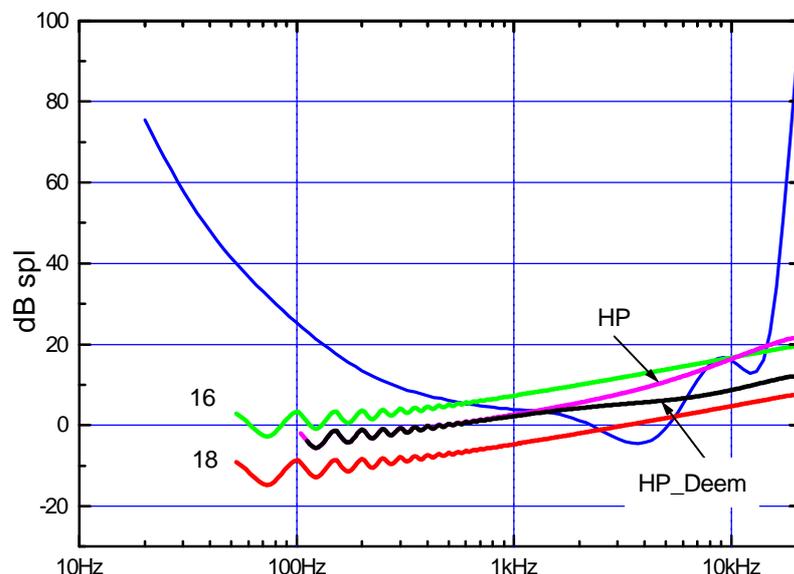
Figure 5. Showing the effect on audibility of the 518's High-pass and Flat dithers. Also showing the noise reduction from de-emphasis.

Dynamic-range optimisation with Noise-shaped Dither

The section following page 37 describes some of the background to noise-shaping.

Essentially noise-shaping works by an averaging method that is well matched to human hearing. The noise-floor of the system is shaped by moving energy from the mid-range – where listeners are most sensitive – to high frequencies. A correctly designed noise-shaper allows the noise of the channel to be made inaudible *and* allows resolution well below the normal wordsize.

The diagram below shows how 518 can obtain inaudible noise *and* effectively 20 bit resolution *on a 16 bit CD*!
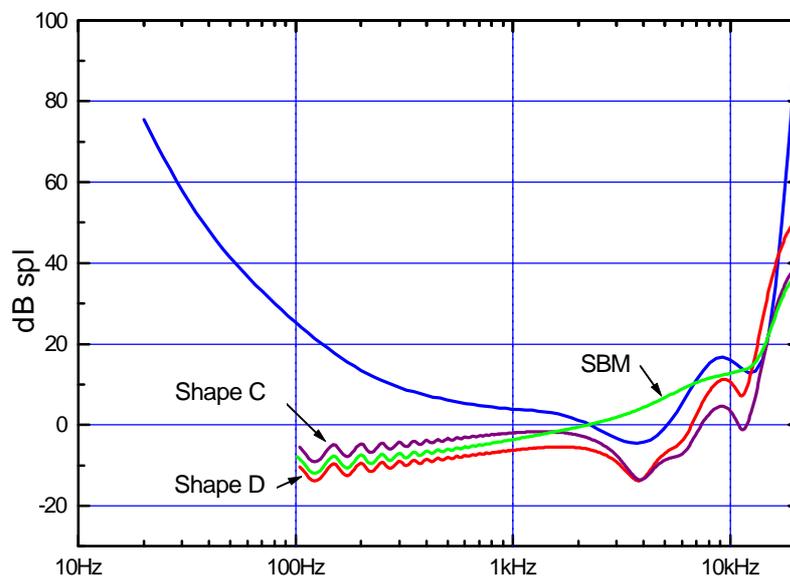
Figure 6. Showing the effect on audibility of the 518's Shapes C and D (C using pre-emphasis).

DAC enhancement by using high-frequency dither

The graphs above and in Appendix 1 (page 43) show that some of the noise-shapers produce quite a lot of supersonic noise. This high level of dither can have a very positive effect on DACs by causing them to represent each level by averaging a large a number of different levels. This high-frequency 'lubricant' tends to smooth out truncation and linearity problems in real-world DACs.

Try the various shapes and see which one you like best in your system.

DAC or channel enhancement by word-length matching

Digital systems work best if the input data is matched to the correct wordsize for the device. Particularly where the signal has a larger wordsize than the following device, then truncation distortion will arise. The effects are real, but more subtle the other way round and are to do with jitter and linearity.

In general 518 should be set to match the input and output wordlengths to the incoming signal and following equipment. That will produce the cleanest sound.

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Notes