

dCS 992
Master Clock

User Manual
Software version 2.0x
January 2001

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¹ *dCS* Ltd is Data Conversion Systems Ltd. Company registered in England No. 2072115

PRODUCT FEATURES

Formats

PCM from 96 kS/s down to 32 kS/s

Formats supported are: AES/EBU (XLR and BNC), Dual AES (XLR) and SDIF-2 Word Clock (BNC).

Syncing

Master mode or can sync to Word Clock or 1MHz, 5MHz or 10MHz GPS source, in Slave mode or Learn mode. Sync to video option available

Functions

High stability Master Clock
High speed or Dual AES (88.2 kS/s, 96 kS/s)
Multiple sample rates at the same time
Sync Link operation for multi-channel operation

Test Generator

High quality signal generator.

Ease of Use

Setups
Remembers last settings
Lockouts

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About this Manual

Note that there is a **Full Contents** at the end of the manual (page **71**), along with an index and lists of figures and tables.

References to other sections in the appear as **Section Name** page These are hyperlinks in the softcopy version of the manual.

IMPORTANT!

Important information is presented like this - ignoring this may cause you to damage the unit, or invalidate the warranty.

The manual is designed to be helpful. If there are points you feel we could cover better, or that we have missed out - please tell us.

USING YOUR *dCS 992* FOR THE FIRST TIME

Product Overview

The *dCS 992* Master Clock is a high stability reference generator designed for studio and live recording applications. It is designed to generate multiple outputs at all commonly used sample rates, and it can output many different sample rates simultaneously – allowing all the components of a multiple sample rate digital audio system to be synchronised. The unit can operate in Master mode from its own TCXOs², or can slave to an external source, such as GPS. It can “learn” the frequency of the external source, such that if this is interrupted for any reason, the unit carries on seamlessly at the learnt frequency. If the external reference reappears, the unit re-acquires lock in a very gradual and graceful manner, such that any recording work is not interrupted.

The unit provides reference clocks to support systems sampling from 32kS/s to 192kS/s or DSD, via AES3 or SDIF-2 Word Clock formats. It also offers a variety of “Superclock” options.

The unit is a sophisticated and powerful frequency synthesiser, with many options. It may be controlled from its front panel, but we recommend that it be set up using the Remote software, running on a PC – perhaps at base. These setups may then be stored in the *dCS 992*, and recalled from its front panel without a PC, perhaps on location. We strongly recommend this mode of operation. The unit is pre-loaded at *dCS* with a small set of useful setups in safe stores.

It is mains powered and is housed in a 1U (46mm) high 19” rack mounting case. The unit is highly software based, and more functions and features will be added from time to time. Software updates from *dCS* are free!³

What’s in the Box?

The contents of the box are at least:

- dCS 992*
- User Manual
- Control Summary
- Mains Lead
- 2 Spare Fuses
- Floppy disk with Remote software
- Remote cable

Mains Voltages

The *dCS 992* is shipped with its mains voltage preset for operation in the destination country. The voltage is not intended to be changed by the user. If it needs to be changed, contact your dealer or *dCS*.

² TCXO stands for Temperature Compensated Crystal Oscillator

³ free if we email them, and you download from a PC COM port. Low cost if you ask us for EPROMs or other media - we charge for media and handling.

Installing Unit in a Rack

The unit is supplied with 19" rack mount ears fitted. If it is to be installed in a 19" rack, the ears supplied may be used to locate it in the rack - but:

IMPORTANT!

The ears should not be used as the only mechanical support. The unit should rest on a shelf, or be supported in some other way. The ears will just locate it in the rack, and stop it sliding forwards.

If the unit is not to be rack mounted, the ears may be removed.

Getting Started

Here's what to do:

do this: Check the appropriate mains supply for your local mains is marked on the rear panel.

do this: If it is, using the lead supplied, connect the unit to the mains - connect no other leads at this stage - and switch on.

The 7-segment display will briefly show:

- - - - 4

and then the sample rate, for example:

9 6

do this:

do this: Connect an output (e.g. from **Word Clock Out 1**) to the Reference input of an ADC or DDC in your system. If you lock a DAC to the Master Clock, ensure the source driving the DAC is locked to it as well.

do this: Press the **Sample Rate** button (left hand end button) repeatedly until the sample rate you want is displayed.

do this: If your system is running Dual AES at 88.2 or 96kS/s, press the **Output Format** button until the indicator beside it changes to **2**, otherwise set it to **1**. Dual AES requires only one Reference connection.

Set up like this, the *dCS 992* will operate in Master mode, and the system it is connected to will (have to) lock to it. You should have audio.

Note that all the outputs are active simultaneously on the *dCS 992* and may all be connected to external equipment simultaneously if required.

Now you will need to familiarise yourself with how the front panel controls and the menu system work.

do this: Read the short section **The Software – the Menu** on page **18** so you know how the buttons and menu work.

You may also find it convenient to refer to the **Control Summary** sheet while you are getting to know the unit.

If the unit does not behave the first time you power up – contact your dealer, or *dCS*.

THE HARDWARE – ARCHITECTURE, CONTROLS AND CONNECTORS

dCS 992 Architecture

The *dCS 992* is capable of generating some extremely complex clocking arrangements. To help understand some of its features, the architecture is described below.

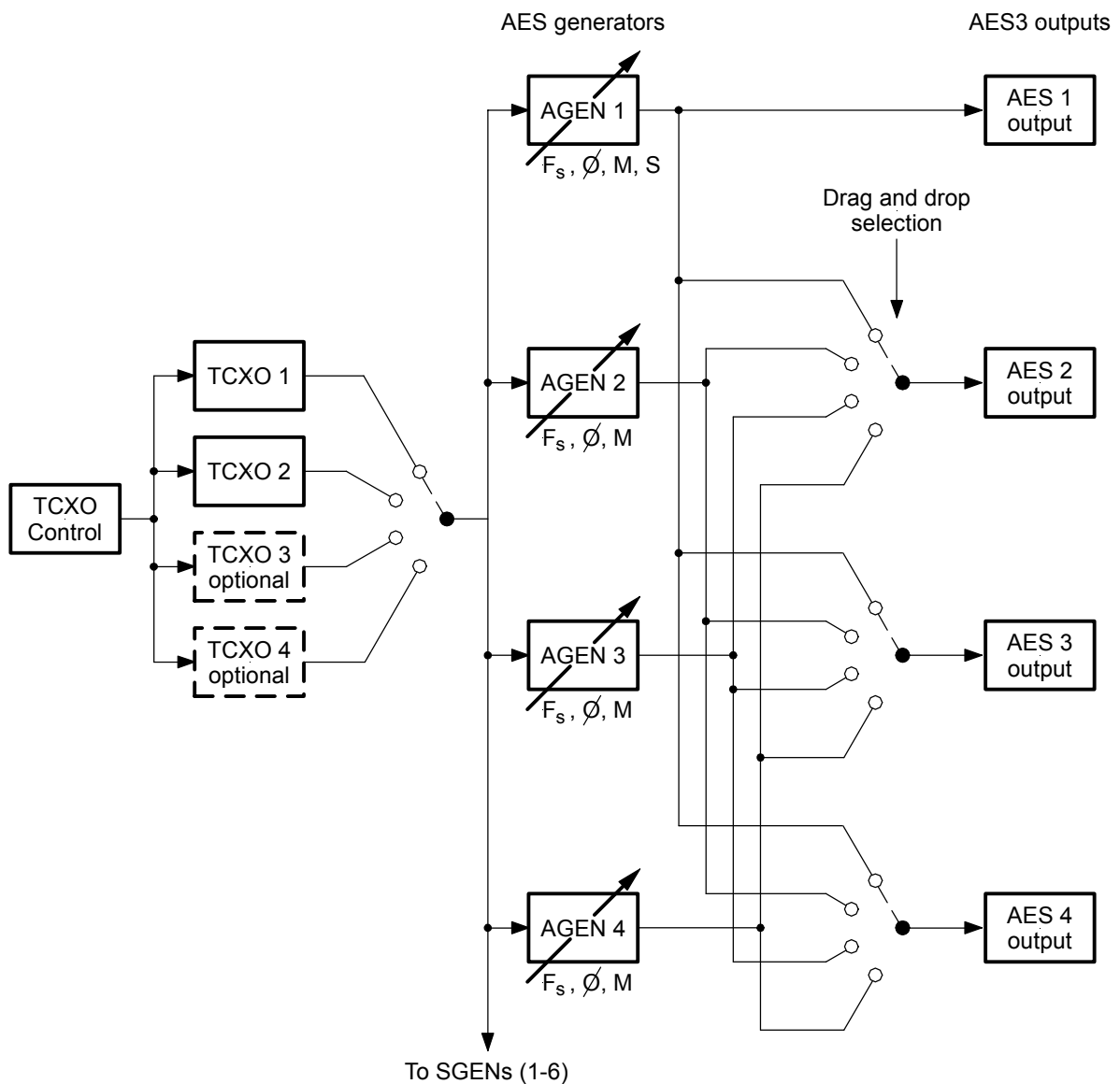


Figure 1 – Internal clocking, AGEN generators and AES3 output matrix

F_s = Sample Rate, ϕ = Phase, M = AES3 message, S = Signal (tone)

TCXOs and AGENs

The unit contains several TCXOs, only one of which is active at any time. The active one is temperature compensated and controlled by a DSP. Its output is routed to four independent⁴ AGEN AES3 generators (AGEN 1–4). The **AES 1** output is always connected to AGEN 1 – all other AES3 outputs (**AES 2 - 4**) may be connected to any AGEN – they can all be driven by AGEN 1, or they can have one each, or anything in between. AGENs can be programmed for sample rate, output phase, AES3 message content, and (in the case of AGEN 1) the audio signal it carries.

AGEN 1 is special – its output sample rate determines which TCXO is used. It will have the lowest jitter. If other AGEN sample rates are set to integer multiples or sub-multiples of AGEN 1's, then they have negligible jitter. If, however, they are set to sample rates with complex relationships to AGEN 1, then the DDS used to generate them will dither the transition times, generating jitter. If, for example, AGEN 1 is set to 48kS/s, and AGEN 2 is set to 44.1kS/s, then the output of AGEN 2 will have about 44 nsecs of jitter on its edges. Although this sounds a lot, it is high frequency noise shaped jitter that is easily rejected by a receiving PLL, and is well within the requirements of the AES3 data eye spec.

AGEN 1 is also special in that it has a tone generator associated with it, so that it can have an audio tone superimposed on it. The other AGENs cannot.

Can be programmed for	AGEN 1	AGEN 2	AGEN 3	AGEN 4
Sample Rate (Fs)	yes	yes	yes	yes
Phase (Φ)	yes	yes	yes	yes
AES3 Message (M)	yes	yes	yes	yes
Signal from tone generator (S)	yes	No – digital silence	No – digital silence	No – digital silence

Table 1 – AGENs, and what can be programmed

⁴ There are some restrictions on independence to do with 32kS/s operations

SGENs

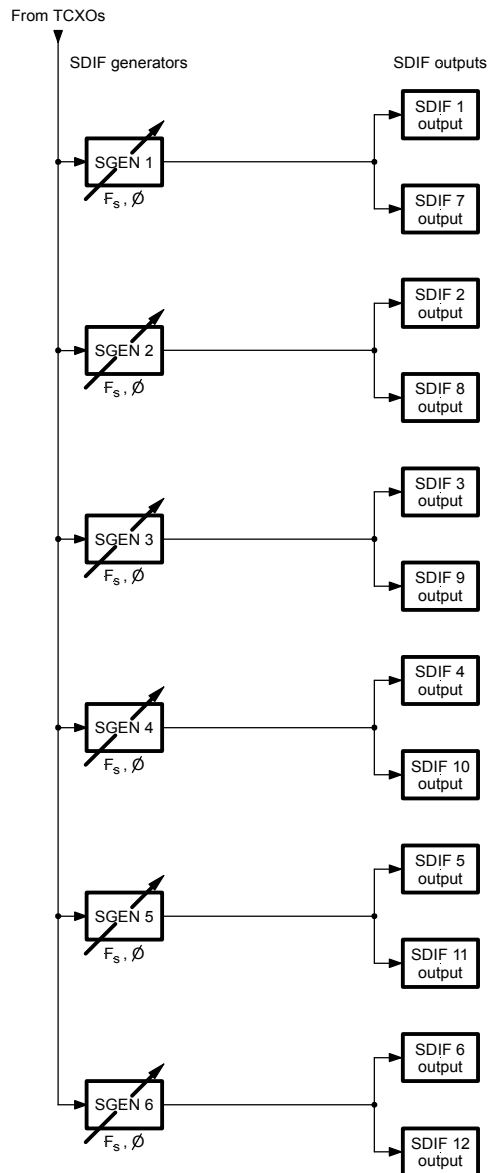


Figure 2 – SGEN generators and Word clock outputs

The unit also contains six independent SGEN word clock generators, that are routed (with no flexibility) to pairs of SDIF-2 (BNC) word clock outputs. The signals coming out of these can be independent, or linked to AGEN 1. Multiples of the normal word clock output rates can be selected (“Superclocks”) up to 12.288 MHz (or 11.2896 MHz – the 256 F_s superclock).

Sync Link

The *dCS 992* is capable of Sync Link operation with *dCS 972s* – see **Figure 14** on page **41**. This operates for all supported sample rates of 44.1kS/s or higher⁵ (so 48kS/s, 88.2kS/s, 96kS/s, 176.4kS/s, 192kS/s are all okay), and needs no additional setting up.

⁵ If you need it to operate at other frequencies, contact *dCS*

Rear Panel

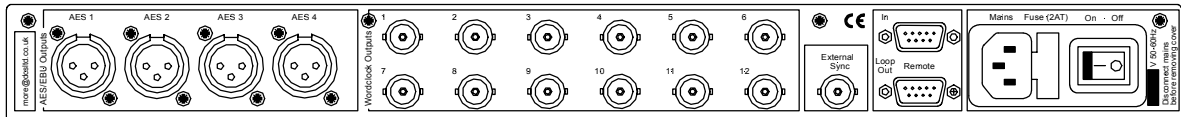


Figure 3 – Rear Panel

All input and output connectors are mounted on the rear panel. Individual connectors are clearly identified by the panel legend. Viewed from the rear from left to right, the connectors are as follows:

AES 1, 2, 3 & 4 Clock Outputs **3 pin XLR male (4 off)**

These may be used as four independent AES/EBU outputs in single wire format or 2 Dual AES pairs (**AES 1 & 2** and **AES 3 & 4**) in two wire format.

In master clock applications, any of the 4 outputs may be used as a reference source since the (single) AES Reference Input on the destination equipment will ignore the Channel 1 / Channel 2 message. While using the Test Generator in Dual AES mode, these outputs must be used in pairs to drive a Dual AES input for correct operation.

The outputs may be tied together, or independently programmed.

SDIF-2 Word Clock 1 – 12 Outputs **BNC (12 off)**

12 independent Word Clock outputs. They may be programmed in pairs, or linked together.

External Sync Input **BNC**

The unit may be slaved to an external Word Clock or a 1MHz, 5MHz or 10MHz GPS or laboratory reference connected to this input. The unit auto detects 1MHz, 5MHz or 10MHz.

Remote In & Loop Out **9 pin D type male (2 off)**

These are for use with the Windows™ - based Remote software. If this is in use, connecting **Remote In** to a COM port on a PC running the Remote Control program will allow the unit to be controlled by the PC. **Loop Out** may be connected to another suitably equipped *dCS* unit, allowing several units to be controlled by the same PC. The Remote software will allow the unit to be software upgraded without removing the lid by downloading new software via the **Remote In** connector.

Connect up Remote ports using a 9-way screened cable, fitted with 9-way 'D'-type female connectors at each end, wired pin 1 to pin 1, pin 2 to pin 2, etc. The same type of cable can be used unit to unit as com port to first unit. Suitable cables are available from *dCS*.

Mains Supply **3 pin IEC (CEE22)**

Switched, fused and filtered IEC mains connector.

Additional Information

As well as connectors, the rear panel displays the following information about the unit, near the mains supply connector:

Mains Voltage The actual voltage setting supplied.

Model Number *dCS 992*

Manufacturers Name and Country of origin (*dCS* Ltd, UK)

There will be a label on the underside of the unit that contains a number such as 992-4B1-6B2-2A1-3A2-12345. This is the serial number, but it also contains vital configuration information. We will need this number (all of it) to give you support over the phone, or to ship you software updates.

Front Panel

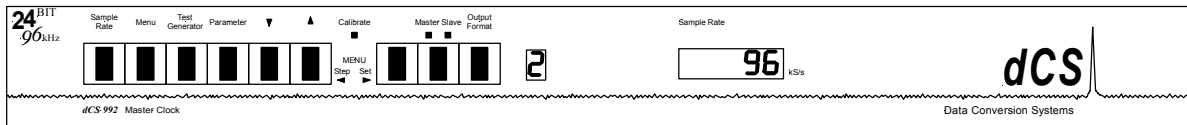


Figure 4 – Front Panel

The *dCS 992* uses a combination of front panel buttons for frequently changed functions and a step through menu for features you might set and forget.

Sample Rate Button

Press the **Sample Rate** button repeatedly to cycle through the sample rates in the order:

96 ... 88.2 ... 48 ... 44.1 ... 32 ... 96 ... etc.

Do not press the button too fast as a delay is built in to the software. The sample rate selected is shown on the LED display in the centre of the panel.

Menu Button

Press the **Menu** button to open the Function Menu, see **The Software – the Menu** on page 18. Press again to step through the menu pages.

Test Generator, Parameter, ↓ and ↑ Buttons

These buttons control the high quality sine wave generator.

do this: Press the **Test Generator** button – **Off** will be displayed for a few seconds. Quickly press **Test Generator** again to turn it **On**.

At power up, the generator is always set to **Off**, **1 kHz** and **-18dB0** to prevent damage to your ears or loudspeakers.

do this: Press the **Parameter** button to select **Level** adjustment. Press the **↑** button repeatedly to increase the tone level in 0.1dB steps up to a maximum of 0.0dB0 (full scale). Press the **↓** button repeatedly to reduce the tone level in 0.1dB steps down to a minimum of -120.0dB0. Hold down the **↓** or **↑** buttons to change level more quickly, the rate accelerates.

do this: Press the **Parameter** button again to select **Frequency** adjustment. Press the **↑** button repeatedly (or hold it down) to increase the tone frequency in 0.1kHz steps from 1kHz to a maximum of 48% of the sample rate. Press the **↓** button repeatedly (or hold it down) to reduce the tone frequency in 10Hz steps from 1kHz to 100Hz. Below 100Hz (0.1kHz), the step size changes to 1Hz until the minimum tone frequency of 1Hz (0.001kHz) is reached.

If a number between 0.0 and -120.0 is displayed, it is a Level. If a number between 0.001 and 47.0 is displayed, it is a Frequency. If in doubt, press the **Parameter** button to see what is selected.

IMPORTANT!

*If the **Output Format** is set to **2**, the Test Generator output should only be taken from the **AES 1 & 2** pair or the **AES 3 & 4** pair to a Dual AES input. There is no data (and so no tone) on SDIF-2 Word Clock outputs.*

The **↑** button may also be used to step through menu pages. See **Entering the Menu** on page **18** for details.

Calibrate indicator

This will light up after the unit has been under power for 6 months to warn you that the calibration guarantee has expired. The unit will continue to operate and the drift in sample frequency caused by crystal ageing may not be important in your application. To have your *dCS 992* re-calibrated, please contact *dCS*. You may be able to re-calibrate your unit locally.

Menu Set Button

Menu **Set**

Press the Menu **Set** button to change a menu option, see **The Software – the Menu** on page **18**.

Master/Slave Button

Menu **Down**

The **Master/Slave** button sets the clocking mode (master, slave, or learn modes) , or in the menu acts as the **Down** button.

Outside the menu, pressing it cycles through:

Master ... Slave ... Learn ... Master ...

In Master mode, the calibrated voltage controlled crystal oscillators (TCXOs) inside the unit generate an accurate sample rate. The LED labelled **Master** will be lit to indicate this.

Slave mode - if an accurate standard reference source, such as GPS⁶ source or an accurate SDIF-2 Word Clock source is available, this may be connected to the **External Sync** connector. To slave the unit to the External Reference, press the **Master/Slave** button. The unit will attempt to lock to the reference source - this will take a few seconds. When lock is achieved, the **Slave** LED will light up brightly and the **Master** LED will turn off. If the reference source is lost, the unit will revert to Master mode, unless it is in ...

Learn mode – press the **Master/Slave** button again. This mode slaves to the incoming reference, but if the reference is lost, the unit carries on at the learnt frequency.

To return to Master mode, press the **Master/Slave** button again.

If the **Auto-Slave** menu option is turned **On** the unit will automatically slave when a suitable reference is connected, see **A-SL – Autoslave ON/Off**, page **22**.

The **Master/Slave** button is also used to decrement the setting of the **Offset** and the **RS232** address.

Output Format Button

Menu **Up**

Pressing the **Output Format** button toggles the output format between Single AES at Double speed and Dual AES at Standard speed, if the sample rate is set to 88.2 or 96kS/s. In the menu, it also operates as the **Up** button.

⁶ GPS stands for Global Positioning System

Single AES is the only option available if the sample rate is set to 32, 44.1 or 48kS/s so the **Output Format** button has no effect.

As the **Up** button it is also used in the menu to increment the setting of the **Offset** and the **RS232** address, and other parameters that need adjusting.

Mode Display

The single digit LED mode display to the right of the **Output Format** button shows the output format:

Display	Output Format
1	Single AES
2	Dual AES

Table 2 – Output Data format indication, higher sample rates

When the Output Format is selected, the main display briefly shows the format code:

A1	for Single AES, Standard speed encoding.
b1	for Single AES, Double speed encoding.
b2	for Dual AES, Standard speed encoding.

Sample Rate Display

The main display generally shows the sample rate in kS/s. When other parameters are set, it briefly shows the new setting (Mode, Tone Level, Offset, etc.) then reverts to displaying sample rate. In the case of an error condition, it will display an error message.

If the unit is being slaved, the display shows the following:

xxx	the sample rate, in kS/s (32, 44.1, 48, 88.2 or 96).
b xxx	slaved to the External Sync input.
o xxx	in Learnt mode, with external reference lost.
d xxx	temporary display during locking – the unit thinks it knows what the input reference frequency is, and is attempting to lock to it.

Important error messages are given below – a full list is given in the section **Error Codes and Messages** on page 64.

BadFs	The clock source is not in pull in range, or is poorly formatted. The unit cannot lock to it.
Err.xy	An error has been detected.
Hot	The unit is overheating, probably due to inadequate ventilation. Please check positioning and cooling.
Ouch	The “ Hot ” warning has been ignored and the unit is getting so hot damage may follow.
(blank)	If the display is blank for any significant period, turn the unit off for 10 seconds then back on. If this does not solve the problem, please contact your distributor or <i>dCS</i> .

The display is also used for **Menu** options.

THE SOFTWARE – THE MENU

Overview

The *dCS 992* has many other functions that either need to be accessed only occasionally, or are informative in nature. These functions can be accessed either by the Remote software, running on a PC and connected to the unit by an RS-232 link - or (in most cases) by the **Menu**. For the more complex functions, we strongly recommend use of the Remote software – this can be used to set up complex options, and then store these in user stores in the unit (stores 1 – 9). The complex stored setups can then be easily recalled without use of a PC or computer connection – perhaps on location. The Remote software is covered in section **Remote Software** on page **26**.

If a function is set by the menu or the remote, the unit remembers it, and it will be set this way for ever (or until you set it to something different). In the case of an unwanted complex setup be remembered, the unit can easily be reset to a known clean condition by recalling one of the *dCS* preset stores (**Stores A - E**). **Store A** is the simplest setup. The menu (and Remote) allows access to some information-only items. When called up, these are displayed for a time, then the display reverts to normal.

Menu buttons are indicated by white text on the front panel. There are for:

Step	otherwise Overload Level
Set	otherwise ADC/Data
Down	otherwise Master/Slave
Up	otherwise Output Format

Entering the Menu

There are two ways to enter the Menu:

- Press the **Menu** button once, or
- Hold down the menu **Step** button and press the menu **Set** button once. (This might make one-handed operation easier.)

The display will show:

Func

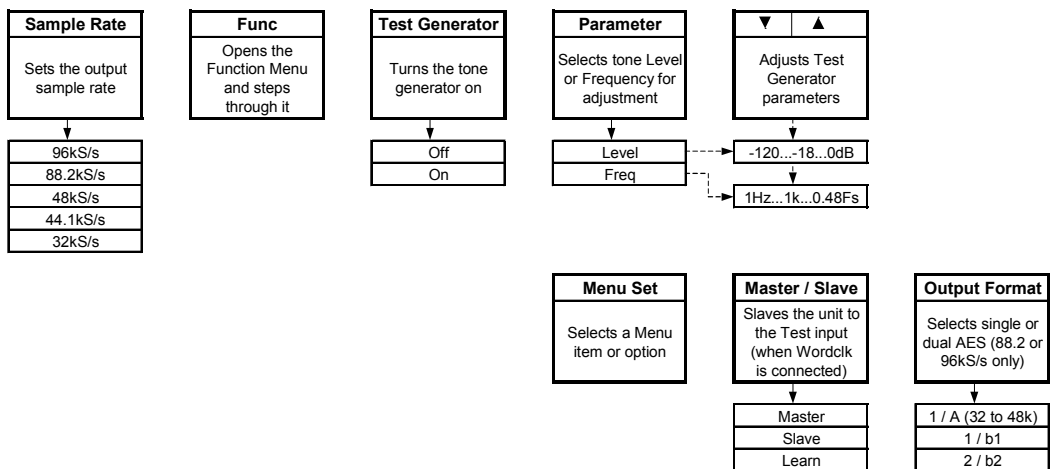
Moving through the Menu

Press the **Menu** button again (or the Menu **Step** button if you prefer) within 5 seconds to step through the Menu items listed below. When you reach the required item, press the Menu **Set** button to change its setting. This either toggles the previous state, or causes an information function to read out, or selects a numerical setting (**Offset** and **RS232** address). For a numerical setting, press the **Down** button to reduce it by 1 digit or the **Up** button to increase it by 1.

If no changes are made in 5 seconds, the unit exits the Menu. When one item has been set, press the **Menu** button again if you wish to continue cycling through the Menu.

There is a knack to doing this easily – once it has been gained, it becomes very easy to use.

The Menu Sequence



To access the Function Menu, press the **Menu** button.
 To step through the Menu items, press the **Menu** button repeatedly.
 To select an item or one of its options, press the **Menu Set** button.
 Use **Menu Up** and **Menu Down** buttons to alter **RS232** address and **Offset**.
 To exit the Function Menu, either select the **End** item or wait five seconds.

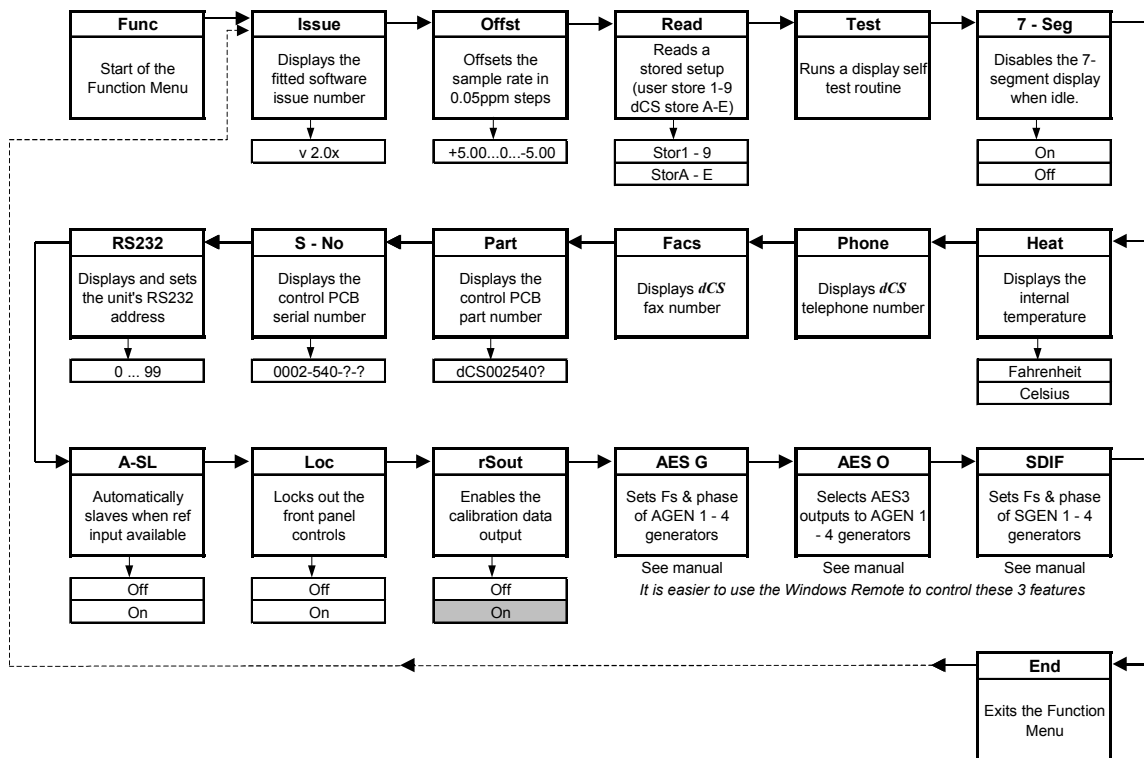


Figure 5 – Menu Sequence and Control Summary

Menu Items

Issue – Software Issue

Displays the software issue when Menu **Set** is pressed.

Offst – VCXO Frequency Trim

Trims the appropriate TCXO frequency in master mode, by up to ± 5 ppm in 0.05ppm steps. Press the **Down** button to reduce the value or the **Up** button to increase the value. The Offset for both VCXO's is remembered.

Read – Setup Unit from a Store

Reads back the content of a store, and sets the unit up accordingly. There are nine user programmable stores (**Stores 1-9**) and five *dCS* pre-loaded stores (**Stores A-E**). The *dCS* pre-loaded stores may not be overwritten – the user stores may be loaded by the user when setting up the unit with the remote from a PC. Note that there is no facility to load the stores without using a PC – the possibility of an erroneous setup is too high.

Stores A or **B** may be regarded as a factory reset – they set the unit up for straight forward 44.1kS/s or 48kS/s operation. Press menu **Step** to scroll through the stores (1-9, then A-E) then **Set** to select one.

The intended mode of use is that the unit be set up using the Remote software running on a PC, and then the setup stored. The unit can then recall the setup either in the studio or on location – even if it is complex. This way, set ups only have to be worked out once.

The contents of **Stores A-E** is pre-loaded as in **Table 3** below.

Parameter	Store A (compatible with earlier dCS 992, 44.1k outputs)	Store B (compatible with earlier dCS 992, 48k outputs)	Store C (DVD mastering, front/rear)	Store D (DVD mastering, front/rear from 44.1k source)	Store E (SACD and CD mastering from 44.1k source with DSD bit clock)
AGEN 1	44.1k, 0	48k, 0	96k, 0	96k, 0	88.2k, 0
AGEN 2	44.1k, 0	48k, 0	48k, 0	48k, 0	44.1k, 0
AGEN 3	44.1k, 0	48k, 0	48k, 0	48k, 0	44.1k, 0
AGEN 4	44.1k, 0	48k, 0	48k, 0	48k, 0	44.1k, 0
AES 1 Out to	AGEN 1	AGEN 1	AGEN 1	AGEN 1	AGEN 1
AES 2 Out to	AGEN 1	AGEN 1	AGEN 1	AGEN 2	AGEN 1
AES 3 Out to	AGEN 1	AGEN 1	AGEN 2	AGEN 3	AGEN 2
AES 4 Out to	AGEN 1	AGEN 1	AGEN 2	AGEN 4	AGEN 2
SGEN 1	AGEN 1, 0	AGEN 1, 0	AGEN 1, 0	44.1k, 0	AGEN 1, 0
SGEN 2	AGEN 1, 0	AGEN 1, 0	AGEN 1, 0	44.1k, 0	AGEN 1, 0
SGEN 3	AGEN 1, 0	AGEN 1, 0	AGEN 1, 0	48k, 0	AGEN 1, 0
SGEN 4	AGEN 1, 0	AGEN 1, 0	48k, 0	48k, 0	44.1k, 0
SGEN 5	AGEN 1, 0	AGEN 1, 0	48k, 0	96k, 0	44.1k, 0
SGEN 6	AGEN 1, 0	AGEN 1, 0	48k, 0	96k, 0	2.8224M
PLL bandwidth	250 mHz	250 mHz	250 mHz	250 mHz	250 mHz
Revert_mode	learn	learn	learn	learn	learn
7 segments	on	on	on	on	on
Autoslave	on	on	on	on	on
Master mode Offset	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm

Table 3 – Store A-E Contents

Test – Unit Self Test

Runs a display and DSP self test routine. When successfully completed, the unit displays **Pass** and returns to normal operation. Otherwise an error message **Err.xy** is displayed – please refer to **Error Codes and Messages** on page 64 for more specific information.

7-Seg – Display Disable

Disables the 7-segment LED display when idle. When set to **Off**, the display turns off 5 seconds after the last button press. A dot in the lower right hand corner of the display remains lit to indicate that the display has been deliberately blanked. The display springs back into life (temporarily) if the control settings are changed or the menu is used. Error or warning messages are displayed regardless of this setting.

Heat – Unit internal Temperature

Displays the internal temperature of the unit. Press menu **Set** to toggle between Fahrenheit and Celsius.

Phone – dCS Phone Number

dCS telephone number scrolls across the display.

Facs – dCS Fax Number

dCS fax number scrolls across the display.

Part – Internal Number

The control board part number (version) scrolls along the display. Although this is recorded at dCS with the serial number, it is a good double check to give us both these numbers when calling for help.

S-No – Serial Number

The control board serial number scrolls along the display. You will need something to write this on, if you call us for help.

RS232 – RS-232 ID

Displays - and allows access to – the unit's RS-232 identity code (an address between 0 and 99). The address is used by the Remote Control software, to send specific messages to specific units. Use menu **Up** and **Down** to change this address if you are controlling several units at once.

IMPORTANT!

Each unit connected to a Remote Control daisy-chain MUST have a different RS-232 address.

A-SL – Autoslave ON/Off

Turns Auto-Slave **On** or **Off**. When set to **On**, connecting a Word Clock or GPS 10MHz source to the **External Sync** input causes the unit to slave and lights the **Slave** LED. When set to **Off**, the unit ignores connection to the **External Sync** input.

Loc – Panel Lockout

Panel Lock, normally **Off**. Set to **On** to prevent unauthorised changes using buttons. The menu has to be accessed to turn the lock off again.

Rscout – RS-232 Calibration data Output

This feature is intended for use by dCS only. It should be set to **Off**, especially if you are using the Remote Control or upgrading your software.

When set to **On**, calibration data is sent to a PC via the **Loop Out** connector and this will slow down the Remote Control, and possibly crash your PC. Leave it turned off!

AES G – AGEN Generator Setup

This entry allows the phase and sample rate of the AGEN generators (1-4) to be set up, in the absence of a PC. It is an emergency only control method – we very strongly recommend the use of the Remote software running on a PC, and communicating over the RS-232 link. However, if you are caught short, and need to do it manually, **Figure 6** below shows the operation of the command. Once in the menu, at the **AES G** entry, vertical black arrows correspond to a press of the menu **Step** button, and horizontal grey arrows correspond to a press of the menu **Set** button.

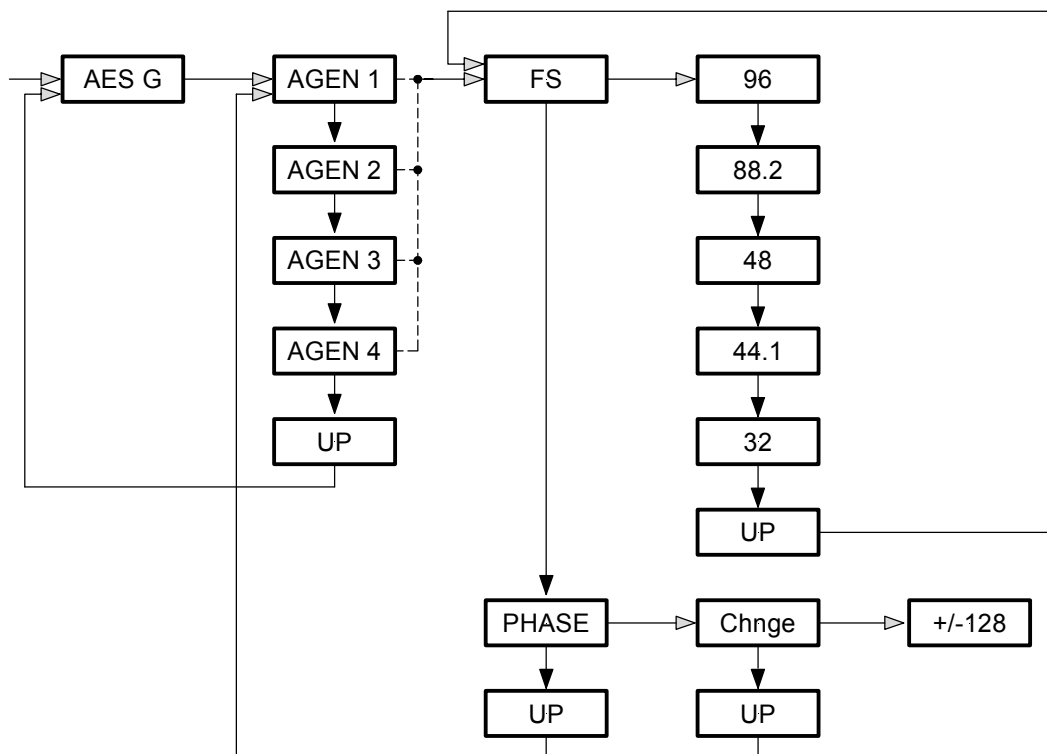


Figure 6 – AES G Menu Command Operation

AES O – AES3 Output Selector

This menu entry allows each AES3 output to be attached to the AGEN of choice. As with the AES G command, it is an emergency only control method – we very strongly recommend the use of the Remote software running on a PC, and communicating over the RS-232 link. However, if you are caught short, and need to do it manually, Figure 7 below shows how. The same conventions are used as in AES G – that is, once in the menu, at the AES G entry, vertical black arrows correspond to a press of the menu **Step** button, and horizontal grey arrows correspond to a press of the menu **Set** button.

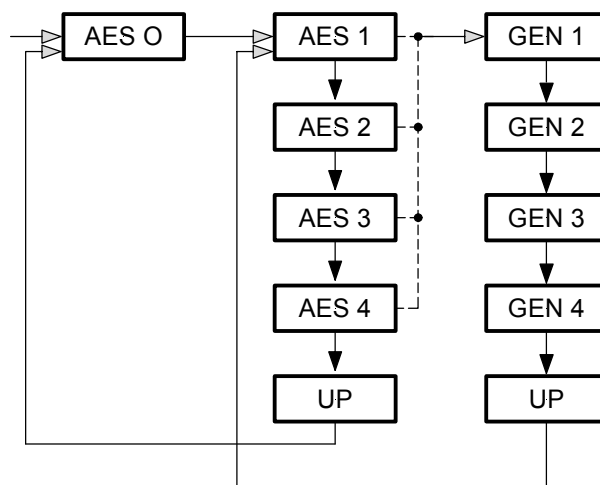


Figure 7 – AES O Menu Command

SDIF – SDIF Output Adjuster

This menu entry allows the phase and sample rate of each SGEN generator to be set up. As with the AES G command, it is an emergency only control method – we very strongly recommend the use of the Remote software running on a PC, and communicating over the RS-232 link. However, if you are caught short, and need to do it manually, **Figure 7** below shows how. The same conventions are used as in AES G – that is, once in the menu, at the AES G entry, vertical black arrows correspond to a press of the menu **Step** button, and horizontal grey arrows correspond to a press of the menu **Set** button.

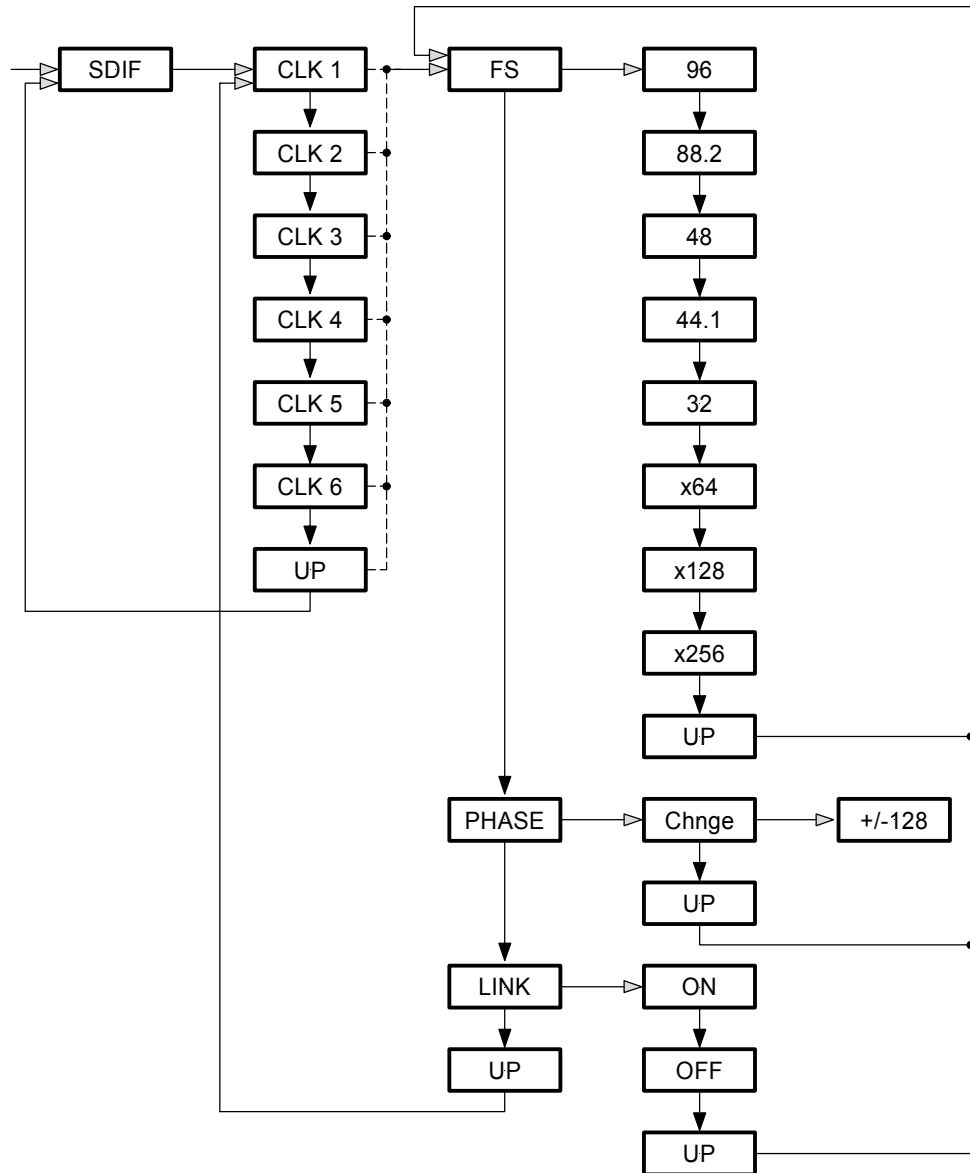


Figure 8 – SDIF Menu Command Operation

End - Menu Exit

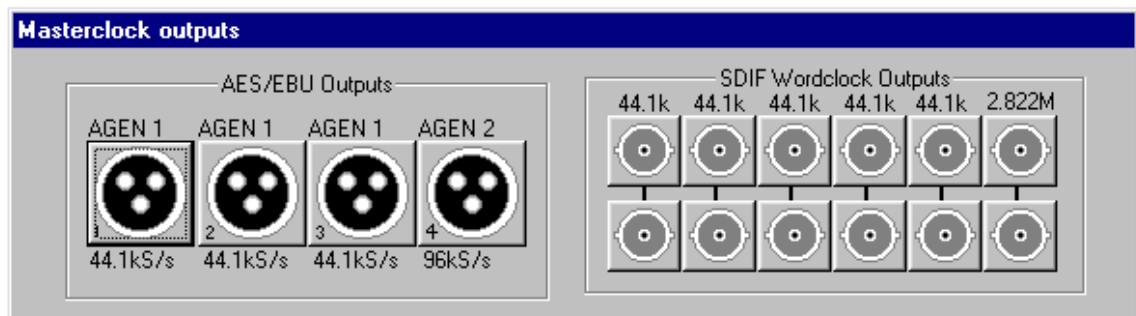
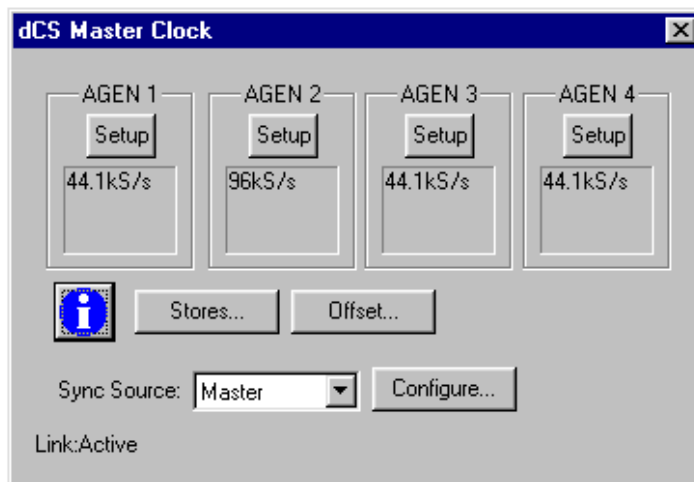
Exits the menu. Alternatively, the menu may be left to time out.

REMOTE SOFTWARE

Overview

The dCS Windows Remote is the recommended way of setting up unit to make full use of it's extended features.

It consists of 2 main screens, as below:

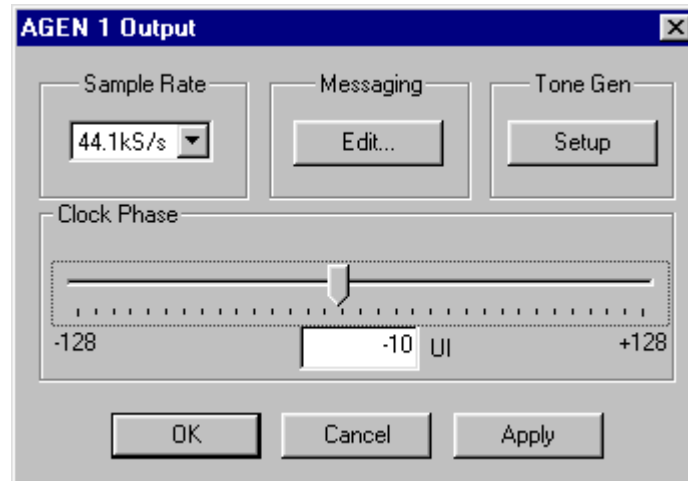


AGEN Generator Control

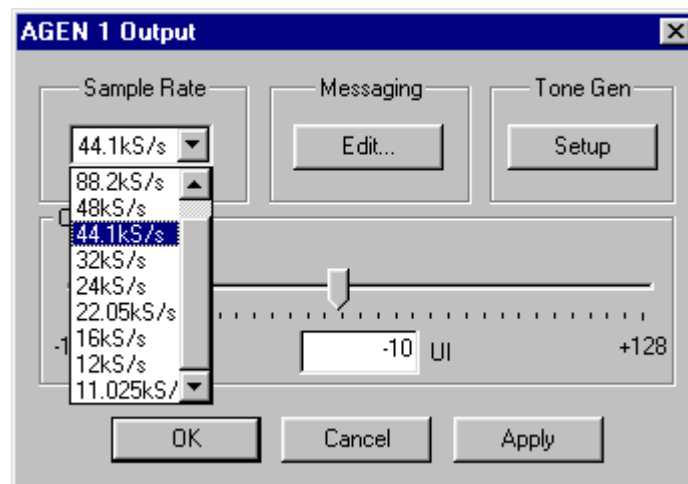
There are four independent⁷ AES generators on the 992 (AGEN 1-4), of which AGEN 1 is of special note. It determines the TCXO that is used, and has a tone generator that can be applied to it. Because it determines the TCXO used, its output is very clean. It can also be used as the only frequency, by using the "Link to AES1" feature. See **dCS 992 Architecture** on page 8 for a fuller description.

To set up an AGEN generator, click on the **Setup** button for the generator you wish to modify. This will display the following dialog (example is AGEN 1):

⁷ There are some restrictions to do with 32 kS/s operation



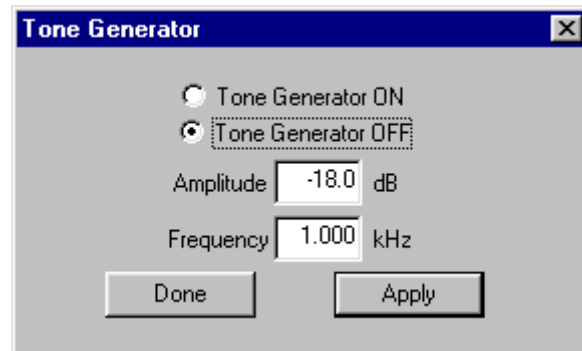
To change the sample rate, click on the **Sample Rate** drop down list, which will show the available frequencies for this output:



Pressing the **Edit** button allows you to modify the messaging on this generator, by displaying the following dialog:



If this is the AGEN 1 generator, a Tone Generator section is displayed. Pressing the **Setup** button allows you to configure the signal generator, by displaying the following dialog:



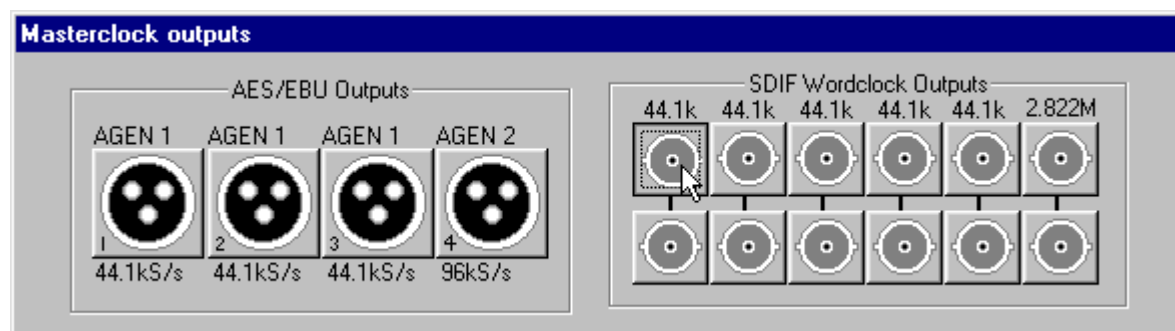
The **Clock Phase** slider represents the phase offset of the generator, relative to a zero point. You can specify the offset in AES Unit Intervals (UIs), where +128 is a one sample delay. The unit always deals in UIs, so if you change the frequency of the output, the offset will scale accordingly to the new output frequency.

Pressing the **OK** or **Apply** buttons will transmit the changes to the unit, which will then act on them. The **OK** button closes the dialog, whilst the **Apply** button leaves the dialog open (useful for tweaking the phase, for example).

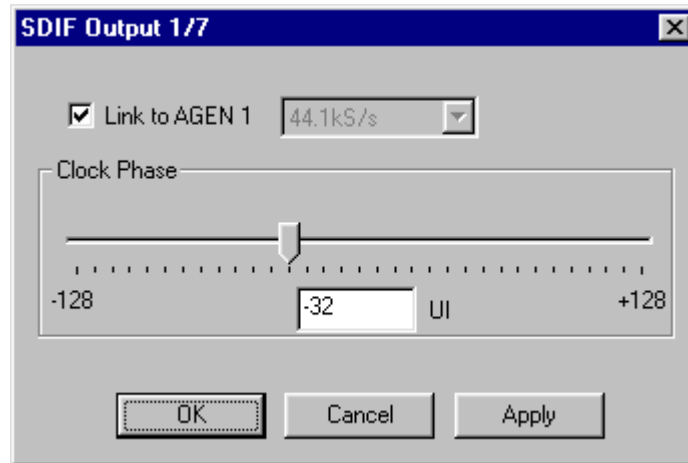
Cancel will close the dialog, discarding any changes you have made.

The SGEN Generator Control

In addition to the four AGEN generators for the AES3 outputs, the unit also supports six separate SGEN clock generators for the SDIF Wordclock Outputs. Each SGEN generator is connected to two SDIF word clock outputs, and the linkage cannot be changed. The SGEN generators are specific to their outputs, which means that they are set up from the "Masterclock outputs" dialog. Select the generator you wish to modify, by clicking on it (example below shows selecting SGEN 1):



This will then display the following dialog:

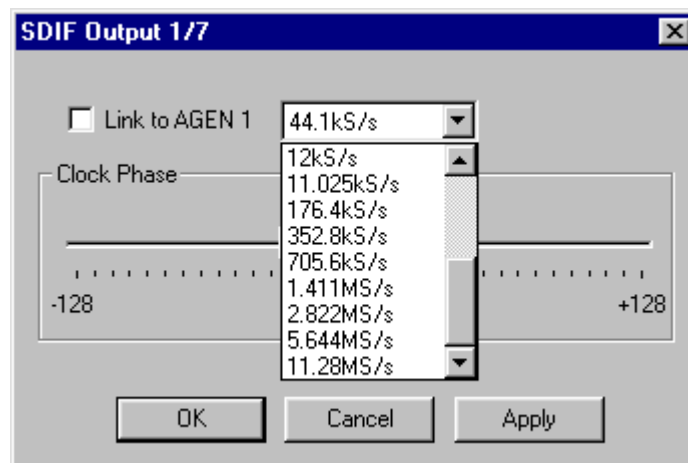


In this case, this output has “Link to AGEN 1” selected, which means that this SGEN generator will track the frequency output by the AGEN 1 generator (which might NOT be coming out of the **AES 1** output). Linking to AGEN 1 means that only the phase of the generator, and not the frequency, can be adjusted. Every time the AGEN 1 generator changes frequency, this output will follow it. If you uncheck this box, then the frequency list becomes available.

SGENs can also generate “superclocks”, which are multiples of standard clock rates. These are slightly different from standard wordclock outputs as follows:

- Superclocks only run at a multiple of the AGEN 1 generator frequency. For example, if AGEN 1 is a 48k based frequency, available superclock outputs are 192kHz, 384kHz, 768kHz, 1.536MHz, 3.072MHz, 6.144MHz and 12.288MHz. A 256 Fs superclock, as used by some manufacturers, would be 12.288MHz
- Superclocks cannot have their phase altered

The following dialog shows the frequency list with available superclocks, with AES1 generator set to be 44.1k.

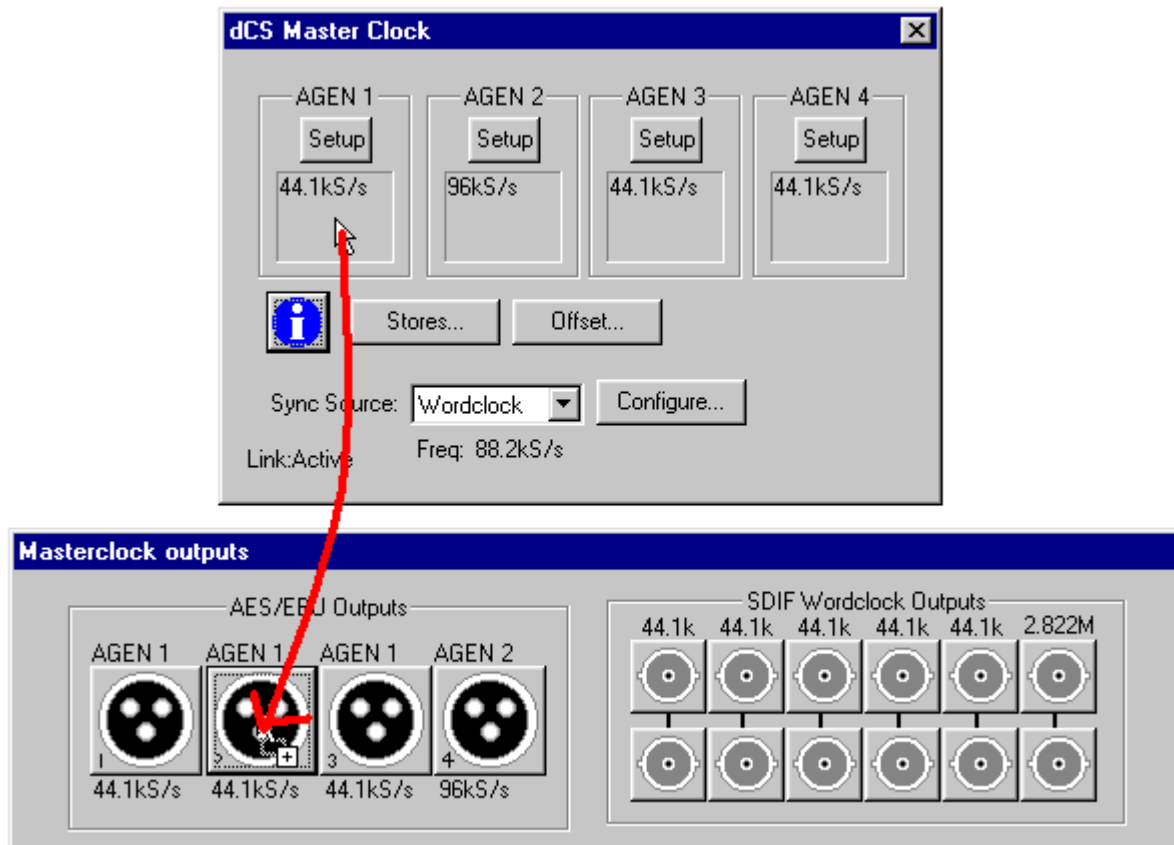


The **Clock Phase** offset slider, **OK**, **Cancel** and **Apply** buttons behave in the same way as for the AES generators.

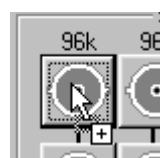
Assigning Generators to Outputs

Each AGEN generator can be routed to between 0 and 4 AES outputs simultaneously. The mechanism for this is as follows.

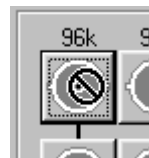
In each AGEN generator box is the **Setup** button, and below it is a box showing the frequency of that generator. To route that generator to an output, click in that box and drag to the output that you want, as below:



You can also drag the AGEN 1 generator over the SDIF outputs, and this makes them "Linked to AGEN 1". However, you cannot drag any other AES generators over the SDIF outputs, and the remote will reflect whether an output can accept a generator by the following means:



generator acceptable

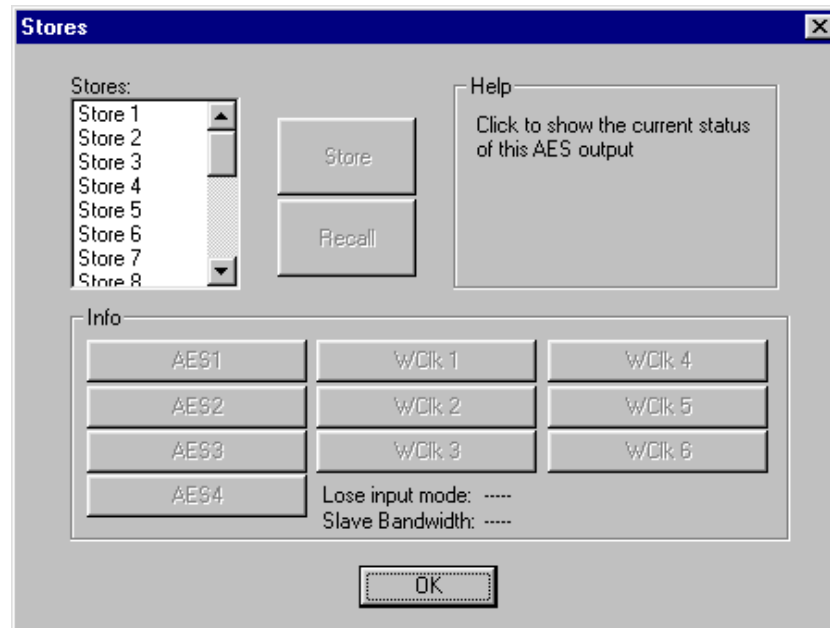


generator not acceptable

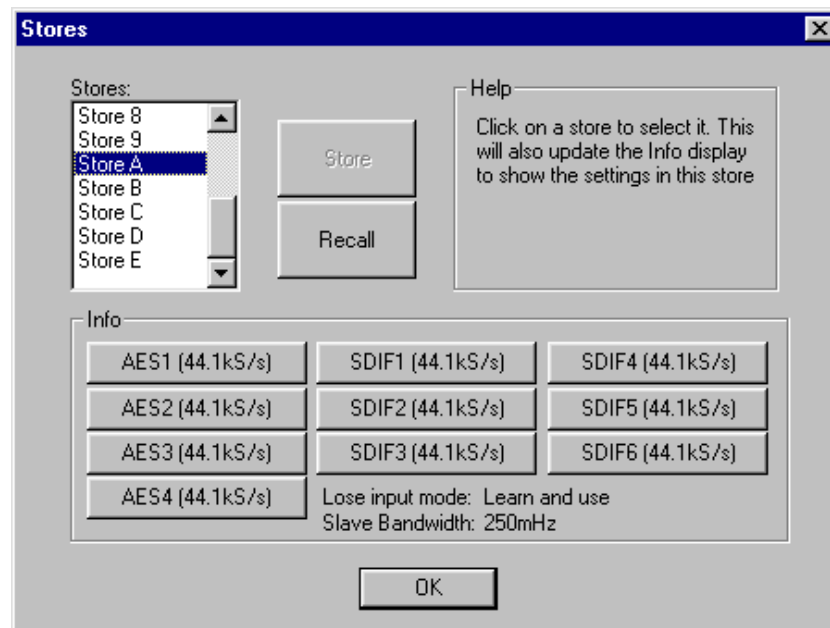
The Stores

The *dCS 992* has the capability of remembering up to 9 user-definable stores, and also has an additional 5 stores which are pre-loaded by *dCS* and cannot be changed by the user. The user stores are **Store 1-9**, and the fixed stores (*dCS* Stores) are **Store A-E**. See page 20 for more details. Any of these stores can be recalled via the front panel, but the remote allows modification and inspection of stores.

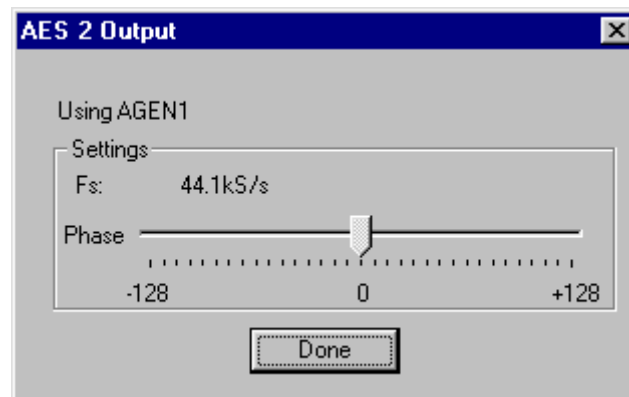
To access the stores, press the **Stores** button. This will display the following dialog:



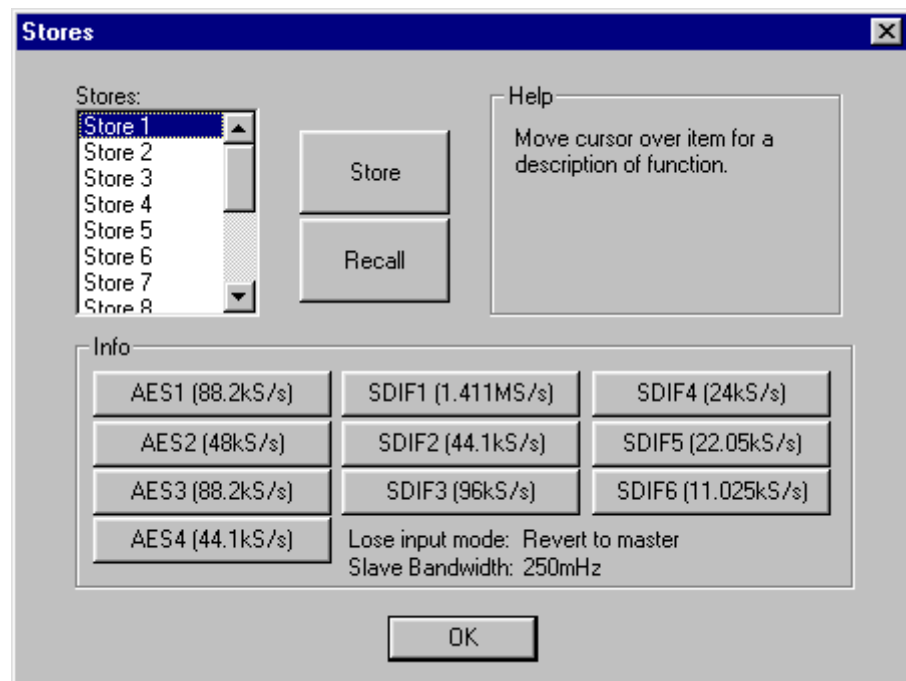
Everything will be disabled until you select a store to inspect, so if we select **Store A**, it will display the contents, as follows:



The “Info” section shows the contents of the store. To see more detail on a particular output in a store, click on it’s associated button, e.g. AES 2:



If you select a user store, for example **Store 1**, the contents of the store are displayed, and the **Store** button is enabled:

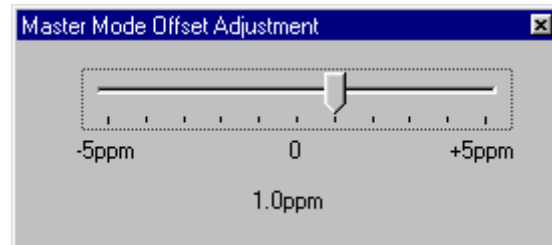


Pressing the **Store** button now will overwrite whatever was in **Store 1** with the current set of parameters for the unit.

To recall a store, simply select it and press **Recall**. The unit’s current set of parameters will be overwritten with whatever was in the currently selected store.

Offset

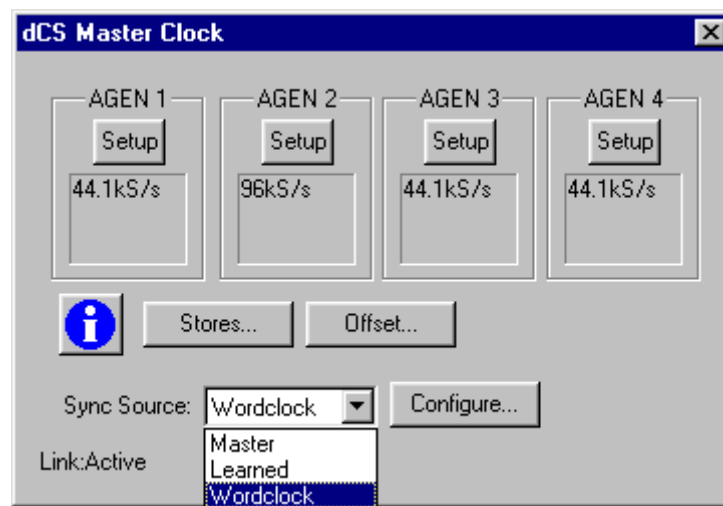
The *dCS 992* offers the facility to offset its absolute frequency by $\pm 5\text{ppm}$. It can only do this when in “Master Mode”, i.e. not Slave or Learned modes. To access this, press the **Offset** button, which will display the following dialog:



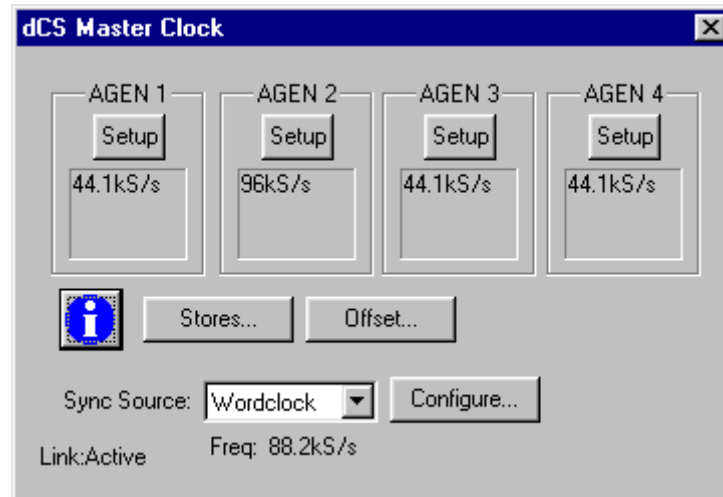
In this case, the unit has a +1ppm offset – this applies to all of its outputs. The Offset dialog is different from other dialogs in the remote, in that it can “float” all the time, and the main master clock dialogs continue to respond. It also applies its changes on-the-fly, so that dragging it immediately causes the unit to move its output. The change is glitchless – the unit can be used in recordings while this happens.

Slaving the unit

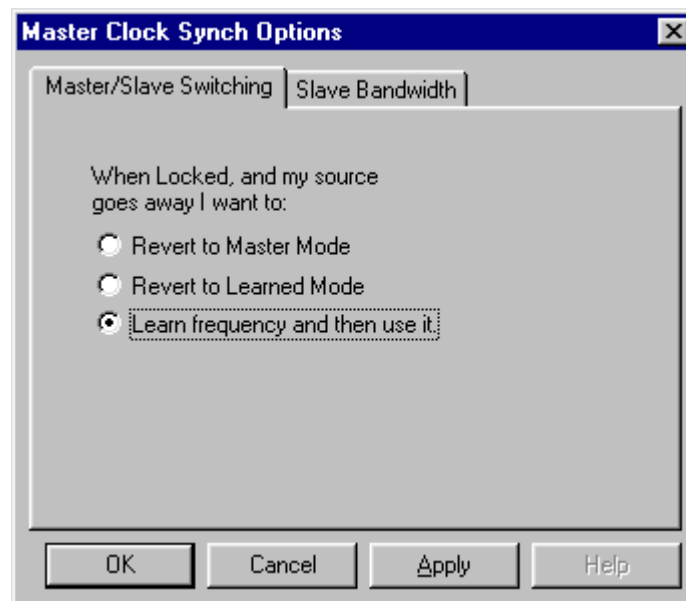
The main master clock dialog has a drop down list labelled “Sync Source”. This allows you to choose between Master, Learned and Word clock modes of operation. In Master mode, the unit uses its internal calibrated TCXOs. In Learn mode, the unit slaves to its input, but remembers where it was if the input goes away. In slave mode, the unit follows the input. Setting up is as follows.



The Word clock entry will appear/disappear, depending on whether or not the word clock is active. If the unit is slaved to the **External Sync** input, it will then show the frequency at the **External Sync** input, as follows:



There are a few parameters that affect slaving, and also how the unit reacts when the input is removed, which can be accessed by pressing **Configure**. This gives two pages of settings – the first page covers behaviour when sync is lost:

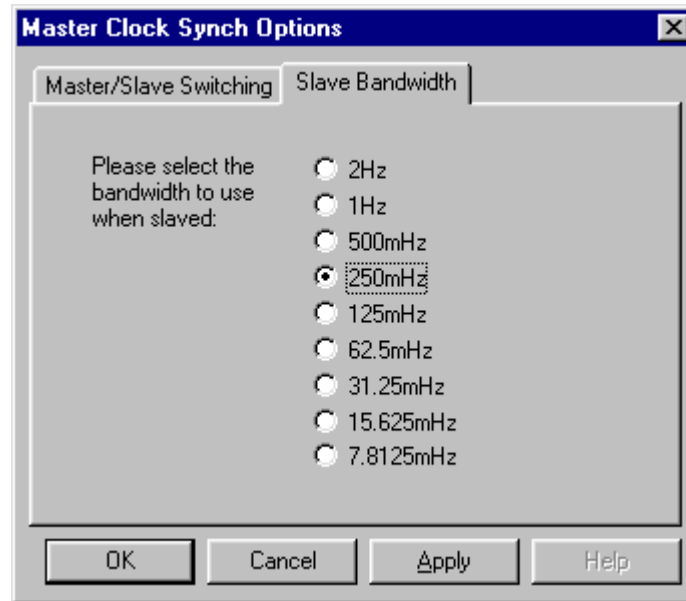


“Revert to Master Mode” – when the input goes away, the unit reverts to the 992 native master frequency.

“Revert to Learned Mode” – when the input goes away, the unit reverts to its stored learned frequency.

“Learn frequency and then use it” – this means that the 992 continuously monitors the clock input, and updates it’s internal stores to reflect this. If the input goes away, the unit remembers what the frequency was, and goes on outputting that. This is the recommended mode.

The second page of this covers behaviour when synchronised – you can select PLL bandwidth:

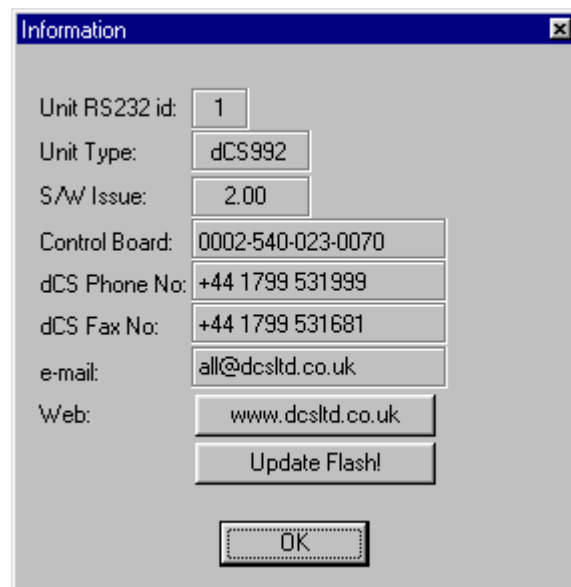


The setting tells the unit the bandwidth to use whilst in "Fine Lock". Note that these bandwidths are very low – you may wish to look at section **General Technical Information** on page 54 before using the lower values.

These settings are remembered "per-store", and so are displayed in the "Stores" dialog.

Info

Contact and unit information can be displayed on the Info screen.



TYPICAL APPLICATIONS

Using a dCS 992 to Sync a dCS 904

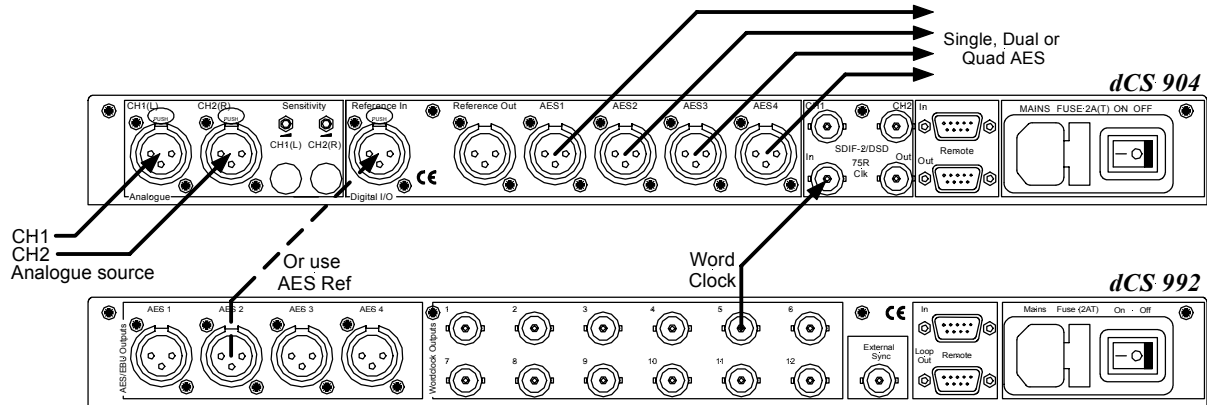


Figure 9 – Syncing a dCS 904 to a dCS 992

Any or all of the Word Clock and AES outputs may be used to synchronise the various units in a system.

The “base” sample rate (44.1, 48, 88.2 or 96kS/s) generated by the dCS 992 may be multiplied internally by a dCS 904, allowing it to lock at sample rates up to 192kS/s.

Another output from the dCS 992 may be used to synchronise a recorder.

Using a dCS 992 to Sync a dCS 972 Upsampling a CD

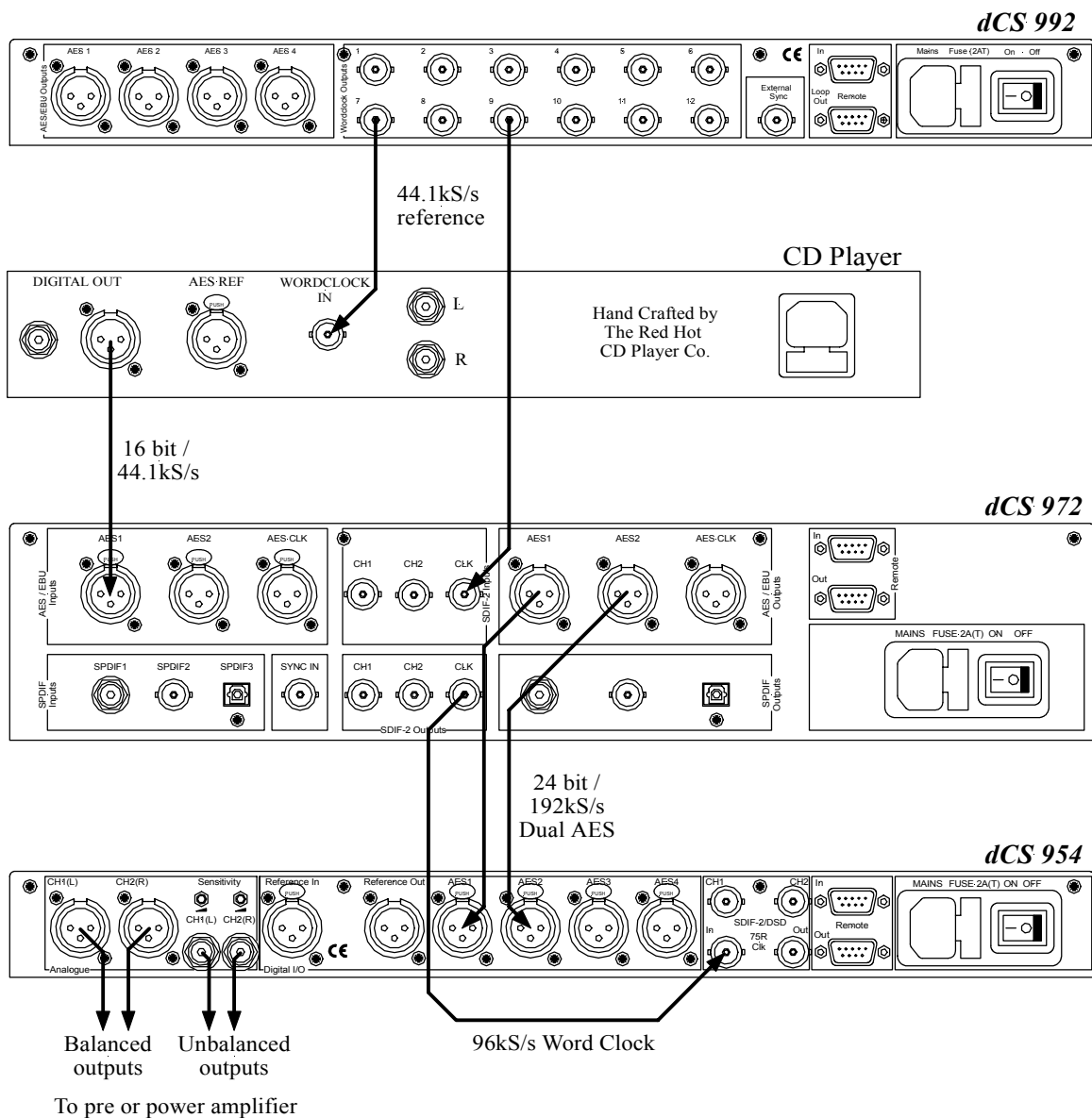


Figure 10 - Using a dCS 992 to Sync a dCS 972 Upsampling a CD

The dCS 992 synchronises the CD player and the dCS 972 to its 44.1kS/s outputs. The dCS 972 upsamples the CD player's digital output to 88.2, 96, 176.4 or 192kS/s in Dual AES format.

Note that the dCS 954 DAC is locked to upsampled word clock from the dCS 972, NOT to a 44.1kS/s feed from the dCS 992.

AES/EBU outputs may be used instead of Word clock outputs for synchronisation you prefer.

Using a dCS 992 to Sync a dCS 972 Converting PCM to DSD

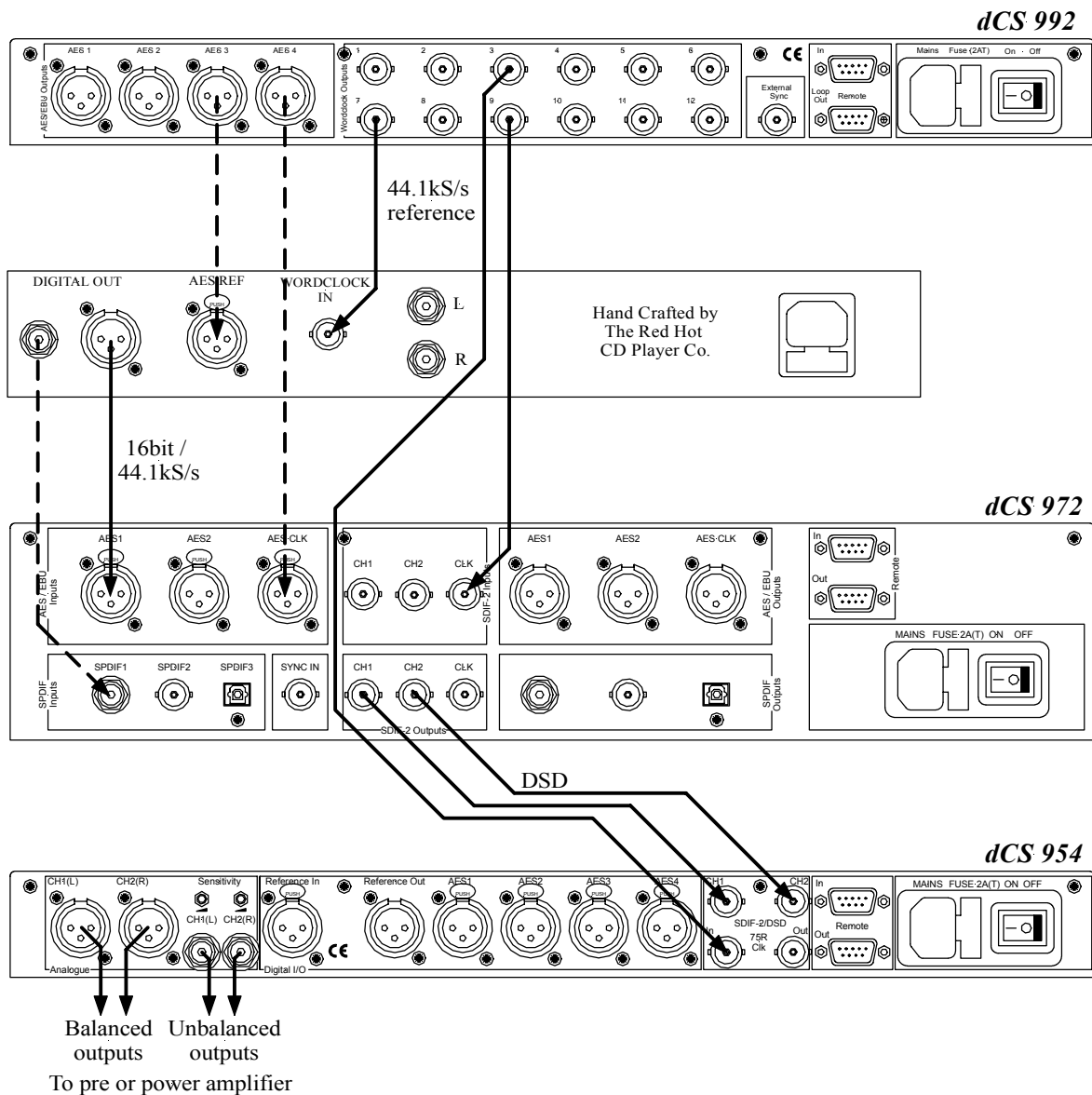


Figure 11 - Using a dCS 992 to Sync a dCS 972 converting 16 bit / 44.1kS/s data from a CD to DSD

The dCS 992 synchronises the CD player, the dCS 972 and the dCS 954 to its 44.1kS/s Word Clock outputs. The dCS 972 converts the CD player's digital output to DSD format.

AES/EBU outputs may be used instead of Word Clock outputs for synchronisation you prefer.

DSD is a single bit, 64 times oversampled format.

8 Channel P3D DSD Set Up with Monitoring

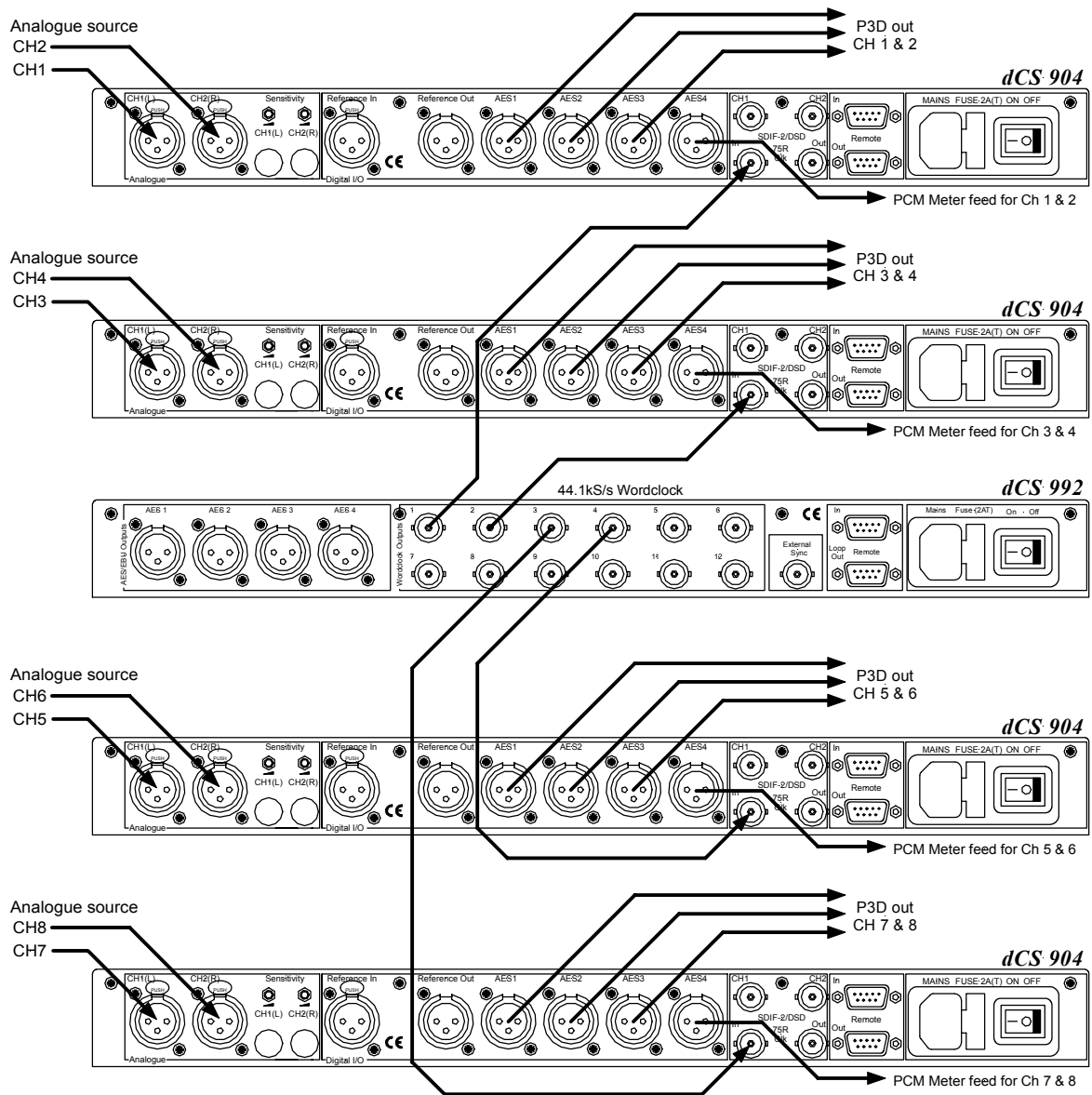


Figure 12 – 8 Channel P3D DSD Set Up

A dCS 992 with four P3D capable dCS 904 units can be used as above to give 8 channel DSD with additional simultaneous AES3 PCM outputs to give level monitoring on PCM equipment.

P3D format codes DSD data into 3 AES links running at 24 bit / 44.1kS/s, allowing DSD to be recorded conveniently on a multitrack digital recorder.

Operating Several Units on One Remote Chain

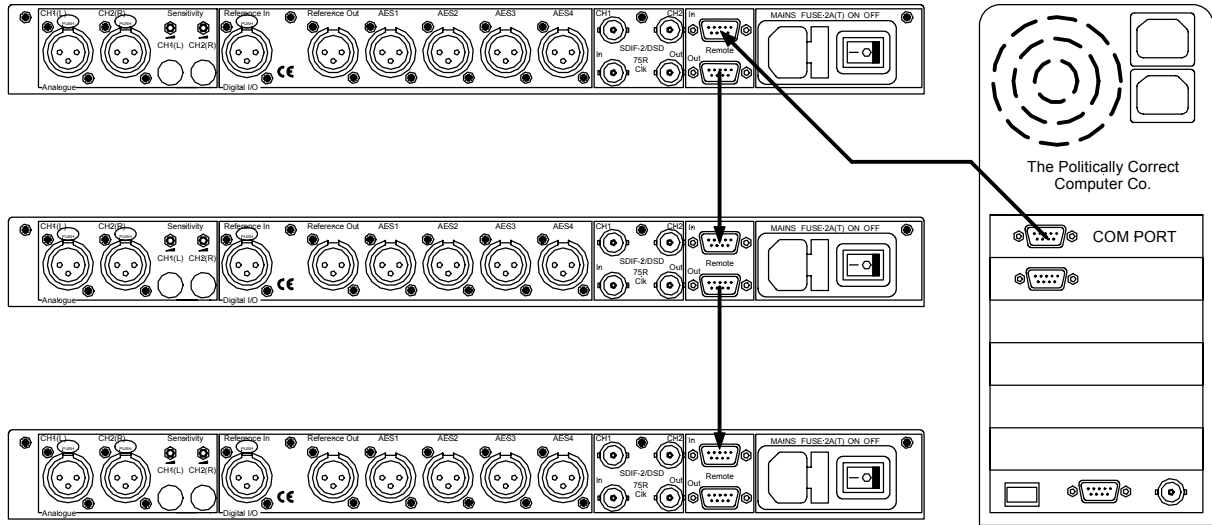


Figure 13 – Multi-unit Remote Daisy Chain

The PC can control several *dCS* units (up to about 5) on each daisy chain. To make them individually addressable, each unit needs its RS232 address to be different. They can then be identified, and grouped, in the Remote window. The units may be of different types.

See page **12** for cable details.

IMPORTANT!

Ensure the **RS out** option in the Menu is set to **Off**.

Multi-channel Sample Rate Conversion – with multiple sample rates out

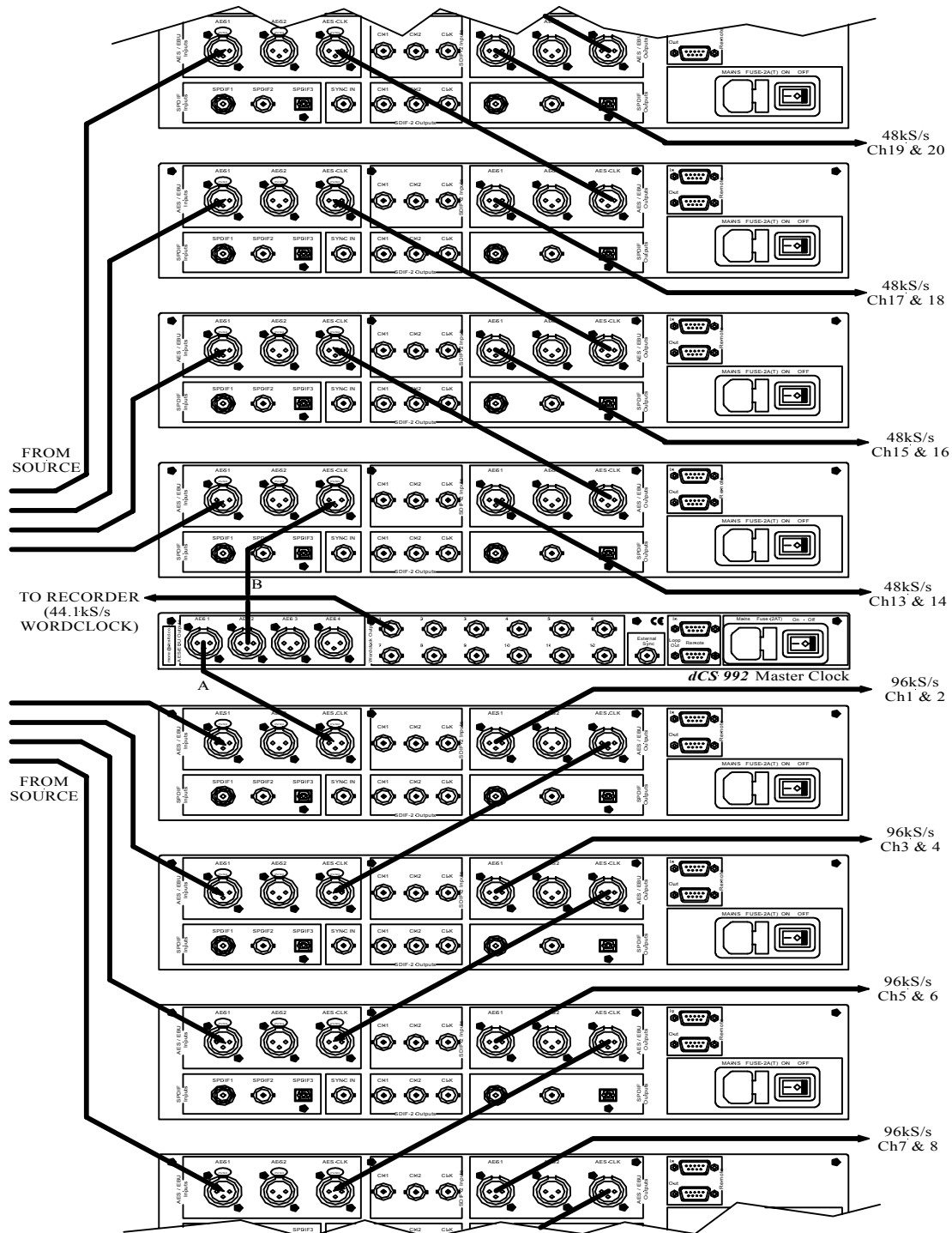


Figure 14 – Multi-channel Sample Rate Conversion with multiple sample rates out

A *dCS 992* Master Clock⁸ can also be used to sync up the source and more than one set of units, all at different sample rates, and be the master. DVD production may require different sample rates for different channels – this set up will give real time 48 kS/s rear channels and 96 kS/s front channels from a multi-channel 44.1kS/s source. For all *dCS 972* units, set the **Multi-channel Sync** option to **On**. They will all set up as slaves. Make sure that all the other settings are the same on each unit in a group.

Synchronising the *dCS 992* to a GPS Clock

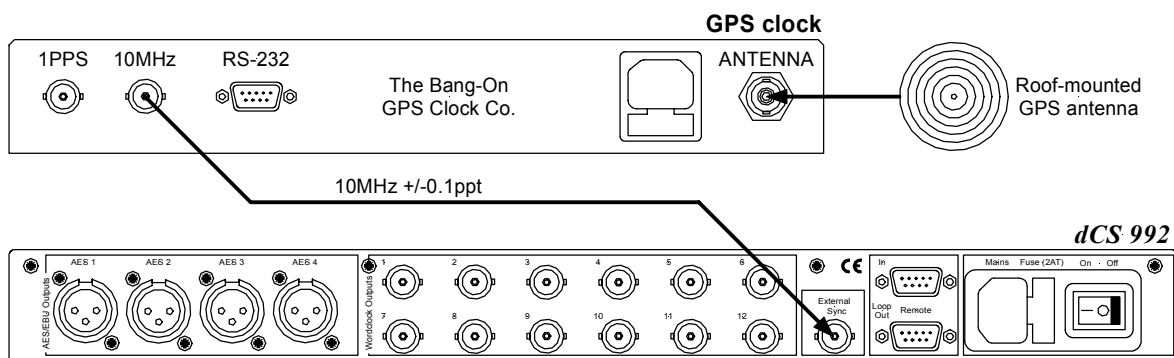


Figure 15 – Synchronising *dCS 992* to a GPS clock.

The *dCS 992* may be slaved to the very accurate 10MHz signal generated by a GPS⁹ Clock. The microwave carrier from the satellite is derived from an atomic frequency standard, giving a long-term accuracy of the order of 0.1ppt (parts per trillion). Unfortunately, the receivers can show Doppler shifts from the satellite signals, and there may be times when not enough satellites are available to lock to. It is probable that the 0.2ppm variations seen in **Figure 18** are caused by GPS Doppler shifts.

⁸ this software version or higher

⁹ Global Positioning System – an absolute position location system based on transmissions from an array of orbiting satellites, originally used by ships.

dCS 992 TECHNICAL INFORMATION

Clocking

The sample clock quality significantly determines the performance of a digital audio system.

The highest quality clocks that are available are crystals, so we use these. The *dCS 992* uses one of two on-board voltage controlled crystal oscillators in a temperature compensated (TCXO) configuration, as a clock source – one for 48 kS/s related outputs and one for 44.1 kS/s related outputs. These TCXOs are aged to allow the crystal to relax from manufacturing stresses then specially selected for predictable behaviour over temperature. After assembly, the unit is subjected to repeated temperature cycling, during which calibration data is collected. This data is unique to each unit, and is stored in non-volatile memory in the unit. A final calibration run confirms the accuracy of the unit.

When an external clock is applied for Slave operation, the correct VCXO is chosen and synchronised to it by a phase locked loop (PLL). The PLL uses substantial DSP to achieve ultra low bandwidths (in the mHz area) without large resistors or capacitors. These components can add substantial amounts of flicker noise. If synchronising to an external source is needed (a house sync, for example), the PLL provides a high degree of "clock cleaning". Even a poor quality source may be cleaned up and used by a *dCS 992* to re-generate an excellent one, if necessary. A consequence of the narrow (possibly very narrow) bandwidth is that it takes quite a long time for the PLL to lock to a new clock frequency.

Operating Modes

The unit can operate in Master mode, or in Slave mode.

In Master mode the TCXOs can be controlled to operate from their calibration data, or the frequency can be offset by ± 5 ppm. The temperature compensation still operates in this Offset Master mode.

In Slave mode, the unit can just follow its sync'ing input, or it can learn the sync'd input and remember and use it if the input disappears. Thus, a unit may be left "learning" the frequency of a house sync, until it is required to be taken out on location. It can then recall the house sync, still temperature compensating it. Or, a GPS signal might be used as an accurate reference – but GPS signals can disappear for short periods. The *dCS 992* will continue to run at the last learned frequency if this happens. If the reference reappears, the *dCS 992* will very slowly and gradually adjust its frequency and phase to align with the reference again – there will be no switching glitches. The re-alignment can take 10 minutes or more, and is independent of PLL bandwidth setting.

Master clock

Accuracy at 6 months	< ± 1 ppm
Accuracy when shipped	typically ± 0.1 ppm. See Figure 18 .
Temperature range	-10°C to +60°C (+14°F to +140°F). See Figure 19 .
Warm up time	< 30 mins from turn on - see Figure 17 . < 4 mins when changing from one TCXO to the other

The calibration accuracy is guaranteed for 6 months. Crystals do age, and although we burn them in, they can still drift with time. In general, the amount crystals age decreases with time.

The TCXO frequency can be trimmed by using the **Offset** function in the menu (see **Offset – VCXO Frequency Trim** on page 20). Each TCXO is independently adjustable

Synchronising to source, PLL

Pull-in range	± 300 ppm about nominal frequency
PLL Bandwidth	adjustable in factors of two with the remote from 7.8 mHz to 2 Hz

The PLL is very robust, and will lock to very poor signals if necessary. An External Reference should be a very accurate, very clean signal, of course ...

Learn Mode

Typical performance is shown below. A unit was left to learn, for about an hour, and then the reference removed. The scope has been left recording the reference and the *dCS 992* output, over a period of half an hour. The *dCS 992* has changed in phase relative to the reference less than 3 usecs – so the learning and subsequent temperature compensation was accurate to about 0.002 ppm.

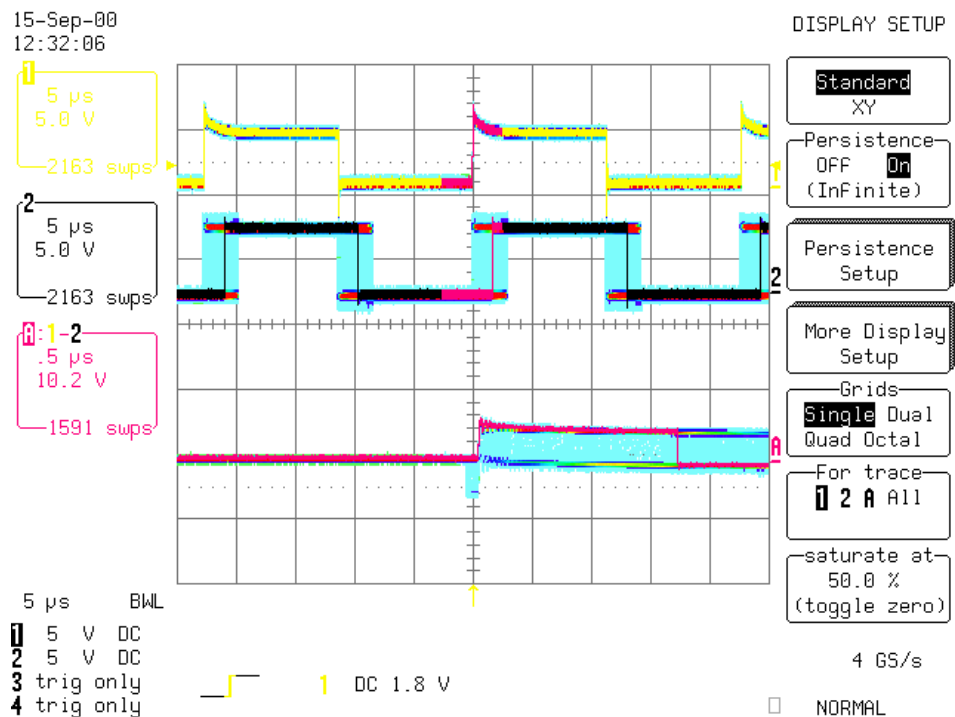


Figure 16 – Learn mode performance

Calibration data from a typical unit

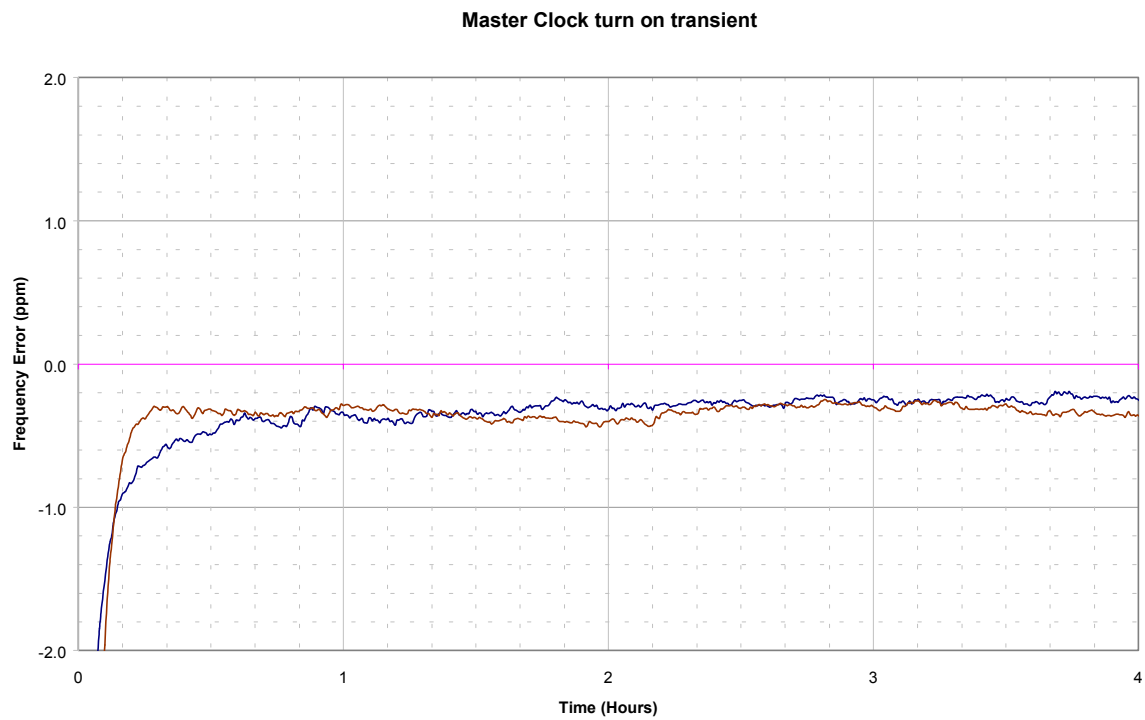


Figure 17 – Turn On Transient

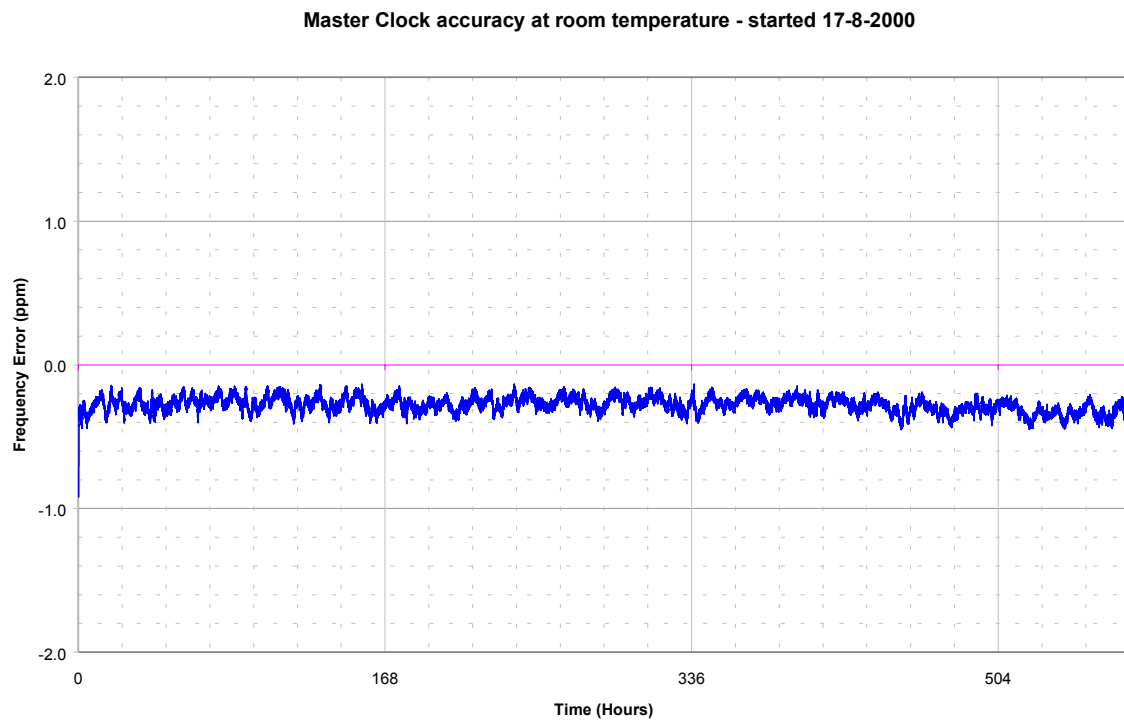


Figure 18 – Long Term Accuracy and Drift

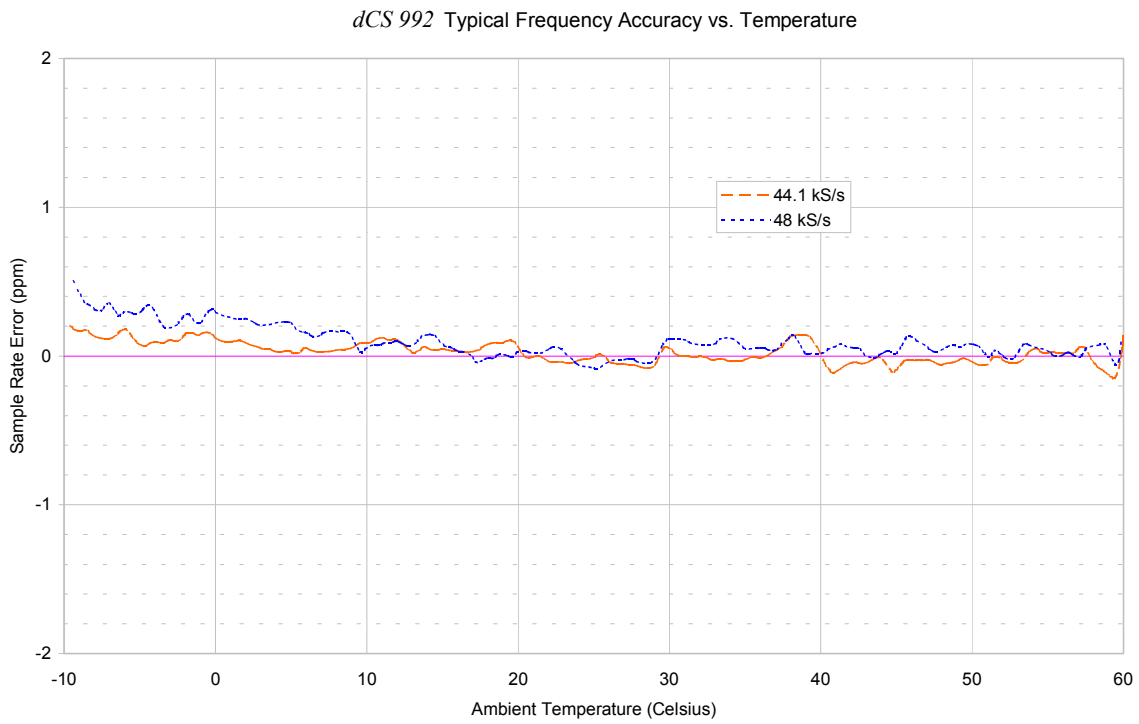


Figure 19 – Typical frequency accuracy over temperature

Digital Interface Specifications

AES/EBU (AES3)		Outputs	
Type		<i>Balanced, differential</i>	
Impedance		110	Ω
Output level (unloaded)		7	V pk-pk
Connector		XLR3 male	
Connections	Pin 1	Ground or shield	
	Pin 2	+Signal	
	Pin 3	-Signal	

Table 4 – AES/EBU output specifications

SDIF-2 Word Clock		Ext Sync	Outputs	
Type		<i>Single ended, ground referred</i>		
Impedance		1k	25	Ω
Sensitivity (unloaded)		TTL	TTL	
Damage level		> 10		V pk-pk
Time skew				
Wordclock in / out			< 40	ns
Connector		BNC	BNC x 12	

Table 5 – SDIF-2 Word Clock i/o specifications

Remote control interface		In / Loop Out
Type		RS-232
Level		RS-232
Data Format		Contact <i>dCS</i>
Connector		9 way D-type male
Connections		Wire pin-to-pin

Table 6 – Remote Control Interface Details

AES3 (AES/EBU) Format

Message Handling

The AES/EBU interface transmits a data structure that conforms to the *dCS* version of AES3-1992. This contains 28 bits of Manchester encoded data, and a 4 bit near-Manchester encoded preamble in a subframe, and subframes are further assembled in a block and frame structure. Each subframe contains:

- preambles, to allow the receiver to sync up
- up to 24 bits of audio data, transmitted lsb first
- V, a validity bit
- U, a user bit, for the "User Message"
- C, a Channel Status bit, for the "System Message"
- P, a parity bit

The default AES/EBU message attached to the output data by the unit before being changed by the user is as follows:

Professional:	On
Non-Audio:	Off
Mode:	Not indicated
Source:	dCS1
Destination:	null

For more information on the way *dCS* implement the AES3 system message to handle higher sample rates, see the Appendix to this manual. For the formal definition of the AES3 interface, see footnote¹⁰, from the AES.

How Far will it Go?

The AES/EBU format was designed to go reasonable distances, at 44.1 kS/s and 48 kS/s. **Figure 20** and **Figure 21** overleaf show it over 16 m and 94 m using average cables. The waveform at 94 m can still be decoded, although it is quite degraded. Cable delay is about 5.6 nsecs/metre.

At 96 kS/s (twice the data rate the format was designed for) the allowed cable length is less. **Figure 22** and **Figure 23** overleaf show this over 16 m and 94 m. At 16 m the waveforms are still very good, but at 94 m they are really quite unreliable. The upper trace in each pair was taken at the unit output, the lower trace at the termination at the far end of the cable.

We recommend restricting 96 kS/s cable runs to 20 m or less, and using good cable near this length.

¹⁰ AES3-1992 (ANSI S4.40-1992) "AES Recommended practice for digital audio engineering – Serial transmission format for two-channel linearly represented digital audio data".

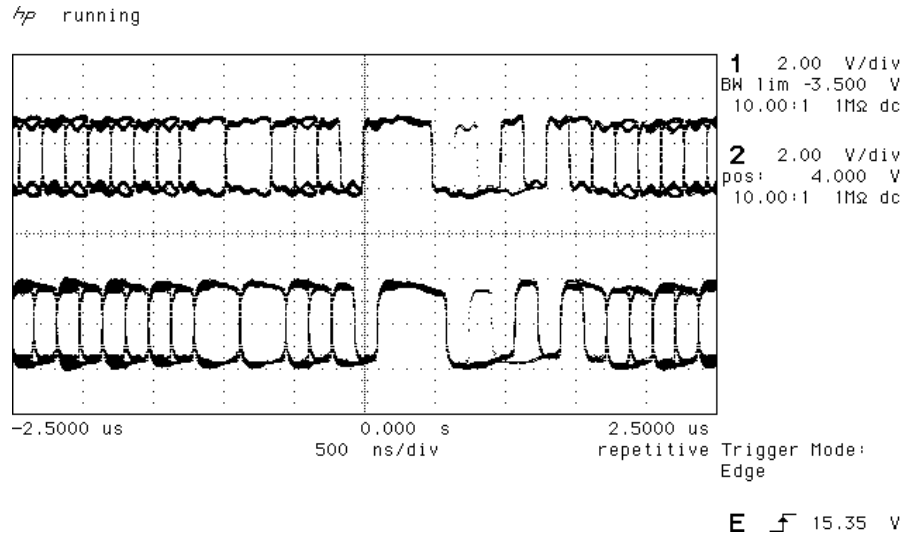


Figure 20 - AES3 format at 48 kS/s over 16 metres

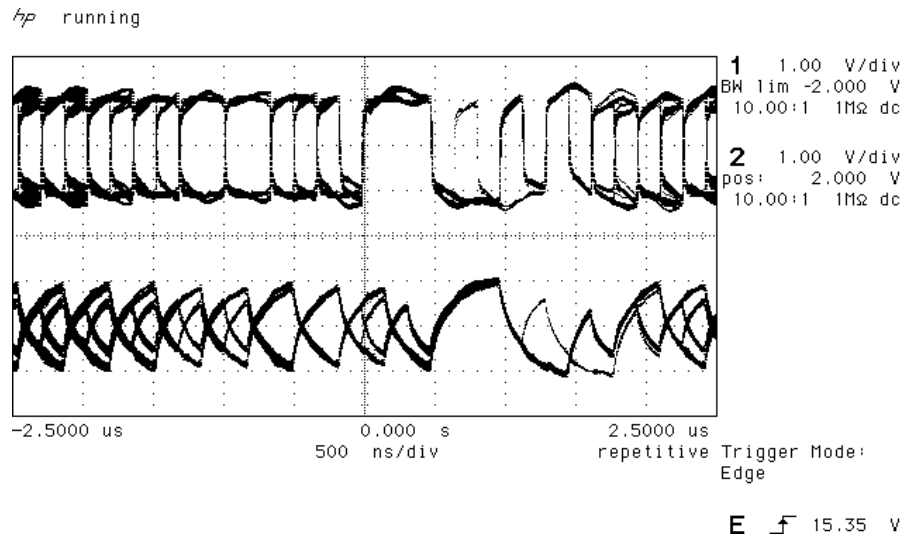


Figure 21 – AES3 format at 48 kS/s over 94 metres

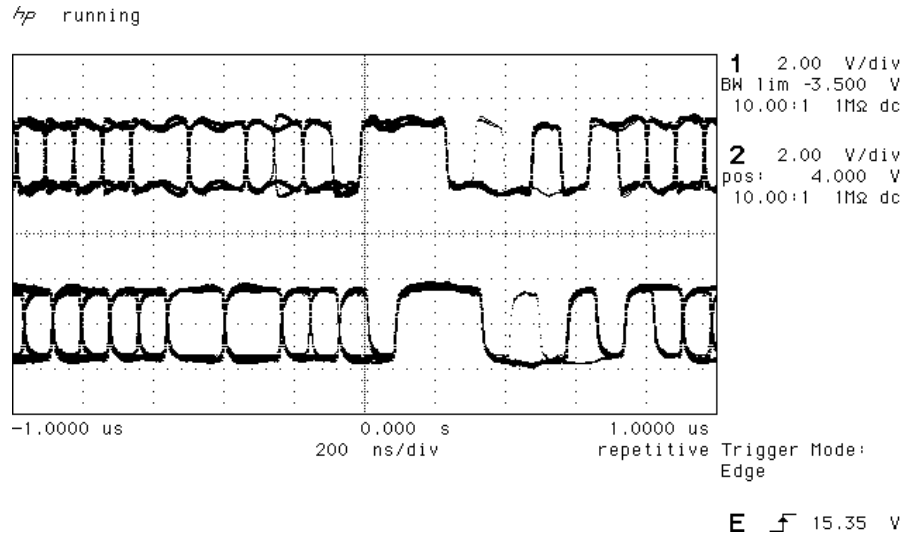


Figure 22 – AES3 format at 96 kS/s over 16 metres

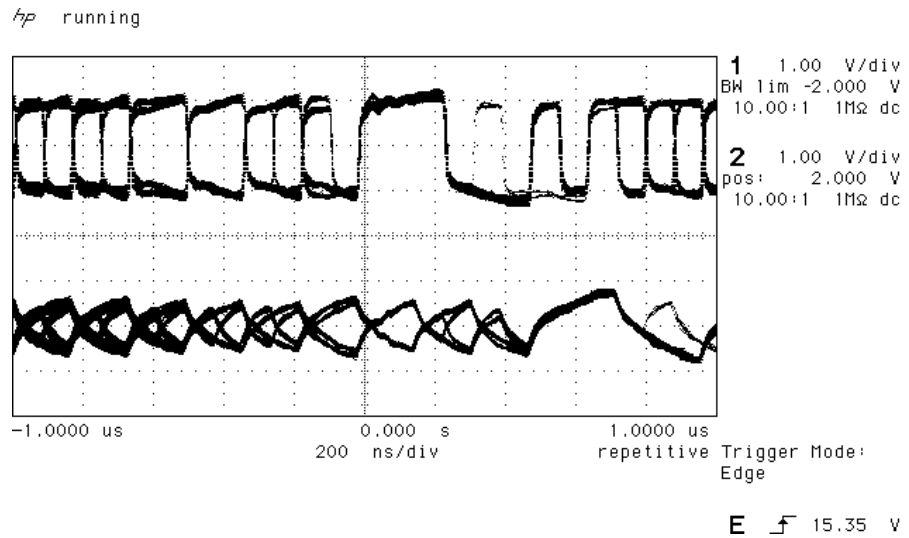


Figure 23 – AES3 format at 96 kS/s over 94 metres

Power Consumption

The *dCS 992* has a linear power supply, and so power consumption changes as the mains voltage changes. The internal regulation is comparatively efficient for a linear supply, so these changes are kept to a minimum.

Power Consumption with Mains Voltage

(measured as AC power into mains socket):

Nominal mains	18 W
Mains -10%	17 W
Mains +10%	19 W

These figures include a 2W allowance for loading all the outputs.

The actual intended supply voltage is shown on the rear panel. 50 Hz or 60 Hz operation is not important – the unit can use either. In general, users will not need to change the mains input configuration. If you do need this to be done, please see the section [Error! Reference source not found.](#) on page [Error! Bookmark not defined.](#) in this manual and contact your distributor or *dCS*.

Size, Weight and Operating Conditions

Size and Weight

The *dCS 992* dimensions correspond to a standard 1U 19" rack mount case. Four heavy duty feet, fitted to the base, extend the overall height to slightly greater than 1U.

Dimensions

Width	430 mm	see note (i)
Height, without feet	44 mm	(1U)
Height, with feet	52 mm	
Depth	390 mm	see note (ii)
Weight	6.8 kg	see note (iii)

note (i) Removable 19" rack mount ears are supplied, taking total width to 483 mm (19").

note (ii) Measured from front panel to rear panel connectors. Additional depth should be allowed to accommodate cable connectors.

note (iii) The high quality case is necessarily heavy, consideration should be paid to appropriate support shelving when installing the units in a rack.

Operating Conditions

The case of the *dCS 992* has no ventilation slots or fan cooling, to give:

- quiet operation (does not need to be installed in a machine room)
- internal temperature stability
- improved electrical safety
- long term reliability
- no regular maintenance or cleaning requirements

It dissipates relatively low power, so that usually allowing natural convection provides enough cooling. Do not install the unit near heat sources such as radiators, air ducts or direct strong sunlight. Ambient should not exceed 50°C, should not fall below 0°C, and should be non-condensing. If in doubt, the easy test is – the *dCS 992* is happy to work anywhere a human is.

GENERAL TECHNICAL INFORMATION

PLL bandwidths

The lower the bandwidth of a PLL, the more slowly it tracks an incoming signal and, effectively, the more it averages in the incoming frequency. The lower the bandwidth, the less the PLL responds to small variations in the input, and the more filtering it applies. So, jitter rejection should be better as the bandwidth goes down.

However, all clock sources (GPS, Rubidium, Crystal, etc – everything) have a small amount of close in phase noise. This produces small but noticeable low frequency (slow) timing variations. Outside the PLL bandwidth, a slaved clock cannot track these variations in the input. As the PLL bandwidth reduces, more of these slow variations remain untracked. Surprisingly, perhaps, this means that as the PLL bandwidth is reduced, the low frequency timing variations (jitter) between the input and the slaved tracking generator increase. They may arise in the source, or in the slaved clock, but they are variations that the slaved clock no longer tracks.

As PLL bandwidths move down into the mHz area, these timing variations become significant. If the purpose of the slaving is to match frequencies, and phase does not matter – they are not important, and very low bandwidths can be used. If the purpose of the slaving is to also lock phase, there is a limit below which the PLL bandwidth should not be reduced. This depends on the input clock, but for two VCXO based clocks, the figures below may be useful.

PLL Bandwidth (mHz)	Very Low Frequency Timing Jitter (nsecs, p-p, one unit relative to another)
1000	2.2
250	10
62.5	53

Table 7 – Timing Jitter variation with PLL Bandwidth

From these figures, 250 mHz is a good compromise between reasonable low frequency timing accuracy (± 5 nsecs peak) and the modulating signal suppression of narrow PLL bandwidths. Scope shots showing this data are given as **Figure 24**, **Figure 25**, and **Figure 26** below.

250 mHz is the default PLL bandwidth for a *dCS 992*.

It should be remembered that this jitter is very low frequency, and corresponds to very slow and gradual timing changes. It is very substantially below the audio band.

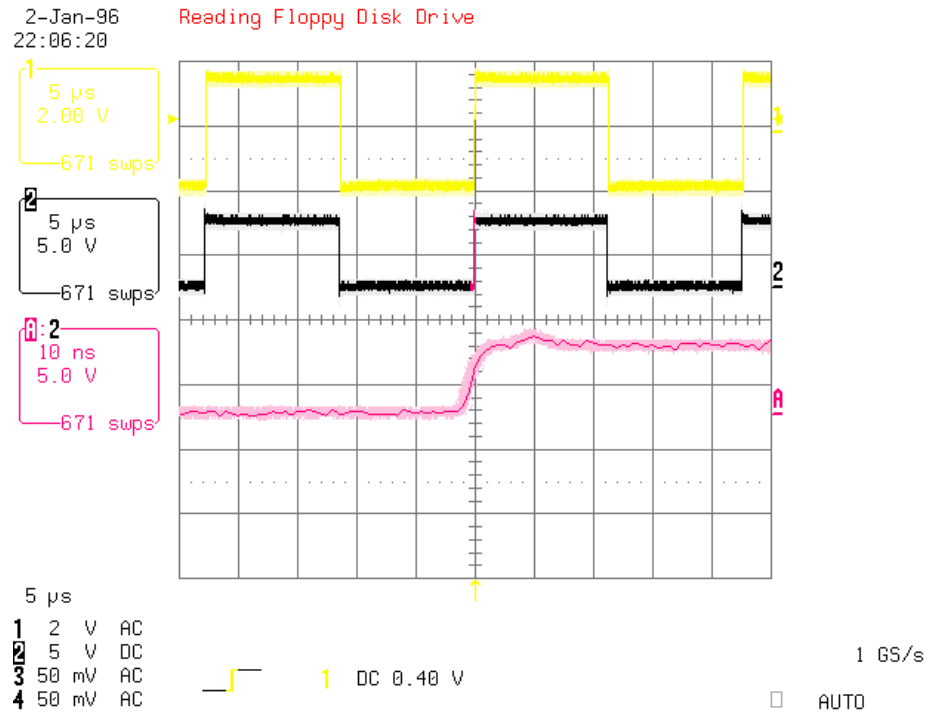


Figure 24 – Low Frequency Timing Jitter, 1 Hz PLL bandwidth

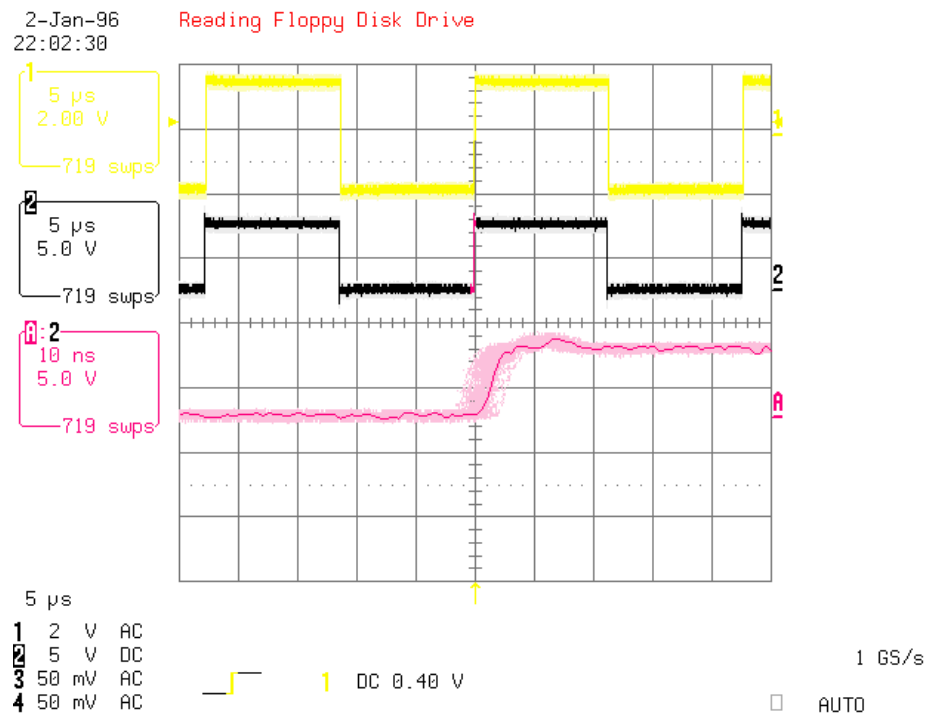


Figure 25 – Low Frequency Timing Jitter, 250 mHz PLL bandwidth

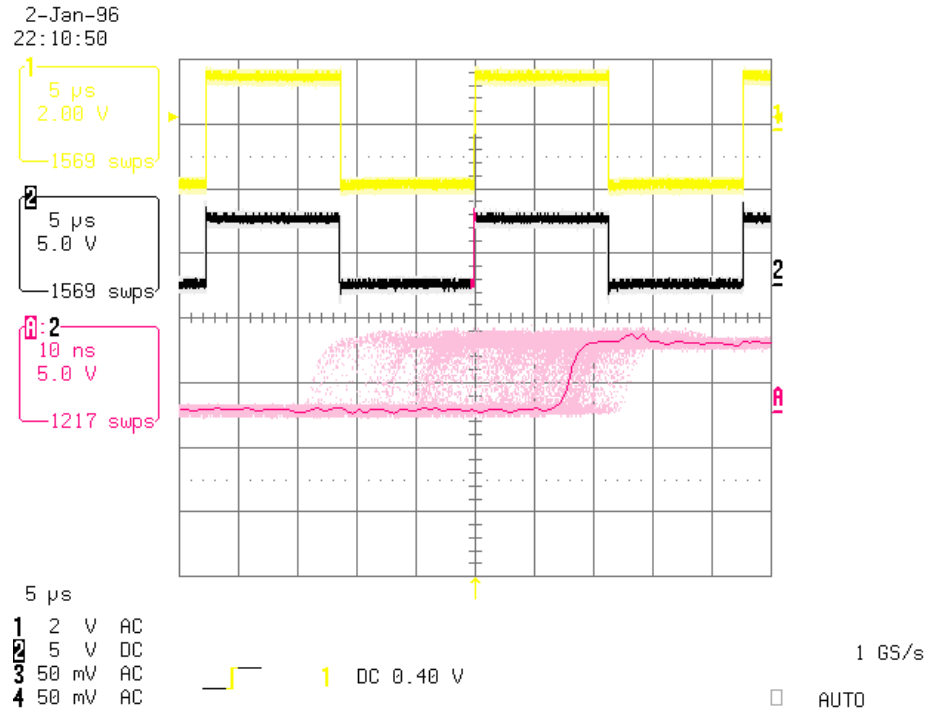


Figure 26 – Low Frequency Timing Jitter, 62.5 MHz PLL bandwidth

OPTIONS

The following options may be fitted to new units or retrofitted at a later date.

Option code	Option
VID	Locking to video sample rates
V5	Mains voltage set to 230/240V
V4	Mains voltage set to 215/220V
V2	Mains voltage set to 115/120V
V1	Mains voltage set to 100V

Table 8 - Options available

Locking to Video Sample Rates

We can fit additional video frequency VCXO's (enabling frequencies such as 44.056kS/s and 47.952kS/s). This option must be fitted at dCS to allow full checking. Contact dCS for details

Mains Supply Voltage

Any unit may be set for operation from 230/240V, 220V, 115/120V or 100V A.C. The voltage setting can be updated later by your Distributor, if necessary. Specify the new voltage code.

Ordering Options for a New Unit

To order any option, check the option codes from **Table 8** above and tell us:

dCS 992 with options <option codes>

IMPORTANT!

You must specify a supply voltage option code.

Having Your Options Changed

dCS support modifications, updates and option changes to supplied units. Major changes are normally carried out at dCS as we have extensive test facilities and can verify the changes. Please contact your Distributor or dCS for details.

IMPORTANT!

Please do not attempt the changes yourself. The unit's performance or reliability may be impaired and the warranty will be invalidated.

MAINTENANCE AND SUPPORT

Hardware

Service & Maintenance

dCS audio products are designed not to need regular maintenance, and contain no user serviceable parts:

- there are no moving parts,
- there are no short life or wear-out parts used,
- the units have no holes through which liquids or contamination can normally enter,
- no dust deposits build up to degrade performance.

All parts are replaceable or upgradeable by dCS, for a period of at least five years from the date you purchased your unit. If your unit is damaged in some way, please contact your Distributor or dCS.

User Changeable Parts

There are no user serviceable parts inside the case. Routine maintenance (apart from calibration) is not necessary and repairs are generally carried out by dCS, since this allows us to thoroughly verify the results before shipment.

There is a mains fuse in the mains socket, accessible from the outside of the unit. This may be changed by the user. The current consumption of the unit is very low (200mA at 115 V) so it only blows if there is a fault - usually if the unit is set to a low voltage setting (100 - 120V) but has been plugged into a high voltage mains (220 - 240V). Usually no other damage is caused, but if the fuse blows repeatedly on replacement, some other damage will have been done and the unit must be returned to dCS for repair.

Fuse Type : 20 x 5mm 2 amp HRC fuse

If the fuse should fail, it is essential that it be replaced with one of the same type. Failure to do so could result in damage to the unit and may invalidate the guarantee. To gain access to the fuse, remove the IEC mains connector, use a small flat bladed screwdriver to pry up the tab on the fuse carrier and pull it out. Push the fuse out of the clip in the carrier and replace it with a new one. Push the carrier back into the unit so that it clicks home.

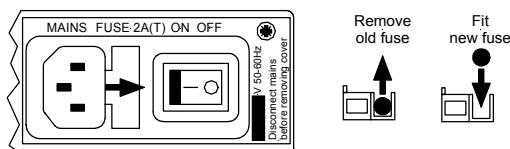


Figure 27 – Changing the Mains Fuse

IMPORTANT!

Disconnect from the mains before changing the fuse.

Software

Installing New Software

Updated operating software can be downloaded via the RS-232 link from a PC COM port, using the Windows Remote software running on the PC, or can be copied from an EPROM installed internally.

Using the RS-232 download is hands free, but takes about 40 mins per unit. With special software (contact *dCS*) multiple units can be daisy chained together so that one PC can update them all serially (overnight).

To update the software by the RS-232 link, load the new software into a convenient directory on the PC, then run the Windows Remote programme with whatever units you want connected. The software will scan the RS-232 chain for units (this takes a while) to see what it thinks is connected, and then reports back. For each unit there is an **Info** button. Select the **Info** button for the unit you wish to update, and then select **Download Flash**. The programme will prompt you for the file to use, and then will start the download. If you want to programme many units automatically (say overnight) contact *dCS* for special software to enable this function.

IMPORTANT!

*Do not turn the unit off until the download is complete. The unit has to erase its current programme before it can store the new one, so if the power is turned off, its internal programme store will have been erased but no new programme installed. Contact *dCS* if this happens inadvertently – the situation can be recovered if it does happen, but it involves taking the lid off the unit.*

To find out if there are any software updates available for your equipment, call us, or email us, with your units serial number, or check our web site (www.dcsLtd.co.uk). In general, software updates are free. Manuals for updated software can be downloaded from our web site, or just call us.

During An Update ...

As soon as the download starts, the 992 will display **Prog**. The Windows programme will say **Erasing Flash** (10 secs), then **Flash Erased** (quick) then **Programming Flash**. At this stage a progress bar with a count down time is displayed, showing how much time is left (30 mins or so). After this has counted down, the PC says **Done** and the ADC reboots itself. Depending on the nature of the software update, it unit may then need to re-initialise its internals – if it does, it will say **Hold** on its front panel. Do not do anything at this stage. Then, when that message disappears, it will be back to normal use.

Warranty

Initial Warranty

dCS Ltd. warrant this product against defects in materials and workmanship for a period of 90 days from receipt by the end user. Warranty repairs must only be carried out by dCS or an authorised dCS Distributor.

Extended Warranty

The period of the Warranty cover may be extended to 1 year from receipt by the end user at no extra cost, by registering your purchase with dCS. Your Reseller should have arranged this on your behalf by filling in an **Owner Registration** form at the time of sale and returning it to dCS. If you do not receive an **Extended Warranty Certificate** for this unit within 30 days of purchase, please note the serial number on the underside of the unit and contact dCS.

Registration ensures you will receive information on important hardware and software upgrades as they become available.

If you sell the unit within the first year, the balance of the Extended Warranty may be transferred to the new owner by completing the **Owner Registration Transfer** form, page 77, and returning it, with the **Extended Warranty Certificate**, to dCS.

The calibration accuracy of the dCS 992 is guaranteed for 6 months use or 12 months from date of purchase, whichever is sooner.

Warranty Exclusions

The Warranty on this dCS 992 shall be void if:

- the product is misused in any way.
- any unauthorised modifications or repairs are carried out.
- the product is not used in accordance with the Operating Conditions stated on page 53 of this manual.
- the product is serviced or repaired except by an authorised dCS Distributor.
- the product is operated in a system without a mains earth (or ground) connection.
- the unit is returned inadequately packed .

Obtaining Service

If you experience problems with your dCS 992, you should check the **Troubleshooting** section on page 64. You may be able to resolve the situation yourself (for example, by changing a menu setting).

If this does not resolve the problem, contact your local authorised dCS Distributor for advice, quoting the model, the serial number from the underside of the unit, the software version number (see **Issue** on page 20) and giving a detailed description of the fault. Please do not return any unit to dCS without obtaining a Service Return number as this will delay the repair. You may also incur costs if the unit is found to have no fault. When returning a unit, the original packing should be used to avoid transit damage. Replacement packaging sets may be purchased from dCS.

During the Warranty period, there will be no charge for repair or replacement.

Hardware Update or Calibration

You may wish to have your unit calibrated and updated occasionally. *dCS* offer this service - we will install any modifications or updates that have occurred since your unit was first shipped, and give the unit a full retest to current standards. The price will depend on the hardware changes necessary – so contact your dealer or us. In order to ensure speedy turn around please contact us prior to returning the unit.

Safety and Electrical Safety

There are no user serviceable parts inside the *dCS 992* and so there is no need to remove the covers. If for some reason you do:

IMPORTANT!

Disconnect from the mains before removing any covers or changing the fuse.

There are no substances hazardous to health inside the *dCS 992*.

TROUBLESHOOTING

Error Codes and Messages

The error codes reported by *dCS 992* provide an effective means to diagnose the majority of problems that may be encountered in use - including problems with the overall system the unit operates in, internal device warnings and internal device failures. Please note that through damage or component failure, the unit self check may fail to operate. If this happens, please contact your Distributor or *dCS* for assistance.

Internal Device Error Codes

Sometimes the unit may misbehave. If there is an internal reason, an internal device error code may be displayed as follows:

Err.xy an error xy (see table below) has been detected.

where **xy** values have the following meanings:

Code	Description
01	E ² memory (EEPROM) not present
02	Error initialising DSP
03	Error loading DSP
04	Error initialising DSP for coefficients
05	Error initialising DSP for coefficients
06	Error loading DSP coefficients
07	Error loading DSP coefficients
08	Error sending command
09	Error sending command
10	Error sending command
11	Error sending command
12	Error with LSB/MSB configuration
13	Error with LSB/MSB configuration
14	Error with LSB/MSB configuration
15	Error configuring FPGA
99	DSP error

Table 9 – Internal Error Codes

If you get any of these, please contact *dCS*, with as much information as possible to help us re-create the problem. Some of these may have hardware problems as their cause, some may be caused by software problems.

System Messages and Error Codes

Some other messages may be displayed that give indications of errors from other sources (outside the unit):

Display	Description
Hot	The unit is overheating, and performance may suffer. See page 53.
Ouch	The unit is seriously overheating, and may be damaged shortly. Switch off! See page 53.
BadFs	The sample rate coming in is not one the unit can lock to, or there is an input signal quality problem.

Table 10 – System Error Codes

Troubleshooting Your System

If you experience difficulties when using your *dCS 992*, the following suggestions may help to resolve the problem.

The unit fails to power up

- Ensure there is power available on the mains cable and the units mains switch is On.
- Check the rated supply voltage shown on the rear of the unit matches the local supply voltage.
- Check that the fuse has not blown - if so, correct any obvious cause then replace the fuse as described in the section **User Changeable Parts** on page 60.
- Check that the mains cable is pushed fully home into the mains inlet in the rear of the unit.

The unit hangs up after a period of use

- This can result from power brown-outs or lightning discharges causing the internal microcontroller to crash. Try switching off for 10 seconds then powering up again.
- If the unit hangs up again, try a different mains outlet and cable.

The unit fails to slave to an external reference

- Press the **Master/Slave** button to select **Slave** mode. If a suitable reference is connected, the **Slave** LED should light and the unit should lock after a few seconds.
- Check that the External Sync cable is of the correct type, connected correctly and is not damaged.
- Check that the **Test In** option is set to **In**.
- Connect a different piece of digital equipment to test the locking capability of the unit. If the condition persists, contact your Distributor or *dCS*.

Equipment does not lock reliably to the *dCS 992*

- Check that the digital audio cable is of the right type, correctly connected and not damaged. Damaged cables are a VERY common source of malfunctions!
- Check that the equipment to be synchronised is set to receive a reference input.
- The cable length may be excessive, especially if the fault occurs at 88.2 or 96kS/s but not at 48kS/s. See **How Far will it Go?** on page 49.
- Try a connecting to a different AES/EBU or Word Clock output (as appropriate) to see if this cures the fault.
- If this condition persists, contact *dCS* or your distributor.

The synchronised equipment reports the wrong sample rate

- If the *dCS 992* is set to 88.2 or 96kS/s but the synchronised equipment reports 44.1 or 48kS/s, the Output Format may be set to Dual AES (2 on the Format display) while the synchronised equipment is set to Single AES. Press the **Output Format** button to correct this.
- The Phase Locked Loop (PLL) in some equipment may incorrectly identify 88.2 or 96kS/s clock signals and lock at half the incoming sample rate. Try changing inputs or unplugging then reconnecting the reference cable to force a re-lock.
- If you change the *dCS 992* sample rate but the synchronised equipment ignores the change, it is probably not set to accept a reference input or auto-slave.

The main display blanks out a few seconds after pressing a button

- Access the Menu and set the **7-Seg** option to **On**.

The Remote Control program freezes up periodically

- Access the Menu and ensure the **RS out** option is **Off**.

The sample rate is more than 1ppm out

- If the **Calibration** indicator is lit or the unit has not been calibrated for 12 months, it is in need of re-calibration. There is no real-time clock inside the *dCS 992*, so it can log how long it has been powered for but does not know how old it is. Crystals age slowly with time, as well as use.
- If you have just changed the sample rate or switched the unit on, wait at least 30 minutes for the crystal oscillator to stabilise and check again.
- Access the Menu and, if necessary, set the **Offst** option to zero then check again.
- Check that the **Master** LED is lit. If not, disconnect any cables from the **External Sync** connector.
- If the sample rate is more than 10ppm out of calibration after running undisturbed for 30 minutes, the unit may be faulty – contact *dCS*. Crystals may be damaged if the unit is subjected to a heavy blow or dropped on a hard surface.
- Please ensure you are checking the accuracy against a reliable source, such as a GPS receiver.
- If the unit is very hot or very cold, the calibration will not be effective. Access the Menu and check the **Heat** option.
-

The Test Generator produces the wrong tone frequencies

- If the **Output Format** is set to **2**, ensure your DAC is set to receive Dual AES and use the AES/EBU outputs only.

I hear periodic clicks from the monitoring DAC

- This may be caused by slaving the DAC to the Master Clock but not the equipment feeding the DAC.
- The use of damaged or unshielded cables can cause this fault.

The system locks but the DAC outputs full scale noise

- This may be caused by having one item in the system set to a different sample rate, rather than slaved to the Master Clock.
- If there is a Sample Rate Converter in the system which is set to change the sample rate, you cannot directly synchronise equipment feeding the SRC, the SRC itself and the DAC connected to the SRC by slaving everything to the *dCS 992*. Slave the DAC to the SRC instead.

dCS SUPPORT

I wish

If you wish your unit did something it does not, or that this manual told you something it does not, or that we made something we currently do not - tell us. If we can fix it with software, or a manual reprint, and we do so - we will update your unit free of charge. If we do decide to make the thing, we will discuss with you how you would like it to operate.

We value our customers, and we want to make products that do what you want.

If You Need More Help

Contact *dCS*. Our office hours are 8:00 am to about 7:00 pm, Monday to Friday, UK time (UTC in summer, or UTC + 1hr in winter). Contact us by phone or fax on:

	Inside the UK	Outside the UK
Telephone	01799 531 999	+44 1799 531 999
Fax	01799 531 681	+44 1799 531 681

Table 11 – *dCS* Phone Numbers

You can write to us at:

dCS Ltd
Mull House
Great Chesterford Court
Great Chesterford
Saffron Walden CB10 1PF
UK

Our E-Mail address: more@dcsLtd.co.uk

Our web site is: <http://www.dcsLtd.co.uk>

Other Information

dCS produce technical notes from time to time on topics related to ADCs. If you are interested in these, please do not hesitate to contact us or check our web site.

INDEXES AND SOFTWARE VERSION NUMBERS

This manual is for software version 2.0x.
V2.0x versions differ from version 1.0x in having:

- multiple clock generators, for multiple sample rate operations,
- Sync link capability
- “Learn” mode,
- many Superclock options
- enhanced TCXO control.

Definitions of Units

dB0	Level in decibels, referred to a full scale sine wave in a sampled system. So, 0 dB0 is full scale.
dBu	Level in decibels, referred to a 0.775V rms sine wave, with no external loading (u = unloaded). The level of 0.775V is derived from the older dBm, for which the reference level is 1mW of signal power into a 600Ω termination from an output with 600Ω source impedance.
dBV	Level in decibels, referred to a 1.0V rms sine wave, with no external loading.
kS/s	Sample rate in kilo-samples per second. This replaces kHz which is technically incorrect when referring to sample rates.

Abbreviations Used

ADC	Analogue to Digital converter, also known as an A/D.
DAC	Digital to Analogue converter, also known as a D/A.
DDC	Digital to Digital converter – used for format conversion and some DSP operations that change the data.
GPS	Global Positioning System.
TCXO	Temperature Compensated Crystal Oscillator.
VCXO	Voltage Controlled Crystal Oscillator.

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2nd Owner

Owner Registration Transfer

To transfer the balance of the Extended Warranty to a new owner, please complete the form below in block capitals and forward it, with the **Extended Warranty Certificate**, to dCS at the address below within 30 days of the sale.

dCS Ltd
Mull House
Great Chesterford Court
Great Chesterford
Saffron Walden
CB10 1PF
U.K.

Serial No: 992-

(located on the underside of the unit)

Name of new owner:

Company name:

Address 1:

Address 2:

City:

Post code:

State:

Country:

Tel:

Date purchased:

Fax:

E-mail:

Website:

Name of registered owner:

Signed:

