PC Maintenance notes.
The hard disk drive.

1.1   The internal mechanics of the hard disk drive.

A hard disk drive is made up of thin disks of aluminium, called platters, which are coated in a magnetic material. These disks spin all the time whilst the power is on and the read/write head moves above the platter on a cushion of air 1/100,000 of an inch thick.

Moving the drive whilst it is switched on will force the head onto the platter and will at best damage the data and at worst will damage the head.

When the power is switched off a spring will move the heads to the outer edge of the drive.

Moving the desk now will not damage any data and the fact that the platter is not spinning gives the head a greater chance of survival.

> On the 430/530 desk the risk of damage to the hard drive is reduced further by shock absorbing rubber mounts which hold the drive in place.

1.2   The physical connections to the hard disk drive.

The connections to the drive depend on the type of drive in use. The two most common types are the IDE and the SCSI.

> All 430 and 530 desks use the IDE type.

The power connector is the same on both types and has 4 pins.

Pins	Colour	Voltage
1	Yellow	+12v
2 & 3	Black	Ground
4	Red	+5v

If this power connector is not attached the computer will give an error. This connector can not be attached the wrong way round.

If the drive is an IDE type the data cable is a 40 way ribbon cable with an IDE connector on each end. Two drives can be connected to a single hard disk controller.

If the drive is an SCSI type the data cable is a 50 way ribbon cable with an IDE connector on each end. Up to 16 drives can be connected to a SCSI controller.

Pin 1 on the cable is identified by a red stripe down one edge. Pin 1 on the drive is usually difficult to identify. Most manufacturers put pin 1 on the end closest to the power connector. If the cable is connected the wrong way the drive will not work but it will not usually be damaged.

The other end of the ribbon cable is connected to the computer. Some computers have these connections on the motherboard. Most PC compatible computers have the connection on an expansion card.

The expansion card for the IDE drive will often have the floppy drive control and the serial and parallel ports on the same card. This is known as a Multi I/O card.

The expansion card for the SCSI card is either a dedicated card for the drive or is also used for other SCSI devices like a scanner or a CD ROM drive.

Both of these card will have a connector which has pin 1 marked.

1.3   Setting up the hard disk drive.

An IDE type drive must be set to one of three options.
a.   The only drive in the computer.
b.   The master drive in a two drive computer.
c.   The second (Slave) drive in a two drive computer.
These settings are made by setting links on the drive.

A SCSI type drive uses a "Logical Unit Number" between 0 and 15 (0 to F in hexadecimal). This number can be set using a rotary switch or with links.

1.4   Setting up the computer.

The computer needs to know the correct size of the hard drive. If the size is set too low it will not use the whole drive. If it is too high it will start to write over the data at the start of the drive when it thinks it is writing data to the end of the drive.

Setting the size of the drive is covered in section 1. CMOS settings.

After telling the computer the correct size it must be formatted. This is a two stage process.

Stage 1.   Partitioning a disk drive. This is only required because of the limitations of DOS. If the computer has DOS Version 5.0 or later you can install a 2 Giga Byte hard disk drive but it can not cope with a single disk area bigger that 528 Mega Bytes. The solution is to make 4 partitions, each partition is 500 Mega Bytes and the computer will treat each partition as if it is a separate disk drive.

Stage 2.   Formatting the disk drive. This is done after setting the disk partition. the surface of the disk can be compared to a car park without lines. If a car is parked in this car park it could be put anywhere. The car park will fill in a random order and it would be impossible to find the car later. Formatting is like painting the parking spaces on to the car park.

Details of how to partition the drive and format the drive can be found in section....

1.5   How the hardware controls the hard disk drive.

1.5.1   Computers with hard drive connectors on the motherboard.

The hardware for the drive is on the motherboard so the software for the drive will also be built into the motherboard.

An EPROM on the motherboard contains the BIOS (Basic Input / Output System). This program links the user software to the PC hardware. One part of it covers the hard disk drive.

The user software makes a request for some data from the disk. The software does not know how to move the disk head on every type of computer ever made so it asks the BIOS program. The BIOS tells the hardware "Move head to this position" then "Read the data going past the head" then "Put the data in the place the software expects to find it" then "tell the software it has finished".

1.5.2   Computers with hard drives attached to expansion cards.

Even if the motherboard does not have a hard drive connector built in, the computer BIOS chip will still contain a standard program for hard disk control.

Note. This BIOS program will operate in the same was as described in 1.3.1.

Most expansion cards for IDE hard disk drives are designed to use this standard program so the control is as easy as the computers with build in hardware.

> The expansion card in the 430 / 530 uses this standard BIOS program.

Some expansion cards are not standard and need to use a different program. These include most types of SCSI card and any card which uses a PCI or VLBUS connector on the motherboard. These types of card will be covered later.

The first type of expansion card has an program on it in ROM. This is copied to the computer when it switches on and is used instead of the disk control program on the onboard BIOS. This is usually done without any need for setting up however some motherboards with built in connectors may require links to be changed to disable the onboard hardware. The PCI card uses this control method.

The second type of expansion card will start by using the standard BIOS program to read data from the hard disk. After it has powered up it copies a program from the hard disk to the computer to replace part of the BIOS program. This new program could, for example, allow it to use a "local bus" connector which can read and write data faster. The VLBUS card uses this control method.

The third type of expansion card is used to add extra hard disk drives to the computer. The main hard drive will use the standard BIOS and standard hardware to control it. After the computer had powered up it reads a program from the standard hard drive which allows the computer to read and write to the new drive. The new program does not replace the existing BIOS program. Many SCSI expansion cards use this control method.

1.6   How the data is controlled - Advanced information.

Section 1.5 refers to a "program" which controls the hardware to move the hard disk drive heads and transfers the data. This program is either written in the BIOS chip, a ROM chip on an expansion card or a program read from the hard drive.

The "program" needs control of three things on the computer motherboard in order to work.

1.   An Interrupt Request line (IRQ). Each time the hard drive needs instructions from it's program it sends an interrupt. The computer looks at the number of the interrupt, goes to the area of memory associated with that interrupt request, and runs the program that it finds there.

2.   The Input / Output Address (I/O address). This is a very small area of memory which is used by the processor to communicate and copy data to and from the hard drive.

3.   A Direct Memory Access line (DMA). The transfer of data from the disk drive to the memory is very slow and the processor can not afford to stop whilst the information is being copied. The DMA controller works independently to the processor. While the processor is doing it's internal calculations it is not reading from or writing to the computer memory. The DMA controller uses this free time to transfer data from the I/O address directly to the computer memory.

If any other device or computer program uses the same IRQ line, I/O Address or DMA line the communication to the hard disk drive will fail.

1.7   Corruption of data on a hard disk drive.

There are two common ways in which a data or program file can be corrupted.
a.   If the disk is turned off in the middle of a data transfer the data on disk will not be complete and it can not be read back. On a PC this is always a risk which is why most word processing software makes regular backup copies.
b.   If the disk is knocked while it is spinning the head can damage the surface of the disk and the data on it.

There are simple ways in which the engineer can identify whether a data file has been corrupted. For example, if a word processor tries to read a corrupt data file it will give an error message which says that the file can not be used.

> If the 430/530 show file on the hard disk is corrupt the desk will switch on without a show and an error will appear on the "Report" screen.

Most data corruption is caused when the computer writes to the hard disk. The program files are only read and not written so it is very rare for these files to be corrupted. If a program file is corrupted then part or all of the program will not run.

The solution is to use a backup copy of the data file on the hard drive or on a floppy disk (Providing one was made). If the program file has been corrupted the program should be loaded again from the installation disk.

Corruption of show data.

The symptoms of this fault will be when the 430/530 desk is switched on and the show is missing.

Solution.

the show should be re-loaded from a copy made on a floppy disk.

The precautions Strand have taken to minimise the risk of this fault.

When a change is made to the show, for example adding a new cue, this information is stored in an area of memory which is protected with a battery. Once every minute the desk copies these changes to the hard disk drive. After the information has been copied the program clears this memory.

When the desk is switched on it looks in this memory. If there is any information still in memory then the desk could have been switched off before it had time to copy the changes, or it could have been switched off in the middle of a copy to the hard drive.

The desk will copy the information from the memory onto the hard drive to ensure that it will switch on with all of the information of the show.

Corruption of program data.

The symptoms :-   The 430/530 desk is switched on and the Genius + / Lightpalette software does not run or tries to run then stops working, the program data may have been damaged. It must be re-loaded from the operating software disk.

The solution.

Connect a PC keyboard and insert the operating software disk in the floppy drive. Switch on the desk and wait for the message "Starting MS DOS" then press F5 on the keyboard.

Move to the floppy drive by typing   A: <Enter>
Install the software by typing GPINSTAL <Enter>

When the installation program is complete switch the desk off then back on again.

> **The precautions Strand have taken to minimise the risk of this fault.**
>
> To ensure the program is safe the 430/530 software will only write show data to the hard disk. Because the program data is not changed the only way in which the program data could be corrupted is if the hard disk drive is knocked whilst it is switched on and the disk head touches the surface of the disk.

If you think that there is a damaged area on the surface of the hard disk drive switch on the computer or 430/530 desk and wait for the message "Starting MSDOS" then press F5.

If you have DOS version 6.0 or later type the following command :-
      SCANDISK C: <Enter>

This program will test the hard disk drive. If it finds any damaged areas it will ask you if it should fix them. After fixing a file it will probably still not work as part of the file will be missing. The most important reason for running this program is to identify and mark the damaged area of the disk to ensure the computer does not try to write to them again.

1.8   CMOS SETUP options for the hard disk drive.

If the hard disk drive is changed the computer must be told the size of the new disk drive. If the size is wrong the computer may not be able to use all of the drive or it may try to use too much (This can damage the drive).

To set the size of the drive switch on the computer. While the computer is testing the memory a message may appear saying "Press DEL to SETUP".

Press DEL and the SETUP options will appear.

Notes.
a.   It is possible to turn off this message. Try pressing DEL anyway.
b.   Some older computers have a setup program on disk. If the hard drive is changed the computer must be started using a floppy disk and the program must be run from this disk to set the size of the drive.

The following sections describe the changes which can be made.

After following these instructions you can choose one of two options.
      "WRITE TO CMOS AND EXIT"
      "DO NOT WRITE TO CMOS AND EXIT".
Select one option then press Y to confirm.

The computer will now switch off then back on.

1.8.1   Setting the drive size.

If the computer has the option "Auto detect hard drive" then choose this option. The disk drive will tell the computer the size. Compare the size with the size on the drive to check it is OK then accept the setting. The computer may now look for a second hard disk drive. If this drive is not fitted then it will give a size of 0. Accept this setting.

If the computer does not have an auto detect facility go to the STANDARD CMOS SETUP screen and move to the Hard Disk C line.

Use the PgUp or PgDn keys to move to a user selectable type of drive. This is usually type 47.

Next move to the disk information area. Copy the information about the number of cylinders (Cyln), heads (Head) and sectors (Sect) from the disk drive. The write precompression (Wpcom) and landing zone (LZone) information is not used on modern drives and should be left at 0.

The size of the drive is calculated by the computer and displayed. This may not exactly match the size written on the drive. This is because the size will change slightly after the drive has been formatted.

1.8.2   Setting the system boot sequence.   *bios features Setup .*

Select the option ADVANCED CMOS SETUP then move to the option "System Boot Up Sequence"

There are two options A:, C: or C:, A:

The first option is used on most computers. If the computer is switched on with a disk in the drive it will look for system files. If there is no disk in the drive it moves to the hard drive and powers up normally.

The second option will tell the computer to look at the hard drive only. If the computer has been told that there is no hard drive fitted it will now look at the floppy drive for a system disk.

The reasons why this option is important is described in section 1.9 below.

CHIPSET FEATURES SETUP.

memory Relocation = Enable.

When putting in new hard drive set to A;C until floppy has loaded in data then set to A;C.

ALL BUT keyboard .

1.9   System files and Error - Non system disk or disk error.

1.9.1 System files.

When the PC switches on it expects to find operating system software. The standard software used in PC's and 430/530 desks is Microsoft DOS.

The Operating software is called COMMAND.COM and this gives the computer just enough commands to let you load your computer programs, eg COPY, DIR (Directory), DEL (Delete) etc.

A disk can be made into a system disk using the format command with /s on the end.   *FORMAT A: /S <Enter>*

All the information on the disk will be deleted and the operating software file called COMMAND.COM will be copied to the disk.

The   system   files   on   the   hard   disk   drive   are   :-
COMMAND.COM
MSDOS.SYS   Hidden system file
IO.SYS   Hidden system file

1.9.2 Non System disk or disk error.

Most computers are given a boot sequence of " A: , C: ". If a floppy disk is left in the drive by accident, and this disk has not be formatted as a system disk, then the computer will give the error "Non system disk or disk error"

To cure this error message remove the disk and press any key to retry.

If the computer gives this error message, when there is no disk in the floppy drive, then the system files on the hard drive are missing or damaged.

Important.   This does not mean that the disk drive has broken or can not be read. This fault would give a different error message.

To find out what is wrong with the hard disk drive and why the system files are missing put a system disk in the floppy drive. The first DOS disk is a system disk.

Put this disk in the floppy disk drive and switch on. The computer will read the system file from the floppy drive and run the DOS program. Exit from this program with F3.

To look at the files on the hard disk drive C: type the command
DIR C:\ /A <Enter>

(The /A addition to this command will also show the hidden files)

Look for the three system files described at the start of this section. If the files are missing the hard drive must be formatted again.

See section .... for details on how to format the hard drive.

The 430 / 530 desk must have the system boot sequence C: , A:. This will ensure that the desk will run the main program even it the operator has left a show disk in the floppy drive.

If the hard drive gives the error message "Non system disk or disk error" then the system files on the hard drive are missing or damaged.

Putting a system disk in the floppy drive will not do any good because the computer will always look at the hard disk drive before the floppy.

To solve this problem go into CMOS SETUP and change the System Boot Up Sequence to A: , C:. (See section 1.8 for instructions).

Now the system disk can be put into the floppy drive and the instructions for checking the system files can now be followed.

After repair of the hard disk drive is complete return the desk to the C:, A: sequence.

1.10   Fitting a brand new disk drive to a computer.

This section covers the installation of a drive as the only drive in a computer.

Connect the new disk drive to the computer then put the first DOS disk in the floppy drive.

Switch on the computer and go to the SETUP CMOS program to set the size of the hard drive. Also set the System Boot Up Sequence to A:,C:. See section 1.8.

When the CMOS program is saved the computer will now run the program on the DOS disk.

The DOS disk will detect that the drive has not been setup. It will ask you whether it should set up the disk now. Accept all of the default options and the hard disk will be setup, formatted and DOS will be copied to the hard drive automatically.

The program will end and you will be asked to remove the floppy disk. The computer will switch off then back on with DOS installed and working.

> The 430/530 operating software can now be installed. Remember to set the System Boot Up Sequence back to C:,A:.

1.11   How to format a disk drive which has lost or damaged it's system files.

Put the first DOS disk in the floppy drive. (The computer must have a System Boot Up Sequence of A:,C:)

Switch on the computer and wait for the DOS program to run. Press F3 to exit from the DOS program.

With the DOS disk still in the drive type   FORMAT C: /S <Enter>

There are several questions to make sure you know what you are about to do !.

After the format is complete switch the computer off then back on. The DOS program will ask it you wish to load DOS. You should do this now and you should accept the defaults when it asks you any questions.

After DOS is loaded the other software can be loaded again.

> The 430/530 operating software can now be installed. Remember to set the System Boot Up Sequence back to C:,A:.

1.12   Installing the 430 / 530 operating software.

> You will need to install the software from disk if the hard drive is changed.
>
> Insert the operating software disk in the floppy drive and type the following.
>
> Move to the floppy drive by typing   A: <Enter>
> Install the software by typing GPINSTAL <Enter>

Copy the power up file so that the 430/530 will switch on and run the operating software. Type the following command.

COPY C:\220os\AUTOEXEC.NRM   C:\AUTOEXEC.BAT

Press Y if it asks you if you wish to replace the old version.

Switch off then back on and the 430/530 will run the software.

Note. Remember to set the System Boot Up Sequence back to C:,A:.

1.13   Hard disk failure.

If the hard disk is broken, or the ribbon cable to the hard disk has come off the computer will give the error message "Hard disk(s) fail (80)"

Check the cable and all other connections.

Check that the disk size is correct in the CMOS SETUP screen. Section 1.8.

If the power to the hard drive is lost the same error may be seen on a computer.

IMPORTANT.   If the power to the hard drive is lost on a 430/530 the data lines will be held and the video card may not work correctly. The screen will be blank and nothing will work.

It is possible that the disk is OK but the disk controller on the disk controller card has failed. There is no way to test this without swapping the controller card.

If the whole disk drive controller card is faulty or missing the computer will give two error messages.

Hard disk(s) fail (80)
Floppy disk(s) fail (C0)

This error can also be caused if there is a bad connection between the disk controller card and the computer motherboard.

On the 430/530 this card is fitted to slot 4 labelled "Printer" on the back of the desk and not directly onto the motherboard.

If you suspect that the adapter card has the fault the motherboard tray can be moved forward and this card can be connected directly onto the motherboard.

1.14   Additional cards which can interfere with the disk controller card.

To be continued.....