

## *dCS Scarlatti Clock*

### **Service Manual**

**October 2009**

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## SAFETY AND CONFIDENTIALITY

### Safety Warnings



**Servicing must be carried out by qualified service personnel only.**



These products contain circuitry that operate at high voltages and/or currents. Removing safety covers can expose personnel to risk of electric shock or other injury.

Take special care when working on the Power Board, as much of the board is at high voltage.



These products contain static-sensitive devices which can be seriously damaged by incorrect handling. Observe standard anti-static precautions at all times.



This product is lead-free to comply with the RoHS directive. If soldering or de-soldering is required, SAC solder (tin / silver / copper) must be used to ensure reliable repairs.

### Disclaimer

Data Conversion Systems Ltd. accept no liability of any kind for loss, accident or injury resulting from service activities.

### Confidentiality



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## UNIT DESCRIPTION



The *dCS Scarlatti Clock* is a Grade 1 digital audio master clock intended for use with a *Scarlatti Transport*, *Upsampler* and *DAC*. The unit is extensively configured by software stored in flash memory. The key features are as follows.

- 8 industry standard Word Clock outputs on BNC connectors.
- 44.1 or 48kHz output frequencies, accurate to better than 1ppm (typically 0.1ppm when shipped).
- Industry standard Word Clock Reference Input allows the unit to be locked to Word Clock or AC sources at 32, 44.1, 48, 88.2 or 96kHz or 1, 5 or 10MHz (e.g. from a GPS receiver or Rubidium source).
- Twin crystal oscillators – one for 44.1kHz, the other for 48kHz.
- “Dither” feature exercises the receiving device’s PLL to improve lock accuracy.
- Discrete Phase-Locked-Loop circuitry is used to lock to external sources.
- Software may be updated by the user from a suitable CD, played on a standard CD Player or Transport. If the software has become corrupted, the unit may be re-booted from a ROM, fitted to a Programmer Board.
- All-aluminium case with laminated damping plates.

## SOFTWARE AND HARDWARE HISTORY

### Software History

April 2007 v1.00 – This is the first issue, there have been no updates so far.

### Hardware History & Configuration Code

For products manufactured since early 2000, the long version of the *dCS* unit serial number may be read from the menu. This contains a great deal of information about the build standard of the unit, allowing *dCS* to advise on the suitability of software updates, whether a hardware update is advisable and (sometimes) the cause of a particular problem.

The example below is a *Scarlatti Clock* with serial number SCK-0S2-7G4--1C5-012-5832.

A typical serial number	This code group means:
SCK	<b>PRODUCT CODE.</b> SCK = Scarlatti Clock, SDC = Scarlatti DAC, STT = Scarlatti Transport, SUP = Scarlatti Upsampler, PPR = Puccini Player, PUU = Puccini U-Clock, PCK = Paganini Clock, PDC = Paganini DAC, PTT = Paganini Transport.
0S2	<b>OPTIONS CODE.</b> First character = product options (e.g. 1394 interface fitted). Second character: B = Black, S = Silver. Third character = voltage setting: 1 = 100V, 2 = 115/120V, 3 = 200V, 4 = 215/220V, 5 = 230/240V. Early versions have only 2 voltage settings: 1 = 100-120V, 4 = 200-240V.
7G4	<b>CONTROL BOARD CODE.</b> The build standard of the Control board.
-	<b>TOP BOARD CODE.</b> The Clock has no top board, so this slot is not used.
1C5	<b>DISPLAY BOARD CODE.</b> The build standard of the Display Board.
012	<b>CASE &amp; BASE CODE.</b> This covers the build standard of the case parts, mains transformer, Power Board, back panel wiring and anything else.
5832	<b>CONTROL BOARD SERIAL NUMBER.</b> Each Control Board has a unique serial number.

## COMMON SET-UP ERRORS

### GOLDEN RULE 1

**The source *MUST* be locked to the Master Clock.**

Locking the DAC (and possibly the Upsampler) to the Clock but leaving the CD Transport unlocked and running in Master mode results in either occasional clicks (which may not be noticed) or frequent clicks (which can make the system unusable), depending on the difference between the 2 clock frequencies.

### GOLDEN RULE 2

**The sample rates used in the system *MUST* be compatible with the Clock frequency.**

Using an incompatible mixture of sample rates in a system generally results in the DAC being unable to lock, and so remains muted.

For example, upsampling CD data to 192kS/s while trying to lock the whole system to a Clock set to 44.1kHz results in the DAC locking to the Clock but being unable to decode the data, and so remains muted. The sample rates used *MUST* be exact multiples of the Clock frequency:

- With the Clock set to 44.1kHz, you can use 44.1, 88.2 or 176.4kS/s or DSD (2.822MS/s).
- With the Clock set to 48kHz, you can use 32, 48, 96 or 192kS/s.

One exception to Golden Rule 2 is the Scarlatti Upsampler, which has been designed for a more flexible response to Clock frequency. It will accept Word Clock at 44.1 or 48kHz while decoding data at any standard rate. The Output Sample Rate should be set to a multiple of the clock frequency to ensure the DAC will accept the data.



Problems caused by ignorance or misunderstanding of these 2 rules are VERY common!

#### **Symptom: The unit fails to power up**

- Check that the rated supply voltage stated on the back panel matches the local supply voltage.
- Ensure there is power available on the power cable, connect it to the unit. Set the back panel power switch to the **I** position (ON), wait 10 seconds and press the **POWER** button.
- Check that the mains fuse under the mains inlet has not blown. If it has, correct any obvious cause then replace the fuse as described in the manual.

#### **Symptom: The Display turns on when a control is operated, then turns off**

- This happens when the Display Settings > Display On/Off menu page is set to OFF. Change the setting to ON to stop the Display blanking out.

#### **Symptom: The unit fails to respond to the controls**

- If the indicator above the **POWER** button is illuminated, press the **POWER** button once to return to normal operation.

#### **Symptom: The Clock will not lock to an External Reference source**

- If you decide to lock the Scarlatti Clock to an external clock source (such as a GPS receiver), ensure the source is more accurate and stable than the Clock's internal oscillator!
- Set the Coupling menu page to the correct setting: Bipolar for RF sources or TTL for Word Clock sources operating at TTL levels. This must be correct or the Clock will not lock reliably, if at all.
- The Clock is designed to lock to a stable external source whose frequency accuracy is within +/- 300ppm of nominal. However, if the external source is anywhere near these limits or is so unstable that the Clock loses lock, it is not a suitable reference for a Master Clock.

**Symptom: The Clock displays SYNC with no External Reference connected**

- This can be caused by crosstalk to the receiver circuit. Set the Coupling menu page to TTL to prevent the Clock trying to lock when there is no external source connected.

**Symptom: The Clock displays CAL**

- CAL indicates that the calibration data has been corrupted. Contact *dCS* to arrange re-calibration.

## DISMANTLING PROCEDURE

Bear in mind that you should not have to completely dismantle the unit to carry out the repair!

Tools required:

- Ratchet screwdriver handle.
- Screwdriver bits: Allen key 2, 2.5 & 3mm A/F, 6mm flat blade, No.1 PoziDriv.
- Allen key 1.5mm A/F.
- Nut spinners / socket spanners: 5.5mm, 7mm, 12.5mm (1/2"), 14mm (5/16") & 16mm (5/8") A/F.



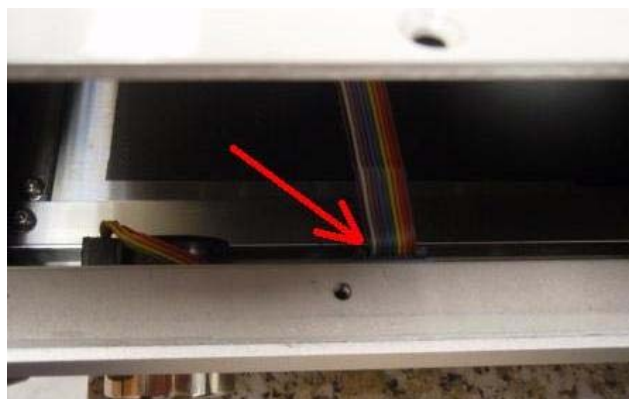
Remember to observe anti-static precautions when dismantling.

### Opening the case

Disconnect all cables from the unit. Rest the unit on a soft anti-static surface to prevent damage to the finish. Turn the unit upside-down and remove the 14 screws shown in red below.



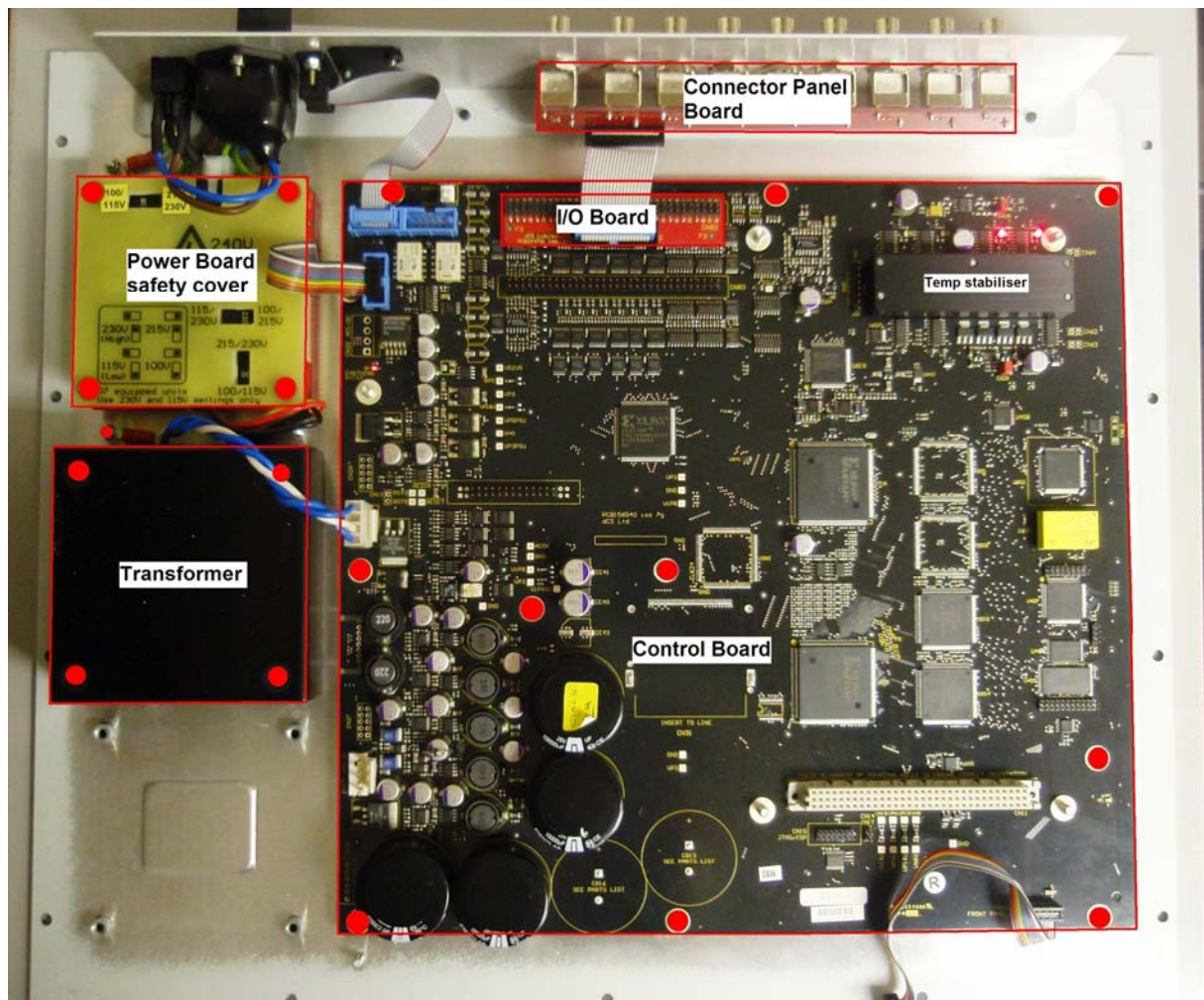
Lift the front edge of the base plate, reach inside and disconnect the ribbon cable from the Display Board, indicated in the picture below by the red arrow.



(Don't forget to reconnect the cable when you reassemble!) Lift the base plate out of the case, taking care that the rear panel connectors clear the back of the case.



## Identification of the sub-assemblies



The fixings are indicated by red dots.

## Removing sub-assemblies

The **Power Board** is protected by a yellow safety cover, fixed by a screw at each corner. The Power Board underneath is fixed by a hex pillar at each corner. Disconnect the cables and lift the board off the 4 studs.

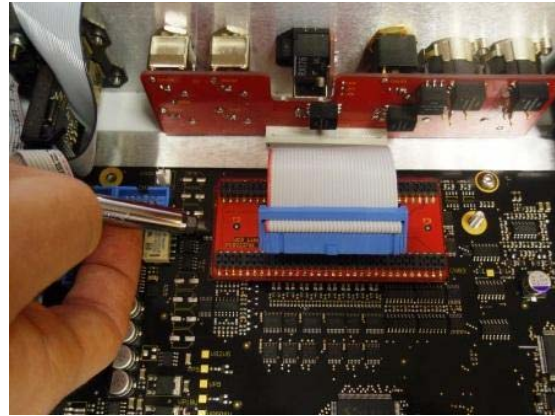
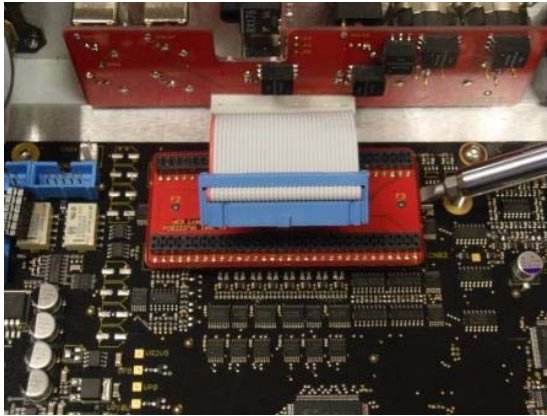
The mains **Transformer** is fixed by a screw in each corner. Remove the screws, disconnect the cables from the Power Board and Control Board, then detach the green/yellow screen wire from the base plate.

The **I/O Board** (made as part of the Connector Panel Board) is a **very tight press-fit** onto Control Board header CN82/83.



**This board is difficult to remove!** Careless use of tools can cause serious (and expensive) damage to the Control Board, **for which dCS shall not be liable**. If you really need to remove it and you are not confident you can do it safely, refer servicing to dCS.

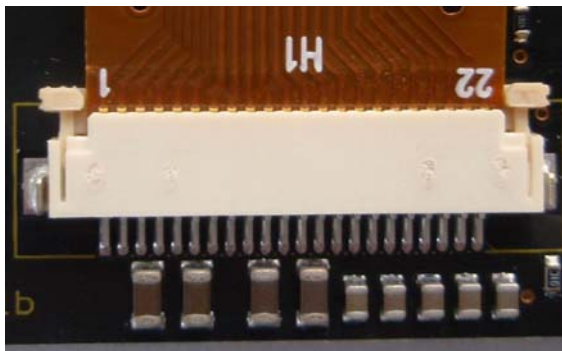
Use a 6mm flat-blade screwdriver to lever the right side of the board up a few mm, pivoting on the top of the stud to the right of the board. Carefully lever up the left side of the I/O Board in the same way, protecting the Control board with your fingers. When the I/O board has been loosened, lift it off. The photos below show the removal of a similar board.



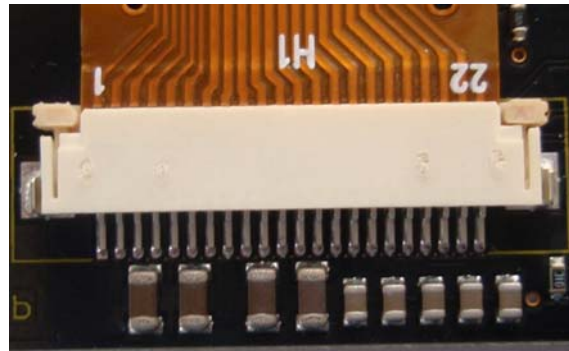
The **Control Board** fixings are shown as red dots on the previous page.

The **Connector Panel Board** is fixed to the back panel by the nuts on the connectors themselves.

The **Display Board** is secured to the case front by 12 nuts and washers. Release the clamps on CN4 by pulling them out of the connector by a few mm. (When reassembling, take care to ensure the flat flex cable is fully engaged inside CN4 and the clamps are pushed back in.) Disconnect the cables from CN4 & 5, remove the nuts and washers and ease the board off the studs.

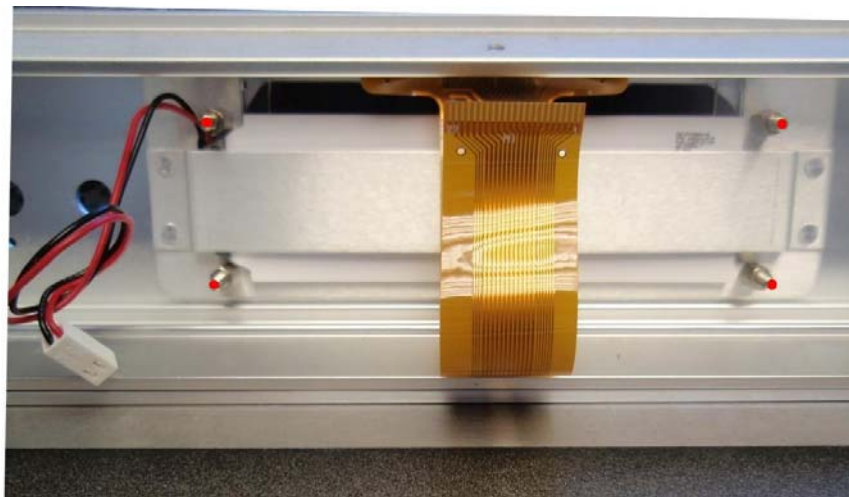


ZIF clamp open



ZIF clamp closed

The **LCD module** is clamped to the front panel by a metal yoke secured by 4 nuts. When re-fitting the LCD module, tighten the nuts just enough to secure the module. Take care not to over-tighten the nuts, as this can cause pale patches on the display or even damage the device. The pillars used to space the Display Board from the front panel are longer (M3 x 10), take care not to mix them up.





## SUBASSEMBLY DETAILS

Subassemblies which are common to other products are detailed in separate Service Manuals.

### Common Subassemblies

#### Control Board DCS156541 v7



The Control Board carries out all the digital processing and provides regulated DC to the unit. This board is common to most other current *dCS* products, it is configured by software. To date, the 7G version of this board has been used on all *Scarlatti Clocks*.

A DCS063290 temperature stabiliser block is fitted over the crystal oscillators on the Clock Control Board.

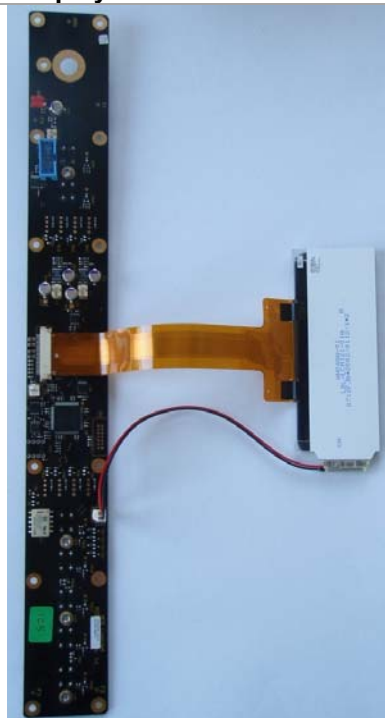
The circuit diagram file is 156540cd7g4.pdf.

The component layout file is 156540cl7g.pdf.

Earlier versions of this board were used on the Classic range.

This board is detailed in the separate **Control Board v7 Service Manual**.

#### Display Board DCS222750



The Display Board carries the front panel controls and remote receiver, it drives the LCD display module MOD0160008 (shown at the right side of the picture). The same board is used on the *Scarlatti DAC* and *Scarlatti Upsampler*.

To date, the 1B or 1C versions of this board have been used on all *Scarlatti Clocks*, version 1D will be introduced shortly. The differences between these versions are minor.

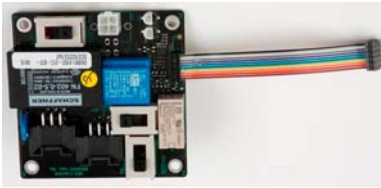
CN2 connects to Control Board CN16. This carries power (+5V / 0V), data, clock, IR remote control and power on/off signals. C4 & CN5 connect to the LCD display module.

The circuit diagram file is 222750cd1d1.pdf.

The component layout file is 222750cl1d.pdf.

This board is detailed in the separate **Display Board Service Manual**.

### Power Board DCS152223



This board filters the mains supply and allows the power to be switched on/off safely from the front panel POWER button. The connection of the mains supply to the Mains Transformer primaries is set by 3 slide switches. It is common to most current products. The Power Board is covered by a yellow insulator board for safety. Several earlier versions of this board were used on the Classic range.

The circuit diagram file is 152223cd5a1.pdf (current version).

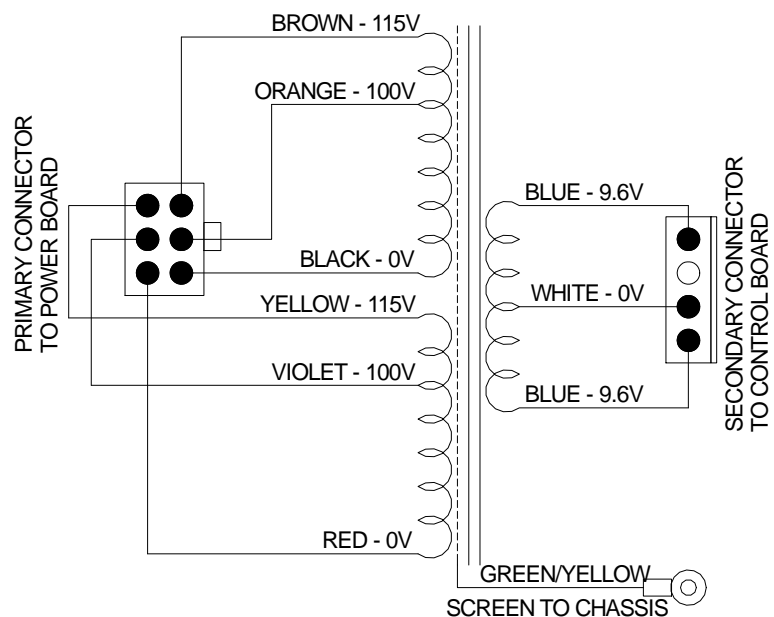
The component layout file is 152223cl5a.pdf (current version).

This board is detailed in the separate **Power Board Service Manual**.

### Mains Transformer DCS002896



This transformer is common to all current products except the *Puccini U-Clock*. The twin primaries allow the transformer to be configured for 100, 115/120, 200, 215/220 or 230/240V.



Early versions of this transformer had four primary wires instead of six and offered two ranges: 100-120V and 200-240V. The Power Board used with this early type should be set to 115/120V or 230/240V ONLY (not 100V or 215/220V – otherwise the unit will not power up).

TYPICAL winding resistances are:

- Black to Orange or Red to Violet: 22 ohms
- Black to Brown or Red to Yellow: 25 ohms
- Blue to White: 0.15 ohms

Note that there is a considerable resistance variation from one transformer to another.

## Unique Subassemblies

### Connector Panel Board DCS224761



This board is in two sections. The main part (the left hand side in the picture) carries the Word Clock I/O connectors. All connections are brought out on ribbon cable CN1.

The second part (lower right-hand side in the picture) fits onto the rear I/O header CN82 on the Control Board. CN1 connects to the ribbon cable CN2 on the main part of the Connector Panel board.

The retention force of CN82 is VERY high. Take great care to avoid damage if it is necessary to detach this board from the Control Board.

The circuit diagram file is 224761cd1b2.pdf.

The component layout file is 224761cl1b.pdf.

## FAULT-FINDING

### Known Faults and Solutions

**Make sure the latest software is loaded.**

At this time, there are no known systematic faults with the *Scarlatti Clock*.

### Fault Finding Guide

#### Symptom: The mains fuse blows

This can be caused by a brief mains voltage surge. Check that the voltage setting is correct, then fit a new fuse of the correct type (20x5mm T0.5A L). If the new fuse does not blow, soak for 24 hours to verify the fix.

If the new fuse blows, the most likely causes are:

- Incorrect voltage setting. See the Power Board Service Manual for details.
- A damaged surge arrestor on the Power Board. See the Power Board Service Manual.
- The mains transformer short-circuits. This is VERY RARE, so please do not make assumptions! Test the transformer against the circuit diagram on page **12**, checking for short-circuits. Note that the secondary windings (Blue and White wires) have a very low resistance.

To date, we have never seen a fault in the rest of the unit that causes the mains fuse to blow.

#### Symptom: The unit fails to power up

- Is AC reaching the Power Board? If not, check the mains wiring and mains fuse.
- Is the full mains voltage AC passing through the Power Board to the mains transformers? If not, make sure the Power Board is turned on and find the point at which the circuit is broken.
- Is low voltage AC reaching Control Board at connector CN18? With nominal mains voltage, the AC voltage (referred to the base plate) at pins 1 & 4 (blue wires) should be 10V and at pin 2 (white wire) should be 0V. If the voltage is substantially different, check the transformers for signs of overheating.
- To check the Control Board Power Supply circuitry, measure the DC voltages between GND (or the base plate) and the various square test point pads around the board. Typical measurements are:

Name	DC Voltage
VR2V5	+2.5V
VP5	+5.0V
VP9	+8.5V
VP18U	+18.0V

Name	DC Voltage
VP5PSU	+5.0V
VP3PSU	+3.4V
VP3	+3.3V
V1P8	+1.8V

Name	DC Voltage
VN18U	0V
VP6U	-6.5V
VN8X	-5.9V

If any of these measurements are different by more than 5%, this indicates a fault in the power supply or that the power supply is being overloaded by the circuitry it is supplying.

- If power is reaching the Control Board, check the behaviour of the red diagnostic LED, located near the front right corner of the Control Board. When power is applied, the LED should flash once and then flash twice a few seconds later, then remain off. If this does not happen but there is some LED activity, the microcontroller is not running. Try reloading the software from ROM, as described on page **19**. (Contact dCS if software later than 1.00 is not yet available.)

- At the back right corner of the Control Board, you will see a black aluminium block, which covers metal-cased crystal oscillators X01 & X02. There is provision for 4 crystals on the board, a red LED behind each turns on when the crystal is powered. At power up, the LED behind X02 should turn on and stay on. During boot-up, the LEDs behind the other 3 crystals should flash together on 2 occasions, then the LEDs behind X01 and X02 should stay on. Check that a 22.6MHz clock appears at U626 pins 3 & 4. If not, X02 or U613 may be faulty.
- If the Control Board microcontroller is running, CN12 may be connected to a PC running Hyperterminal to extract diagnostic information from the Control Board. Please see the **Service Manual for the Control Board v7** for more information.

**Symptom: The DAC does not un-mute**

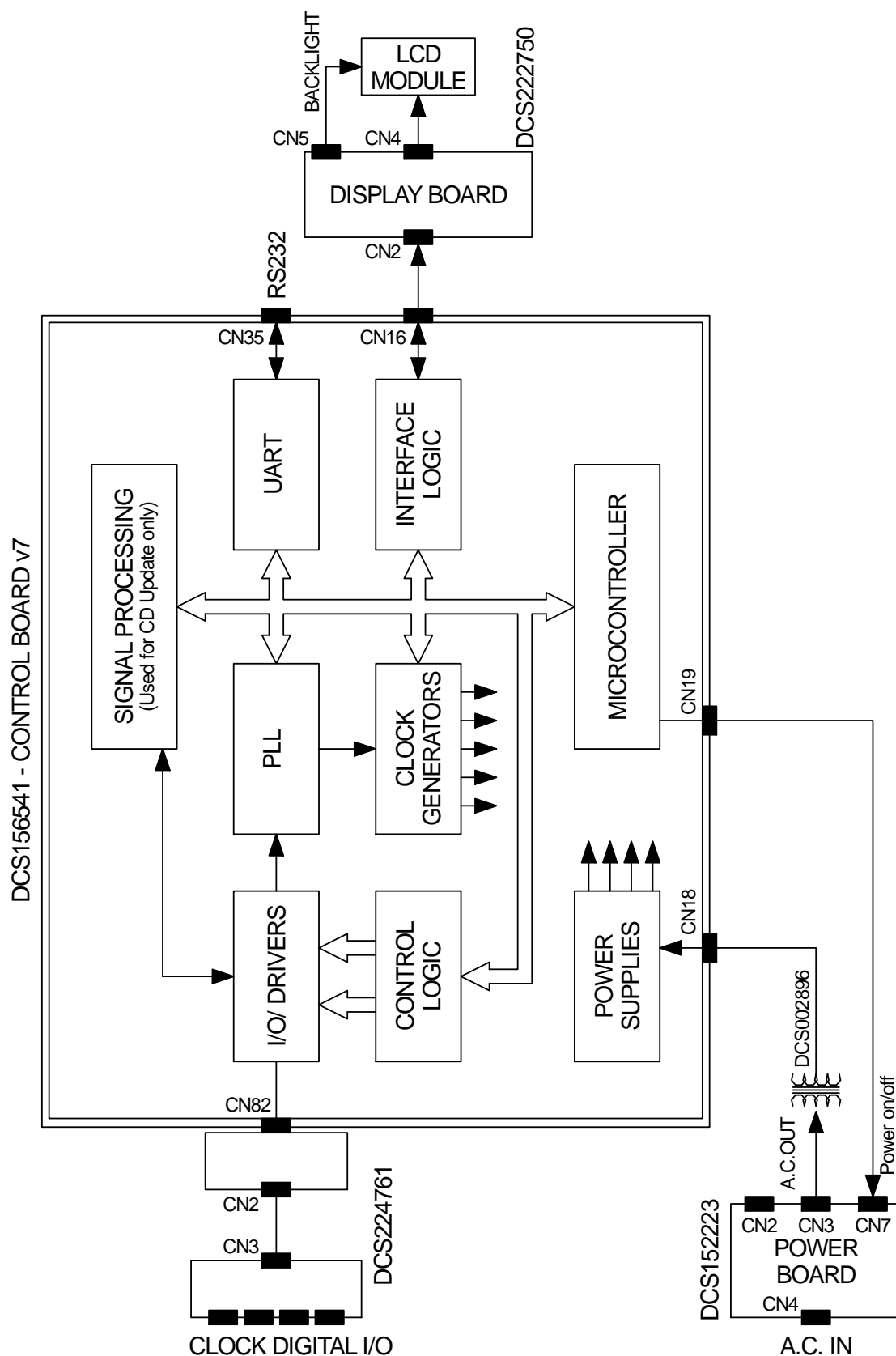
- Check that the clocking arrangements are consistent with the data rate (Golden Rule 2).
- If the Clock is connected to an external reference source, disconnect the external reference and re-check.

**Further tests**

In most cases, the above information will be sufficient to get an unresponsive unit up and running, or indicate a serious fault on the Control Board – which is normally dealt with at dCS.

If the Display Board is not working correctly but the unit is still working correctly as a Clock, please refer to the **Display Board Service Manual**. Note that an intermittent ribbon cable connection to the Control Board is a fairly common cause of Display Board problems.

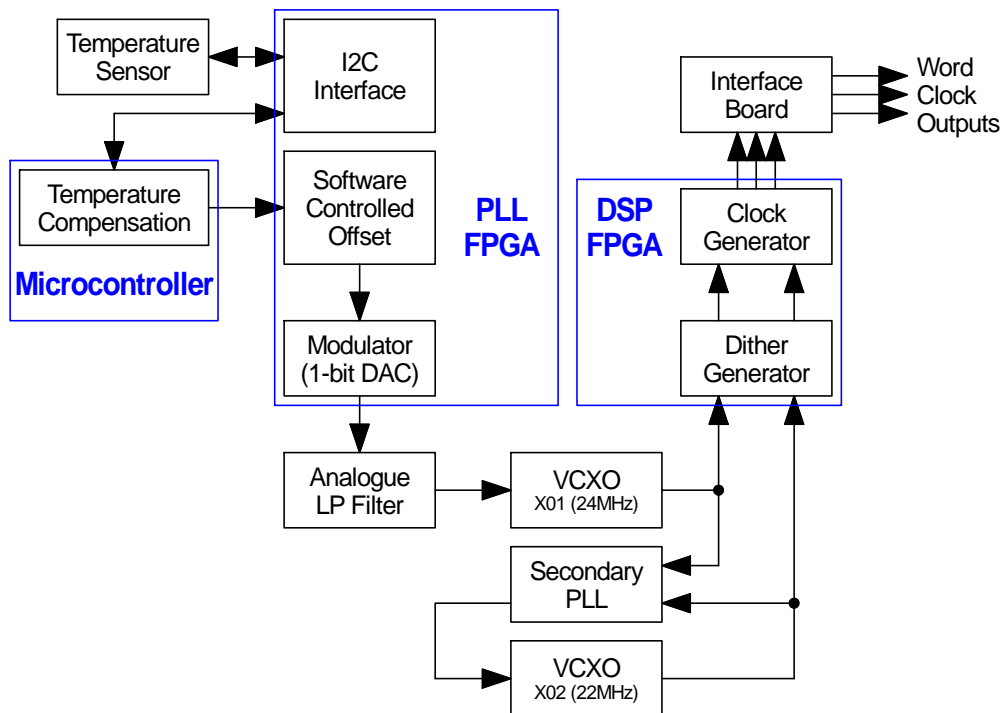
## BLOCK DIAGRAM



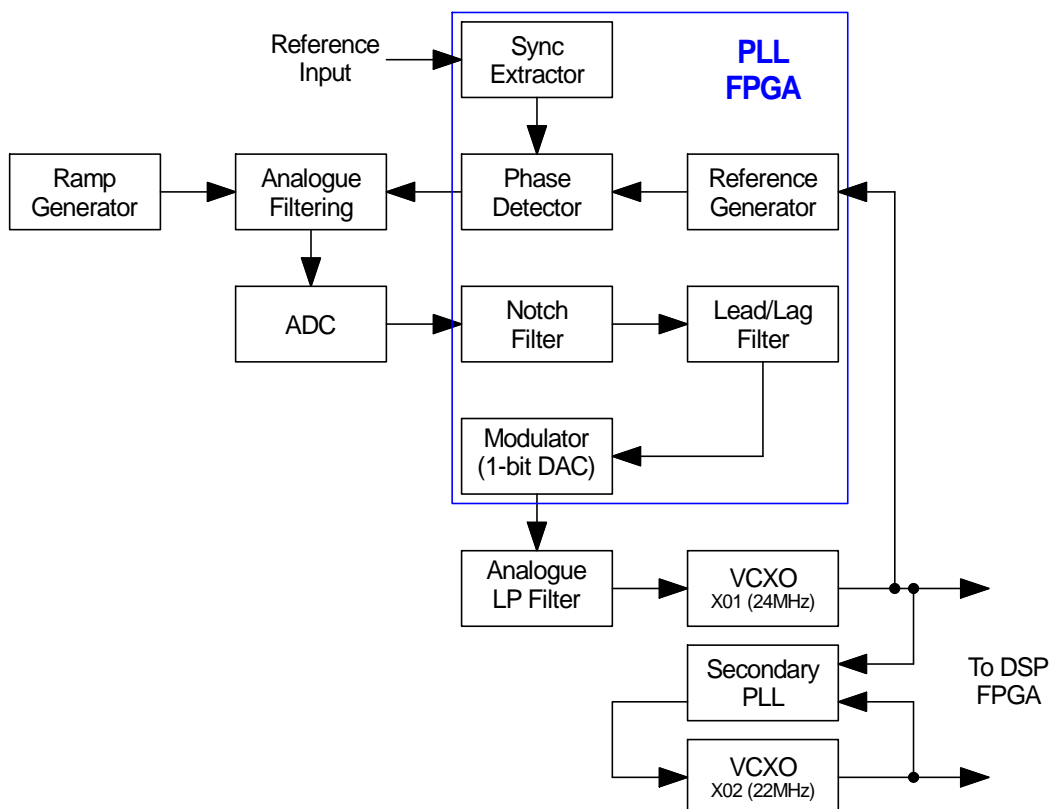


## SIGNAL PROCESSING PATH

### Using the Internal Reference



### Locked to an External Reference



## CD UPDATE PROCEDURE



The *Scarlatti Clock* software is still at version 1.00 at the time of writing, so no update CDs have been issued. When an update is issued, follow the instructions provided with the disc. The procedure below is given for reference only.

Please read these instructions through fully at least once before attempting the update.

### Update Procedure

- Mute your power amplifier.
- Load the *dCS* Update CD into the Transport, **PLAY** the disc for about 10 seconds and then press **STOP**. The disc must **not** be playing at this point.
- Connect the Transport's BNC output to the *Scarlatti Clock*'s SPDIF Input. The Clock should lock and display **00/44.1**.
- Open the *Scarlatti Clock*'s menu by pressing the **Menu** button on the front panel. Press the **Menu** button again to select the **Information** menu. Press the **→** button 3 times to highlight the **CD Update** page and press the **Menu** button to start the update. The display sequence is shown below, with approximate times.

00:00    **Please wait - Please start CD** are displayed in sequence.

Press the Transport's **Play** button. The update is largely automatic from this point.

00:15    **Scanning – OK** are displayed in sequence.

If there is anything wrong with the *dCS* CD that has been loaded, or it does not match the product, or the new software will not run without a hardware update, the unit will display **Wrong Disc!** and revert to normal operation. Don't worry – the internal software is unchanged. If either of the above cases occur contact your *dCS* distributor or *dCS*.

00:35	<b>Ver 1.00</b>	(or later)
01:25	<b>1/32</b>	The first block of data is read from the disc.
02:25	<b>2/32</b>	The second block of data is read ...
...		
33:25	<b>32/32</b>	The last block of data is read.
34:15	<b>Please wait</b>	DO NOT switch off. The unit reboots.
34:20	<b>Scarlatti Clock</b>	DO NOT switch off.
35:50		The unit reboots.
36:00	<b>00/44.1</b>	The unit finishes uploading the new software.

- Switch the *Scarlatti Clock* off (NOT just to sleep mode), wait 10 seconds, then switch on again. Your *Scarlatti Clock* is now ready for use.

### Problems?

- If the display does not change for more than 5 minutes or there is a power failure, switch off the unit at the rear panel switch, wait 10 seconds, then switch on and start the update again.
- If the disc skips or you accidentally advance the transport, the unit will display **Skipped!** Switch off the unit at the rear panel switch, wait 10 seconds, then switch on and start the update again.
- If the **Non Seq** message appears on the display, the most likely cause is that the update CD is faulty. There is no cause to worry as the original software is backed up inside the unit. Check the disc for dirt or damage. If the disc appears to be dirty, wipe it gently from the centre outwards with a dry soft cloth. If the disc is damaged, contact your local *dCS* distributor or *dCS* for a replacement. If it appears to be OK, run the **CD Update** routine again to load the new software.



If the *Scarlatti Clock* starts up correctly but has a problem of some kind, do not repeatedly CD Update as this cannot solve the problem.

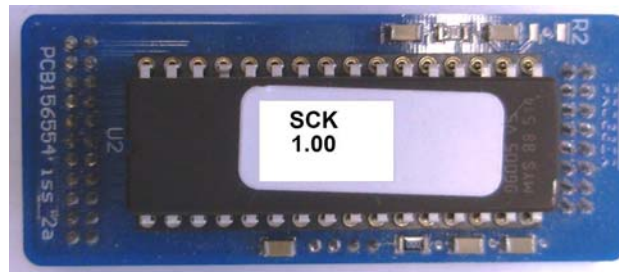
## RE-LOADING SOFTWARE FROM ROM

### Re-loading the Control software

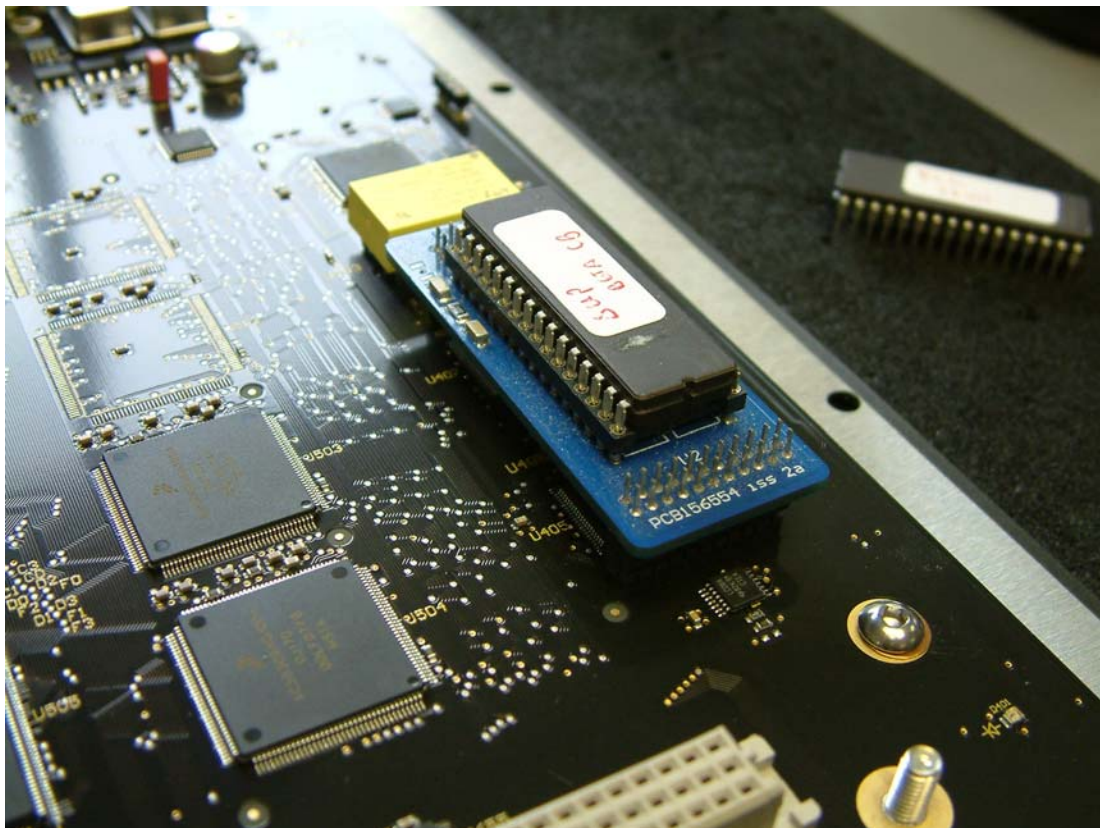
Normally, software can be updated from CD without opening the case, provided the unit boots up and runs correctly.

Occasionally, the software stored in the flash memory becomes corrupt, usually as a result of a power failure or user error while CD Updating. There is also some evidence that nearby electrical storms can do this. If the software has become corrupt, it is necessary to reload the unit from a ROM. To do this, you will need a DCS156554 programmer board and a ROM labelled “**SCK**” which is loaded with the *Scarlatti Clock* software. You can load an older version from ROM and then CD Update to the current version if necessary.

- Power the unit up and then pull out the power cable.
- Open the case, disconnect the Display Board ribbon cable and remove the top cover.
- Fit the **SCK** ROM to the socket in the programmer board, ensuring that the notched end is beside the “U2” label.



- Fit the programmer board onto the 3 headers near the edge of the Control Board, as shown below, making sure all pins fit into the sockets on the underside of the programmer board.



- Connect the power cable.

The Control Board will power up, red LED D401 will flash once and LEDs elsewhere on the board will turn on. The loading process takes several minutes, please be patient. When it is complete, the red LED D401 will start flashing steadily.



If D401 is still off after more than 10 minutes, the software has failed to load for some reason. Pull out the power cable, make quite sure the programmer board and ROM are correctly seated and repeat the process.

- Disconnect the power cable.
- Remove the programmer board and ROM, put them somewhere safe in anti-static packaging.
- Reassemble the unit, remembering to connect the Display Board cable.
- Open the menu and check that on the **Information / Version Information** page, the **Control version** matches the ROM issue.
- Check that the unit is operating correctly.