MP-332 SERVICING COMPUTER MONITORS

Contents:

SAFETY

General Safety Guidelines when working on line powered equipment including:

- TVs
- Monitors
- Microwave Ovens

These guidelines are to protect you from potentially deadly electrical shock hazards as well as the equipment from accidental damage.

Note that the danger to you is not only in your body providing a conducting path, particularly through your heart. Any involuntary muscle contractions caused by a shock, while perhaps harmless in themselves, may cause collateral damage - there are many sharp edges inside this type of equipment as well as other electrically live parts you may contact accidentally.

The purpose of this set of guidelines is not to frighten you but rather to make you aware of the appropriate precautions. Repair of TVs, monitors, microwave ovens, and other consumer and industrial equipment can be both rewarding and economical. Just be sure that it is also safe!

Don't work alone - in the event of an emergency another person's presence may be essential.

Always keep one hand in your pocket when anywhere around a powered line-connected or high voltage system.

Wear rubber bottom shoes or sneakers.

Don't wear any jewellery or other articles that could accidentally contact circuitry and conduct current, or get caught in moving parts.

Set up your work area away from possible grounds that you may accidentally contact.

Know your equipment: TVs and monitors may use parts of the metal chassis as ground return yet the chassis may be electrically live with respect to the earth ground of the AC line. Microwave ovens use the chassis as ground return for the high voltage. In addition, do not assume that the chassis is a suitable ground for your test equipment!

If circuit boards need to be removed from their mountings, put insulating material between the boards and anything they may short to. Hold them in place with string or electrical tape. Prop them up with insulation sticks - plastic or wood.

If you need to probe, solder, or otherwise touch circuits with power off, discharge (across) large power supply filter capacitors with a 2 W or greater resistor of 100-500 ohms/V approximate value (e.g., for a 200 V capacitor, use a 20K-100K ohm resistor). Monitor while discharging and/or verify that there is no residual charge with a suitable voltmeter. In a TV or monitor, if you are removing the high voltage connection to the CRT (to replace the flyback transformer for example) first discharge the CRT contact (under the insulating cup at the end of the fat red wire). Use a lM-1OM ohm 1W or greater wattage resistor on the end of an insulating stick or the probe of a high voltage meter. Discharge to the metal frame which is connected to the outside of the CRT.

For TVs and monitors in particular, there is the additional danger of CRT implosion - take care not to bang the CRT envelope with your tools. An implosion will scatter shards of glass at high velocity in every direction. There are several tons of force attempting to crush the typical CRT. Always wear eye protection.

Connect/disconnect any test leads with the equipment un-powered and unplugged. Use clip leads or solder temporary wires to reach cramped locations or difficult to access locations.

If you must probe live, put electrical tape over all but the last **l/16"** of the test probes to avoid the possibility of an accidental short which could cause damage to various components. Clip the reference end of the meter or scope to the appropriate ground return so that you need to only probe with one hand.

Perform as many tests as possible with power off and the equipment unplugged. For example, the semiconductors in the power supply section of a TV or monitor can be tested for short circuits with an ohmmeter.

Use an isolation transformer if there is any chance of contacting line connected circuits. A Variac(tm) is not an isolation transformer! The use of ELCB (Earth Leakage Circuit Breaker) protected outlet is a good idea but will not protect you from shock from many points in a line connected TV or monitor, or the high voltage side of a microwave oven, for example. A circuit breaker is too slow and insensitive to provide any protection for you or in many cases, your equipment.

Don't attempt repair work when you are tired. Not only will you be more careless, but your primary diagnostic tool - deductive reasoning - will not be operating at full capacity.

Finally, never assume anything without checking it out for yourself! Don't take shortcuts!

MOST COMMON PROBLEMS

Intermittent changes in colour, brightness, size, or position.

Ghosts, shadows, or streaks in picture adjacent to vertical edges.

Magnetization of CRT causing colour blotches or other colour or distortion problems.

Monitor not synchronising on one or more video scan ranges.

Adjustments needed for background brightness (SCREEN) or focus.

Dead monitor due to power supply problems.

3.

MONITOR MANUFACTURING QUALITY AND DRY SOLDER JOINTS

Any intermittent problems with monitors that cause random sudden changes in the picture brightness, colour, size, or position are often a result of bad connections.

Bad solder joints are very common in monitors due both to poor quality manufacturing as well as to deterioration of the solder bond after numerous thermal cycles and components running at high temperature. Without knowing anything about the circuitry, it is usually possible to cure these problems by locating all bad solder connections and cleaning and re-seating internal connectors. The term ‘cold solder joint or dry joint' strictly refers to a solder connection that was either not heated enough during manufacturing, was cooled too quickly, or where part pins were moved before the solder had a chance to solidify. A similar situation can develop over time with thermal cycling where parts are not properly fastened and are essentially being held in by the solder alone. Both situations are most common with the pins of large components like transformers, power transistors and power resistors, and large connectors. The pins of the components have a large thermal mass and may not get hot enough during manufacturing. Also, they are relatively massive and may flex the connection due to vibration or thermal expansion and contraction.

These problems are particularly common with TVs and monitors - especially cheaper monitors.

To locate dry solder joints, use a strong light and magnifier and examine the pins of large components for hairline cracks in the solder around the pin. Gently wiggle the component if possible (with the power off). Any detectable movement at the joint indicates a problem. With the power on, gently prod the circuit board and suspect components with an insulated tool to see if the problem can be effected.

When in doubt, resolder any suspicious connections. Some monitors may use double sided circuit boards which do not have plated through holes. In these cases, solder both top and bottom to be sure that the connections are solid. Use a large enough soldering iron to assure that your solder connection is solid. Put a bit of new solder with flux on every connection you touch up even if there was plenty of solder there before. However, remove any obvious excess. Inspect for solder bridges, sliver, splashes, etc. before applying power.

INTERMITTENT OR MISSING COLOURS

This is a catch all for some of the most common monitor problems. Most of the causes boil down to bad connections of one form or another.

VGA or other video input cable. Sometimes these develop intermittent problems at the connector to the VGA board. These may be internal to the cable in which case it will need to be replaced or if you are handy and have infinite patience, you can replace just the VGA connector.

Alternatively, the male pins of the cable may not be making good contact with the female VGA socket. First try contact cleaner. If this does not work, gently squishing the male pins with a pair of needle-nose pliers may provide temporary or permanent relief if the pins are a tad too small. However, if you go too far, you can damage or break the pins or cause the female sockets to become enlarged and loose fitting for any other monitor you may use.

There may be cold solder joints on the VGA board itself at the VGA connector. These can be resoldered.

Printed circuit board on the CRT neck. This is a common location for dry solder joints. Check with a bright light and magnifying glass for hairline cracks around the pins of larger parts. Prod and tap with an insulated tool to see if the problem is effected. Resolder if necessary.

Dry solder joints elsewhere in monitor usually around the pins of large parts such as transformers, power transistors and resistors, and internal connectors. Inspect with a strong light and magnifier if necessary.

Internal connectors that need to be cleaned and reseated. Remove, clean with contact cleaner, burnish, and replace.

5.

GHOSTS, SHADOWS OR STREAKS IN PICTURE ADJACENT TO VERTICAL EDGE

Complaints about these kinds of problems are very common especially as the screen resolution and necessary video bandwidth keeps increasing. Most are due to cable and video termination deficiencies and not actual monitor defects.

The video signals for red, green, and blue (or just a single signal for monochrome) are sent over cables which are generally 75 ohm transmission lines. These are coaxial cables that may be combined inside a single sheath for VGA, SVGA, MACs, and many workstations but may be separate coaxes with BNC (or other) connectors for other video applications.

Without going into transmission line theory, suffice it to say that to obtain good quality video, the following conditions must be met:

1. A good quality of cable must be used. This means one in which the characteristic impedance is close to the optimum 75 ohms, one which has low losses, and one which has good shielding. For installations using BNC connectors, a good quality of 100% shielded RG59U is often used. The BNC connectors must be properly installed or they will contribute to mismatch problems.

2. Where multiple monitors are to be connected to a single video source, all wiring is done in a daisy chain fashion. The only taps permitted are the minimum necessary to connect each monitor to the chain. This usually means a BNC-T connector or a pair of connectors on the monitor for each video signal. T connections with cable must be avoided.

3. Only the last monitor in the chain should be terminated in 75 ohms. All of the others must be set to Hi-Z. Monitors with BNC connectors will usually have one switch or a switch for each colour to select termination.

Monitors for PCs, MACs, and workstations usually have built in termination and do not offer the choice of Hi-Z. This means that without a video distribution amplifier, it is not possible to connect multiple monitors of this type to a single video source with any expectation of a good quality display.

Failure to follow these rules will result in video ringing, ghosts, shadows, and other unsightly blemishes in the picture. It is often not possible to control all aspects of the video setup. The cable is often a part of the monitor and cannot easily be substituted for a better one. The monitor may not have properly designed circuitry such that it degrades the video regardless of the cable and display board quality. The display card itself may not have proper drivers or source termination.

Ironically, the better the video card, the more likely that there will be visible problems due to termination. This is due to the very high bandwidth and associated signal edge rates.

Some examples of common termination problems:

- Overtly bright picture with trails following vertical edges, perhaps with periodic ringing. This is due to a missing termination. Check if the monitor is set for Hi-Z instead of 75 ohms. If there is no switch, then the termination may be faulty or the monitor may need an external resistor. For BNC connectors, plug-on terminations are available.

- Bright ghost images adjacent to vertical lines. This may indicate that the terminating resistor is greater than the impedance of the cable. You may be using Ethernet Thinnet cable by accident which is RG 58 with an impedance of 50 ohms.

- Dark picture and ghost images adjacent to vertical lines. This may indicate that the terminating resistor is too low - multiple monitors on a chain all set for 75 ohms instead of just the last one. Or, an improper type of cable such as audio patch cord.

- Fuzzy vertical edges. This may indicate a poor quality cable or a run which is just too long. For high resolutions such as 1280x1024, the maximum cable length may be as short as 25 feet or less for poor quality cable. Better cable or fibre-optic repeaters may be necessary.

- Other similar problems - check cables for defective or improperly installed connectors. This is especially applicable to cables with BNC or UHF type connectors which require a kind of artistic talent to assembly properly and consistently.

If only 1 or 2 colours (of the R, G, and B) are effected, then look for improper switch settings or bad connections (bad cable connectors are really common) on the problem colour cables.

BRIGHTNESS ADJUSTMENT

A monitor which has a picture that is very dark and cannot be adequately set with the user brightness and contrast controls may need internal adjustment of the screen (the term, screen, here refers to a particular electrode inside the CRT, not really the brightness of the screen you see, though it applies here), master brightness, or background level controls. As components age, including the CRT, the brightness will change, usually decrease. The following procedure will not rejuvenate an old CRT but may get just enough brightness back to provide useful functionality for a few months or longer. If the problem is not with the age of the CRT, then it may return the monitor to full brightness. The assumption here is that there is a picture but the dark areas are totally black and the light areas are not bright enough even with the user brightness control turned all the way up.

In most cases, the cover will need to be removed. The controls we are looking for may be located in various places. Rarely, there will be access holes on the back or side.

The controls may be located on the:

- Flyback transformer. Usually there is a master screen control along with a focus control on the flyback transformer.

- A little board on the neck of the CRT. There may be a master screen control. a master brightness control, a master background level control, or individual controls for red, green, and blue background level. Other variations are possible. There may also be individual gain/contrast controls.

- Main video board is less common, but the background level controls may be located here.

Display a picture at the video resolution you consider most important which includes both totally black and full white areas which also includes sharp vertical edges.

Set the user brightness control to its midpoint and the user contrast control as low as it will go · counterclockwise.

Let the monitor warm up for at least 15 minutes so that components can stabilize.

If there is a master brightness or background level control, use' this to make the black areas of the picture just barely disappear. Them, increase it until the raster lines just appear. (They should be a neutral gray. If there is a colour tint, then the individual colour background controls will need to be adjusted to obtain a neutral gray.) If there is no such control, use the master screen control on the flyback. If it is unmarked, then try both of the controls on the flyback - one will be the screen control and the other will be focus - the effects will be obvious. If you did touch focus, set it for best overall focus and then get back to the section on focus once you are done here.

If there are individual controls for each colour, you may use these but be careful **as you** will be effecting the colour balance. Adjust so that the raster lines in a black area are just visible and dark neutral gray.

Now for the gain controls. On the little board on the neck of the CRT or on the video or main board there will be controls for R, G, and B gain or contrast (they are the same). If there are only two then the third colour is fixed and if the colour balance in the highlights of the picture was ok, then there is nothing more you can do here.

Set the user contrast control as high as it will go - clockwise.

Now adjust each internal gain/contrast control as high as you can without the that particular colour 'blooming' at very bright vertical edges. Blooming means that the focus deteriorates for that colour and you get a big blotch of colour trailing off to the right of the edge. You may need to go back and forth among the 3 controls since the colour that blooms first will limit the amount that you can increase the contrast settings. Set them so that you get the brightest neutral whites possible without any single colour blooming.

Now check out the range of the user controls and adjust the appropriate internal controls where necessary. You may need to touch up the background levels or other settings. Check at the other resolutions and refresh rates that you normally use.

If none of this provides acceptable brightness, then either your CRT is in its twilight years or there is something actually broken in the monitor. If the decrease in brightness has been a gradual process over the course of years, then it is most likely the CRT. As a last resort (untested) you can try increasing the filament current to the CRT the way CRT boosters that used to be sold for TVs worked. Voltage for the CRT filament is usually obtained from a couple of turns on the flyback transformer. Adding an extra turn will increase the voltage and thus the current making the filament run hotter. This will also shorten the CRT life - perhaps rather drastically. However, if the monitor was headed for the local skip anyhow, you have nothing to lose.

a.

FOCUS PROBLEMS

Slight deterioration in focus can be corrected by adjusting the focus control usually located on the flyback transformer. Sometimes, this is accessible externally but usually not. On monochrome monitors, the focus control, if any, may be located on the main board.

Don't expect to have perfect focus everywhere on the screen. Usually there will be some degradation in the corners. A compromise can generally be struck between perfect focus in the centre and acceptable focus in the corners.

If the adjustments have no effect, then there is probably a fault in the focus power supply.

For most colour TVs and monitors, the correct focus voltage will be in the 4-8 CODE range so you will need a meter that can go that high or some big resistors to extend its range or a HV probe. You must use a high impedance meter as the current availability from the focus power supply is very low.

The pots in the flyback are sometimes accessible by removing their cover, which may snap on. However, a typical focus circuit will have a large value resistor potted inside the flyback (like 200 Megohms).

Try to measure the focus in-circuit. If the value you read is very low (assuming your meter has a high enough impedance not to -load the circuit appreciably), then disconnect the wire (from the PCB on the neck of the CRT or wherever) and measure again and observe any change in picture.

If still low, then almost certainly there is a problem with the pot or the flyback. See if you can open it enough to measure and/or disconnect the pot. If the problem is inside the potted part of the flyback, the only alternative is a new flyback or an external divider if you are so inclined. However, once the focus network goes bad inside the flyback, there is an increased chance other parts will fail at some point in the future.

If the voltages check out with the CRT disconnected, there is a chance of a bad CRT or of a shorted component on the PCB on the neck of the CRT. Look for shorted capacitors or burnt or damaged traces.

ARCING SPARK GAPS

If after removing the cover on a monitor that has power but has no picture or a very dim distorted picture, you find visible arcing at one of the spark-gaps near the CRT, then most likely there is a short inside of the flyback transformer or HV multiplier (if used). In either case, replacement will be needed for the offending component. These spark-gaps are designed to protect the CRT electrodes from excessive voltages. Do not be tempted to remove the spark-gap - it is serving its protective function.

10.

DEAD MONITOR WITH PERIODIC TWEET,TWEET,TWEET OR FLUB,FLUB,FLUB.

A monitor which appears to be dead except for a once a second or so tweet or flub usually indicates a fault in the switching power supply - often a shorted rectifier. The HFR854s (one common type in monitors) or other high speed high efficiency rectifiers in the output side of the switching power supply seem to like to turn into short circuits. (I had a couple of DOA monitors where this was the problem. so much for quality control!) This could also be due to other shorted component such as the horizontal output transistor where there is a separate switching power supply.

After unplugging the monitor and waiting a few minutes for the filter capacitors to discharge (check with a voltmeter but stay away from the CRT HV connector as it may retain a dangerous and painful charge for a long time), use an ohmmeter across the various diodes in the power supply. These appear commonly as black cylinders about 3/8" long by l/4 diameter. (Kind of like lN400Xs on steroids). The resistance of the diodes in at least one direction should be greater than 100 ohms. If it is much less (like 0 or 5 ohms), then the diode is probably bad. Unsolder and check again - it should test infinite (greater than 1M ohms) in one direction. If it now tests good, there may be something else that is shorted.

Check other power semiconductors as well, in particular, the horizontal output transistor.

Other possible causes: bad solder connections, other shorted components like capacitors, other problems in the power supply. Sometimes this is an indication of an over-voltage shutdown due to a faulty regulator or open load.

SMOKING MONITOR

Smoking is just as bad for monitors **as** for people and usually more quickly terminal.

White acrid smoke may indicate a failed electrolytic capacitor in the power supply probably in conjunction with **a** shorted rectifier. Needless to say, pull the plug at once.

A visual inspection should be able to easily confirm the bad capacitor as it will probably be bulging and have condensed residue nearby. Check the rectifier diodes or bridge rectifier with an ohmmeter. Resistance across any pair of leads should be **more than a few** ohms in at least one direction. Remove from the circuit to confirm. Both the faulty diode(s) and capacitor should be replaced (though the capacitor may work well enough to test with new diode(s).

If a visual inspection fails to identify the smoking part, you can probably plug the monitor in for a few seconds until the source of the smoke is obvious but be prepared to pull the plug in a real hurry.

APPLE MONITOR DIES AFTER VARIABLE LENGTH OF TIME.

This is a (Apple) Sony 13" monitor, 4 years old. After being turned on for 30 minutes, the display goes completely blank and the front LED goes off. If the power is shut off for 10 minutes or so, it will come back on for another 15 minutes or so, then go blank again, etc. The +120v and +65v from the power module is still present when it blanks out, but no other voltages (+12, +960, etc) are present on the main circuit board. I've been told it might be the HV capacitor is bad; would like to hear a 2nd or 3rd opinion before buying a new capacitor.

That is the same diagnosis a friend of mine got for her monitor with that identical problem. Replacing the capacitor did fix the problem.

That 'capacitor' is a big red thing is a Sony part which includes some kind of low voltage connection as well. The guy at the place where she got it repaired said that the capacitor is one of the most common problems with those monitors. f50 for the part + f50 for labour, ouch! Only, apparently available from Sony. Why can't Sony design monitors like everyone else? Sure, I know, theirs are better (well, except for the unsightly stabilizing wires on **Trinitrons!) .**

MAGNETIC FIELDS AND DEGAUSSING

Indications of need for degaussing are small or large areas of the screen where the colours are not correct or where colour balance has suddenly changed. There are other possible causes - both electronic and mechanical - but stray magnetic fields is numero uno on the list.

The shadow mask or aperture grill of the CRT - the fine mesh just behind the phosphor screen - is normally made of a material (steel or InVar) which is easily magnetized. This can happen just by rotating the monitor on its swivel, by moving it from one place to another, by switching on or off some piece of electronic equipment near the monitor, even by a local lightning strike.

Since any stray magnetism effects the colour purity and convergence, it is important that the CRT is demagnetized before use.

ULTRA CHEAP DEGAUSSING COIL

Next time you scrap a computer monitor (or a colour TV), save the degaussing coil (coil of wire, usually wrapped in black tap or plastic) mounted around the front of the tube. To adapt it for degaussing sets, wrap it into a smaller coil, maybe 4"-6". To limit the current to something reasonable, put it in series with a light bulb (60-100W). You need AC current to degauss, so just put the bulb in series with the coil and use the your local 240V outlet. BE VERY CAREFUL that you actually wired it in series, and that everything is properly insulated before you plug it in (A fuse would be a real good idea too! !)

A few circles over the affected area will usually do it. Note that it will also make your screen go crazy for a little bit, but this will fade out within a minute or so.

Disclaimer: This has worked consistently for me in the past, but I make absolutely no warranty as to the safety or effectiveness of this procedure in your situation.

Just a couple of points for emphasis:

1. The coil as removed from the TV is not designed for continuous operation across the line as indicated above. In fact, it will go up in a mass of smoke without the light bulb to limit the current. The poor TV from which this organ was salvaged included additional circuitry to ramp the current to 0 in a few seconds after power is turned on.

2. Reducing the coil size by a factor of 2 or 3 will increase the intensity of the magnetic field which is important since we are limiting the current with the light bulb to a value lower than the TV used. You don't need to unwind all the magnet wire, just bend the entire assembly into a smaller coil. Just make sure that the current is always flowing in the same direction (clockwise or counterclockwise) around the coil.

3. Insulate everything very thoroughly with electrical tape. A pushbutton momentary switch rated for 2 amps at 115 volts AC would be useful so that you do not need to depend on the wall plug to turn it on and off.

HOW OFTEN TO DEGAUSS

Some monitor-manufacturers specifically warn about excessive use of degauss, most likely as a result of over stressing components in the degauss circuitry which are designed (cheaply) for only infrequent use. In particular, there is often a thermistor that dissipates significant power for the second or two that the degauss is active. Also, the large coil around the CRT is not rated for continuous operation and may overheat.

If one or two activators of the degauss button do not clear up the colour problems, manual degaussing using an external coil may be needed or the monitor may need internal purity/colour adjustments. Or, you may have just installed your megawatt stereo speakers next to the monitor!

You should only need to degauss if you see colour purity problems on your CRT. Otherwise it is unnecessary. The reasons it only works the first time is that the degauss timing is controlled by a thermistor which heats up and cuts off the current. If you push the button twice in a row, that thermistor is still hot and so little happens.

One word of clarification: In order for the degauss operation to be effective, the AC current in the coil must approach zero before the circuit cuts out. The circuit to accomplish this often involves a thermister to gradually decrease the current (over a matter of several seconds), and in better monitors, a relay to totally cut off the current after a certain delay. If the current was turned off suddenly, you would likely be left with a more magnetized CRT. There are time delay elements involved which prevent multiple degauss operations in succession. Whether this is by design or accident, it does prevent the degauss coil - which is usually grossly undersized for continuous operation - to cool.

FOCUS ADJUSTMENT

One of the most common complaints is that the monitor is not as crisp as it used to be - or just not as sharp as expected.

Assuming that the focus has just been gradually getting worse over time, tweaking the internal focus control may be all that is needed.

On most monitors, the flyback transformer includes two control - FOCUS and SCREEN. The one you want is, of course, FOCUS.

Safety: As long as you do not go near anything else inside the monitor while it is on AND keep one hand in you pocket, you should be able to do this without a shocking experience.

Plug it in, turn it on and let it warm up for a half hour or so. Set your PC to display in the resolution you use most often. First turn the user brightness and contrast fully counterclockwise. Turn brightness up until the raster lines in a totally black area appear, then back a hair until they disappear. Then, turn the contrast control up until you get a fairly bright picture. Fully clockwise is probably ok. Adjust FOCUS for generally best focus. You will not be able to get it razor sharp all over the screen - start at the centre and then try to get the edges and corners as good as you can without messing up the centre too much. Double check that the focus is OK at your normal settings of brightness and contrast.

The SCREEN control adjusts background brightness. If the two controls are not marked, you will not do any damage by turning the wrong one - it will be immediately obvious as the brightness will change rather than focus and you can then return it to its original position (or refer to the section on brightness adjustments to optimize its setting).

INTERFERENCE FROM ELECTRICAL WIRING

If the wiring of normal outlets is done correctly even without a safety ground, the currents should be balanced and you will not experience a problem. However, many circuits, particularly those involving setups like 3-way switches or switched outlets and wiring in older buildings can have unbalanced currents when active. If your monitors are close enough to the wiring, there can be interference which will take the form of a flickering or pulsating display.

Other than recommending moving the monitors, there is no easy solution. They can be shielded with Mu Metal but that is expensive. Or you could run all displays at a 50 Hz vertical rate. However, this is inconvenient and will never be quite perfect.

INTERFERENCE FROM OTHER EQUIPMENT

Any type of equipment which uses or generates strong magnetic fields can interfere with a monitor. Other computer monitors or TVs, equipment with power transformers, and electric motors will cause a pulsating or flickering display. Loudspeakers or other equipment with static magnetic fields will cause colour purity and/or geometric distortion problems which degauss will not cure.

The easiest way to confirm that interference is your problem is to move the monitor or suspect equipment to a different location. The only real solution is to separate the monitor and interfering device.

CONTOUR LINES ON HIGH RESOLUTION MONITORS

These fall into the category of wavey lines, contour lines, or light and dark bands even in areas of constant brightness. These may be almost as fine as the dot pitch on the CRT or 1 or 2 cm or larger and changing across the screen. If they are more or less fixed on the screen and stable, then they are not likely to be outside interference. (However, if they are locked to the image, then there could be a problem with the video board.)

One cause of these lines is Moire (interference patterns) between the raster and the dot structure of the CRT. Ironically, the better the focus on the tube, the worse this is likely to be. Trinitrons, which do not have a vertical dot structure should be immune to interference of this sort from the raster lines (but not from the horizontal pixel structure).

You can test for Moire by slowly adjusting the vertical size. If it is Moire, you should see the pattern change in location and spatial frequency as slight changes are made to size. Changes to vertical position will move the patterns without altering their structure · but they will not remain locked to the moving image.

The patterns will remain essentially fixed in position on the face of the CRT for horizontal size and position adjustments · the patterns will remain fixed under the changing image.

How to eliminate it? If Moire is your problem, then there may be no easy answer. For a given resolution and size, it will either be a problem or not. You can try changing size and resolution · Moire is a function of geometry. Ironically, I have a monitor which is nicer in this respect at 1024x768 interlaced than at 800x600 non-interlaced.

Another cause of similar problems is bad video cable termination creating reflections and ghosting which under certain conditions can be so severe as to mimic Moire effects. This is unlikely to occur in all colours with a VGA display since the termination is internal to the monitor.

MONITOR RELIABILITY WITH SVGA

There are parts in the monitor which may get hotter with SVGA but if it is designed for SVGA resolution, there should be no problem (assuming you are not running in an excessively hot room or with the ventilation holes covered).

A good quality multisync monitor should not mind switching screen resolutions frequently (though doing it every few seconds continuously may stretch this a bit).

Newer multisync monitors should also be smart enough not to blow up if you feed then a scan rate which exceeds their capabilities. However, there are a lot of poorly designed monitors out there.

If it is supposed to run SVGA, use it at SVGA. If it blows up, switch to a different brand. There are a lot of poor quality monitors being sold on their own and bundled with PCs.

LIFE SPANS OF MONITORS

Most manufacturers will quote an MTBF (Mean Time Before Failure) of somewhere in the 30,000 to 60,000 hour range, EXCLUSIVE OF the CRT. The typical CRT, without an extended-life cathode, is usually good for 10,000 to 15,000 hours before it reaches half of its initial brightness. Note that, if you leave your monitor on all the time, a year is just about 8,000 hours.

The only "tune-up" that a monitor should need, exclusive of adjustments needed following replacement of a failed component, would be video amplifier and/or CRT biasing adjustments to compensate for the aging of the tube. These are usually done only if you're using the thing in an application where exact colour/brightness matching is important. Regular degaussing of the unit may be needed, of course, but I'm not considering that a "tune-up" or adjustment.

22.

MONITOR LIFE, ENERGY CONSERVATION AND LAZINESS

A common misconception about the care and feeding of computer monitors is that they should be left on all the time. While there are some advantages to this, there are many more disadvantages:

CRT Life

The life of a monitor is determined by the life of the CRT. The CRT is by far the most expensive single part and it is usually not worth repairing a monitor in which the CRT requires replacement. The brightness half-life of a CRT is usually about l0-15 K hours of on time independent of what is being displayed on the screen. 10 K hours is only a little more than a year. By not turning the monitor off at night, You are reducing the life of the monitor by a factor of 2-3. Screen savers do not make any substantial difference especially with modern displays using X-Windows or MS Windows where the screen layout is not fixed. With video display terminals, the text always came up in the same position and eventually burned impressions into the screen phosphor.

Component life

The heat generated inside a monitor tends to dry out parts like electrolytic capacitors thus shortening their life. These effects are particularly severe at night during the summer when the air conditioning may be off but it is still a consideration year around.

Safety

While electronic equipment designed and manufactured in accordance with the National Standards is very safe, there is always a small risk of catastrophic failure resulting in a fire. With no one around, even with sprinklers and smoke alarms, such an failure could be much more disastrous.

Energy use

While modern monitors use a lot less energy than their older cousins, the aggregate energy usage is not something to be ignored. A typical monitor uses between 60 and 200 Watts. Thus at a 10p per KWH electric rate such a monitor will cost between f48 and f160 a year for electricity. During the night, l/2 to 2/3 of this is wasted for every monitor that is left on. If air conditioning is on during the night, then there is the additional energy usage needed to remove this heat as well - probably about half the cost of the electricity to run the monitor.

The popular rationalization for what is most often just laziness is that power-on is a stressful time for any electronic device and reducing the number of power cycles will prolong the life of the monitor. With a properly designed monitor, this is rarely an issue. Can you recall the last time a monitor blew up when it was turned on? The other argument, which has more basis in reality is that the thermal cycling resulting from turning a monitor on and off will shorten its life. It is true that such thermal stress can contribute to various kinds of failures due to bad solder connections. However, these can be easily repaired and do not effect the monitor's heart - the CRT. You wouldn't leave your TV on 24 hours a day, would you?

Some of the newest ('green') monitors have energy conserving capabilities. However, it is necessary for the software to trigger these power reduction or power down modes. Few monitors in actual use and fewer workstations or PCs are set up to support these features. If you have such a monitor and computer to support it, by all means set up the necessary power off/power down timers. However, using the power saving modes of a 'green' PC with an older monitor can potentially cause damage since some of the modes disable the sync signals. A 'green' monitor which can detect a blank screen and and use this as a trigger can easily be used with a screen saver which can be set to display a blank screen - on any PC or workstation.

Please make it a habit to turn your monitors off at night. This will extend the life of the monitor (and your investment) and is good for the environment as well. For workstations, there are good reasons to leave the system unit on all the time. However, the monitor should be turned off using its power switch. For PCs, my recommendation is that the entire unit be turned off at night since the boot process is very quick and PCs are generally not required to be accessible over a network 24 hours a day.

23.

CRT REPLACEMENT - PROBABLY NOT WORTH IT

The sad fact is that even if you can obtain a new CRT you won't have the proper setup for getting proper alignment and convergence. They generally use various permanent magnet glued to the perimeter of the yoke to set the geometry of -the raster. It takes a special factory jig to do this step or really great persistence and patience. I have done it for monochrome monitors without too much difficulty.

MONITOR DRIFT

Problem: I have a 17" monitor that has an image that EVER SO SLIGHTLY drifts to the left (and stops) after a long day's work (heat, I suppose). Also, the vertical height shrinks a little bit. Is this at all normal/acceptable?

How much is 'ever so slightly'? There are a fair number of components whose values could alter the position/size of a monitor image. I do not find it at all surprising that there should be a small shift due to heat. It really depends on many factors including the basic design, quality of components, ventilation/cooling, etc. Of course, it is possible to have a monitor that has a component that is worse with respect to temperature. Could also be related to line voltage depending on the regulation of your monitor's power supplies.

In general, my feeling is that if it is not objectionable (a l/2" shift would be objectionable) AND it's severity is not changing with time, you can ignore it.

Many monitors do this. TVs do this but you are not aware of it since they are already 5-10% over scanned for just this reason, as well as compensating for component aging and line voltage fluctuations.

MONITOR POWER SUPPLIES

Monitors use -a variety of switching supply techniques and it would be difficult to cover every possibility but here are some comments:

Probably the most common is deflection derived - the voltages are obtained from auxiliary windings on the horizontal flyback (HV) transformer. A number of components can be at fault and produce a 'dead' monitor. The switching supply could also be independent of the HV supply, but this is less common, especially on inexpensive monitors.

Some possibilities:

Horizontal output transistor (usually a TO3 metal or TOP3 plastic case shorts out. This will usually blow a fuse or fusible resistor as well.

Horizontal drive chain - horizontal oscillator, driver, or driver transformer.

Newer monitors may use an IC for the oscillator and this can fail.

Startup - There may be some kind of startup circuit which gets the whole thing going until the auxiliary voltages are available. This could be **as** simple as a multivibrator or transistor regulator to provide initial voltage to the horizontal oscillator chip or circuit.

Output rectifier diodes can fail shorted and load down the outputs to the point of shutting down.

Some load could be shorted or a capacitor could be shorted leading to overload and shutdown.

Flyback transformer can have shorted windings which load down the output. These (primary shorts in particular) may cause the horizontal output transistor to fail as well. Common problem with older Macintosh computers and video terminals.

Also, look for cold solder joints - monitors tend to have these as a result of temperature cycling and bad manufacturing. (Is this sounding repetitive yet?)

Sometimes there is a series regulator after the filter cap and this could be bad as well.

I guess I would attempt to trace the circuit from the main filter cap assuming that has the proper (approx. 150-160 VDC usually) voltage.

If there is no voltage at the main capacitor, then there is probably a blown fuse or bad connection somewhere. However, the fuse may have blown due to a fault in the switcher.

If you can locate the horizontal output transistor, see if there is voltage on its collector, should be the same. If there is, then there is probably a drive problem. If you have an ECG or similar semi cross reference, that will help you identify the ICs and transistors and locate the relevant portions of the circuitry.

26..

SINGLE VERTICAL LINE

Since you have high voltage, the horizontal deflection circuits are almost certainly working (unless there is a separate high voltage power supply - almost unheard of in modern TVs and very uncommon in all but the most expensive monitors).

Check for bad solder connections between the main board and the deflection yoke. Could also be a bad horizontal coil in the yoke, linearity coil, etc. There is not that much to go bad based on your symptoms assuming the high voltage and the horizontal deflection use the same flyback. It is almost certainly not an IC or transistor that is bad.

SINGLE HORIZONTAL LINE

A single horizontal line means that you have lost vertical deflection. High voltage is most likely fine since there is something on the screen.

This could be due to:

1. Dirty service switch contacts. There is often a small switch on the located inside on the main board or perhaps accessible from the back. This is used during setup to set the colour background levels. When flipped to the 'service' position, it kills vertical deflection and video to the CRT. If the switch somehow changed position or got dirty or corroded contacts, you will have this symptom. Flip the switchback and forth a couple of times. If there is some change, then replace, clean, resolder, or even bypass it as appropriate.

2. Bad connection to deflection yoke or other parts in vertical output circuit. Bad connections are common in TVs and monitors. Check around the pins of large components like transformers, power transistors and resistors, or connectors for hairline cracks in the solder. Reseat internal connectors. Check particularly around the connector to the deflection yoke on the CRT.

3. Bad vertical deflection IC or transistor. You will probably need the service manual for this and the following. However, if the vertical deflection is done with an IC, the ECG Semiconductor Master Substitution guide may have its pinout which may be enough to test it with a scope.

4. Other bad parts in vertical deflection circuit though there are not that many parts that would kill the deflection entirely.

5. Loss of power to vertical deflection circuits. Check for blown fusible resistors/fuses and bad connections.

6. Loss of vertical oscillator or vertical drive signals. The most likely possibilities are in the deflection output stage or bad connections to the yoke.

BIG JOHN'S RULES OF THUMB ON MONITOR REPAIRS

1. Use an isolation transformer. A variac can be helpful too. A cheap isolation transformer can be constructed by wiring two identical transformers of adequate power capability back-to-back. (Here is a use for those old boat anchors you can't bear to part with).

2. If it's just the power supply or flyback switching transistors that have failed, then the repair is probably easy enough and quick enough to be worthwhile. Blown power transistors are trivial to locate in the circuit and quite easy to find replacements for. In many cases I've found that the monitor would have lived a much longer life if only the transistor mounting screws had been tightened properly by the manufacturer. Make sure you use appropriate replacements and the proper heat sink parts and heat sink compound.

3. If it's the flyback transformer, then judgment should be made based on the cost and availability of the replacement part. Also, on the risk of there being additional problems beyond that of the bad flyback. Who gets to eat the cost of the part in the event you don't succeed and give up? However, determining that the flyback is indeed at fault may prove challenging without a flyback tester. Sometimes there will be obvious damage such as burnt marks, cracked plastic, or other signs of overheating. If you have the correct resistance measurements, then for the primary you may be able to detect shorted windings. You can also construct the brute force only back tester at the end of the document.

4. If it's the CRT then make the project "someone else's problem" and give the monitor to someone else to use as a parts carcass. My life is much happier since I learned there is no disgrace in making this choice.

5. There is another common failure category which is a result of people who are too lazy to turn off the power switch at night. The constant heat causes the electrolytic capacitors to dry out and become intermittent. I often replace all of the smallest electrolytic in the power supply section especially when I know the switching transistor is good. If after a couple of hours of labour and a dozen caps I still don't have it running, I give up on these too.

6 . Be realistic with yourself about the value of a used working monitor. CGA's EGA's and monochrome Hercules monitors rarely fetch more than $20 at an Auction.

7. Don't sell a used monitor to a friend unless you want to continue repairing the thing until you're old and grey.

8. Don't put a scope on the collector of the supply or flyback transistors, unless you have a special Xl00 high voltage / high frequency scope probe.

29.

PICTURE GRADUALLY DARKENS TO BLACK

Symptom: Intermittently, the picture darkens smoothly to black over a period of 10-15 seconds. A tap on the side of the monitor sometimes restores the picture (this time it "lightens" to normal over 10-15 seconds). The picture is otherwise essentially unchanged in size, position, colour, and focus.

This sounds like the filament to the CRT is losing power. Since the picture s otherwise unchanged, look really carefully for cold solder joints particularly on the little board on the back of the CRT if there is one and/or in any connectors associated with the CRT socket. There isn't much to the filament power supply - it is usually a couple of turns of wire on the flyback. If all colours are more or less equally effected, the it is not the CRT itself as the 3 filaments are welded in parallel to the socket pins.

FLYBACK FAILURE

Flybacks fail-in several ways:

1. Overheating leading to cracks in the plastic and external arcing. These can often be fixed by cleaning and coating with multiple layers of high voltage sealer, corona dope, or even plastic electrical tape (as a temporary repair in a pinch).

2. Cracked or otherwise damaged core will effect the flyback characteristics to the point where it may not work correctly or even blow the horizontal output transistor.

3. Internal shorts in the FOCUS/SCREEN divider network, if present. One sign of this may be arc-over of the FOCUS or SCREEN
spark-gaps on the PCB on the neck of the CRT.

4. Internal short circuits in the windings.

5. Open windings.

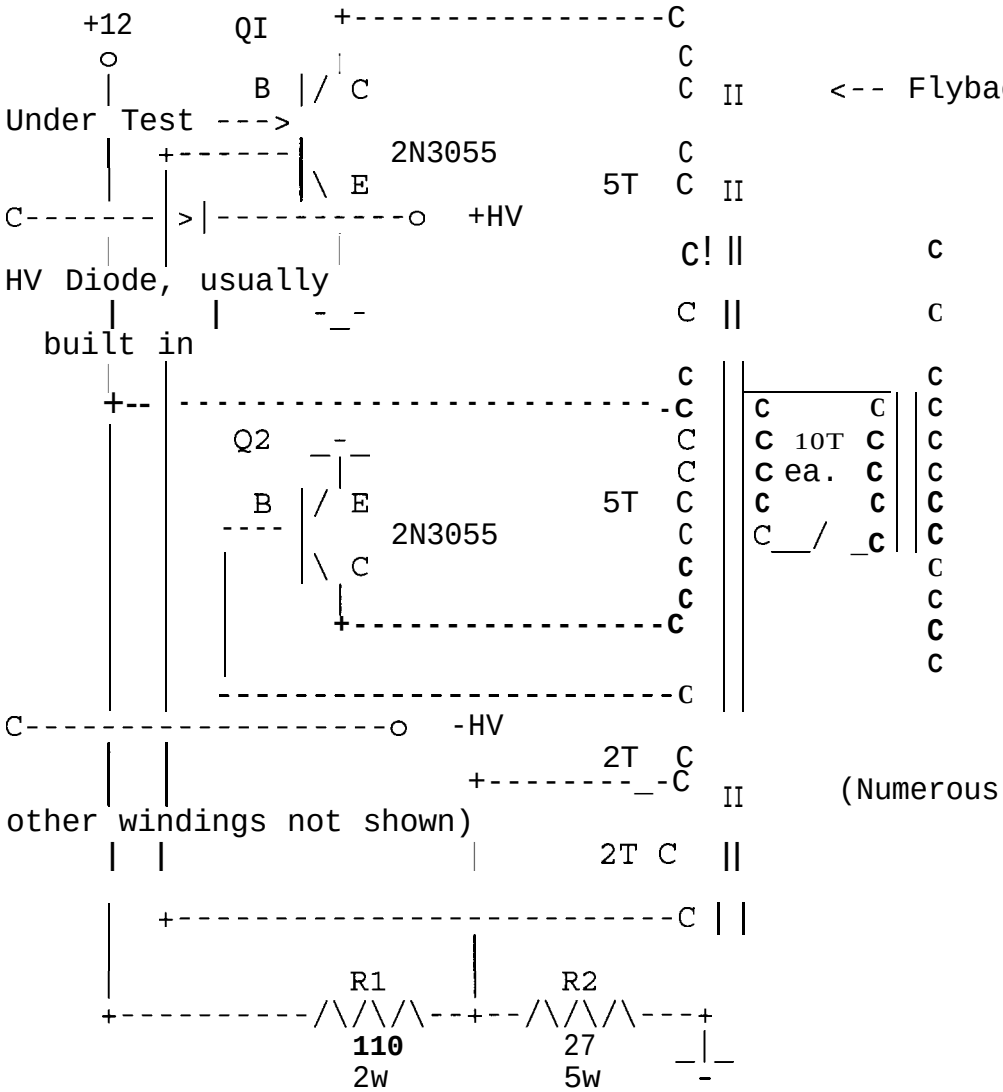
For the low voltage windings, service manuals may provide the expected DC resistance. Sometimes, this will change enough to be detected - if you have an ohmmeter with a low enough scale. These are usually a fraction of an ohm. Open windings, of course can be located with an ohmmeter and service notes. It is difficult or impossible to measure the DC resistance of the HV winding since the rectifiers are usually built in. The value is not published either.

(4) (and sometimes (3) as well) will drastically lower the Q and increase the load the flyback puts on its driving source with no outputs connected. A Q meter or transformer tester can be used, but since many people do not have such equipment, here is a circuit that should work. The only caution is that this tester probably does not put enough stress on the flyback to find an intermittent that fails only under operating conditions.

It is just a 12 V chopper feeding the salvaged core from a flyback. The secondary of this core is a 10 turn coil. You will need to remove the suspect flyback from the TV or monitor. A second 10 turn coil is wound on the suspect flyback anywhere it will fit. Connect one end of each coil securely. Provide an easy way of connecting the other ends momentarily - a push button comes in handy.

If the flyback is good, then with the coils connected there will be several KV at its output - enough to create a small arc (1/8" typical). The load imposed on the oscillator will be modest (the frequency increases in response to load). If there are any shorted windings, then there will be no significant HV output and the load on the oscillator will increase dramatically.

The circuit is shown below. None of the component values are critical.



USEFUL SERVICE AID

When testing TVs and monitors after repairing power supply problems, it is desirable to put a limiting resistance like a light bulb in series with the power line to prevent your newly installed expensive components from destroying themselves should there still be a problem. When using a home-made degaussing coil, you may also may need a limiting resistor.

An easy and flexible solution for both these needs is to construct an electrical box with a duplex outlet where the individual outlets have been separated and wired in series - line-l-> hot 1, neutral-l-> hot-2, neutral-2->line 2. Clearly mark on the box as to how it is wired.

Now, you can plug your monitor into one outlet and a suitable lamp into the other. For a TV or monitor, use a l00-150 W bulb. For testing a VCR power supply, use a 24-40 W bulb. You could use a lamp with a 2-way switch as well. For your degaussing coil, as large a load as your wire can stand can be plugged into the other outlet. This is safer and easier than using crocodile clip leads.