Slot Tech Magazine

Slot Machine Technology for the North American Gaming Industry

March 2010

This Month Featuring:LCD Monitor Repair From the Perspective of a Casino Technician

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Slot Tech Magazine

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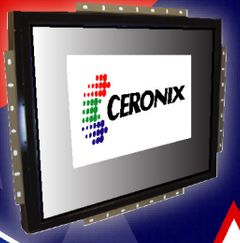

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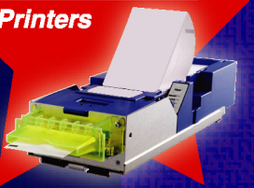

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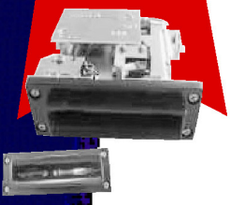

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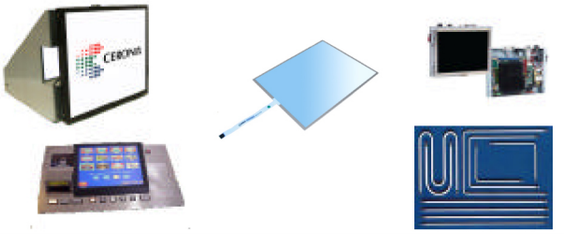

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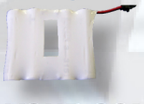

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March 2010

Page 4-Editorial
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Page 22-Quick & Simple Repairs #60
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Randy Fromm

It occurred to me that, although we have presented many articles on the subject of LCD monitor repair in Slot Tech Magazine, we never have published anything definitive on "How it Works." This month we take a look at this ubiquitous display technology with an emphasis not so much on the voodoo and science behind it but on what can be done to repair it when you experience a failure. In all, LCD monitors are easy to understand, easy to troubleshoot and easy to repair, requiring little in the way of "real" electronic skills or training.

Please join me in welcoming our newest contributor, Dean Auger. Dean is the Slot Manager for Kewadin Casino in St. Ignace, Michigan. If any of you have machines from ID Interactive, please pay attention to this little gem because a quick bit of PM here could save you a failure and if you already have this failure, Dean presents the quick and easy repair. Welcome aboard, Dean and thanks for the submission. Dean's contribution begins on page 20.

Naturally, Pat Porath presents us with a nice collection of his Quick and Simple Repairs as well. I do find myself longing for the day that his casino finally gets rid of the last of those Gen 1 printers. Unfortunately, those freaking FutureLogic printers refuse to die and as long as they keep workin', his property's never gonna buy replacements. We may be hearing about these damn things for the next decade!

Randy Fromm

Randy Fromm - Publisher

Randy Fromm's
Slot Tech Magazine

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Command Strips for Touch Sensors help save slot technicians time and casinos money with a quick-to-remove and easy-to-integrate solution for touch displays. Once a touch sensor is mounted with Command Strips it takes only seconds to remove a damaged touch sensor or the working sensor from the damaged LCD display, and then only minutes to reintegrate it. Compared to today's 45-60 minute industry average for removing and integrating a touch sensor, that's time and money saved.

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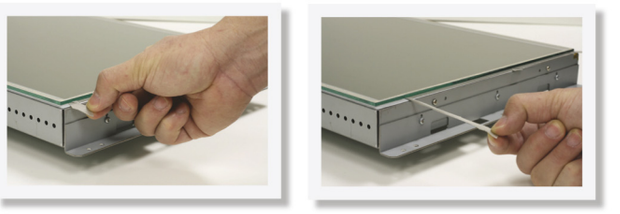

1 Pull Tab at 90 Degrees

Easy to Integrate

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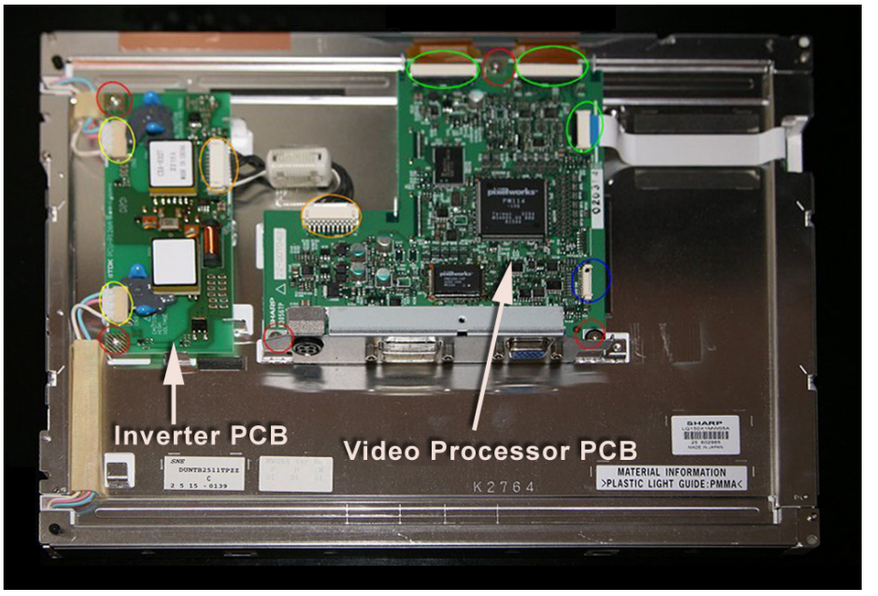
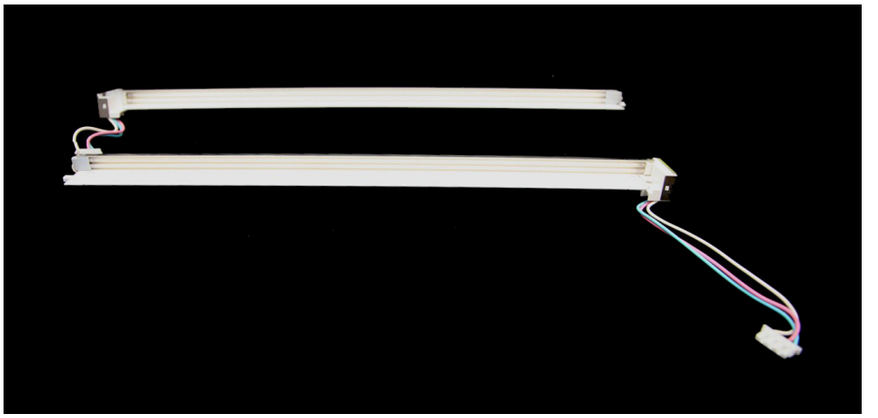
Understanding LCD Monitors From the Perspective of a Repair Technician in the Casino Industry

One way to understand how an LCD monitor works is to look at it backward. I think virtually everything you read about how LCD monitors work begins with the liquid crystals themselves, what they are and the how they can be manipulated to bend light and form an image. We'll get to that eventually but since you can't repair that part (plus it's really reliable so even if you could, it's not a skill you would use too often), let's start by going into the light.



Typical LCD monitor with the frame removed.



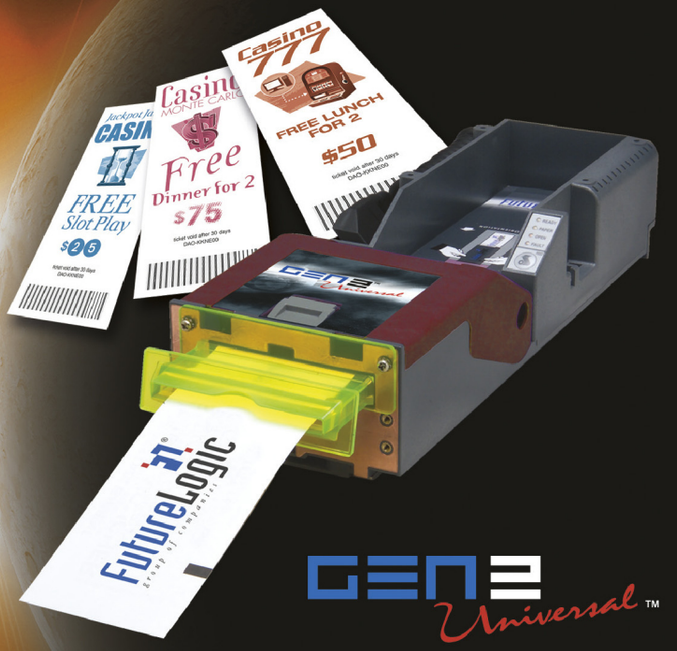
The light you see when observing an LCD monitor, is generated by Cold Cathode Florescent Lamps or CCFLs.

Backlighting

When you look an image on an LCD monitor, the light that enters your eyeballs comes from a simple light box, sort of like what doctors used to use (maybe they still do) to view X-ray films. It's just a light source, with some sort of diffuser covering it so the light from the source is dispersed as evenly as possible over the entire surface of the light box. In the Old Days, we used standard florescent lamps as the light source and a piece of frosted glass as the diffuser. However, a standard florescent tube has a relatively large diameter and so in order to make an

The CCFLs are housed, typically in pairs, within highly reflective channels.

Evolution
in gaming printers



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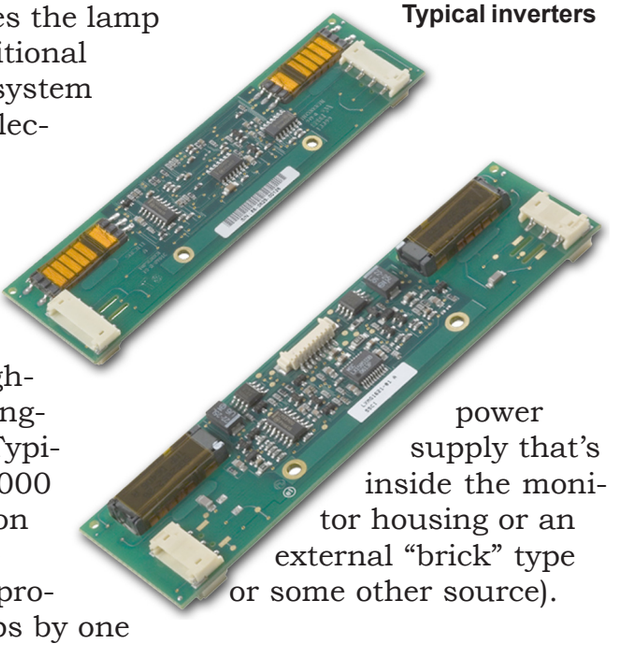
LCD monitor as thin as possible, we use CCFL (cold cathode florescent lamps) as our light source. The CCFLs are housed, typically in pairs, within highly reflective channels that are mounted at the top and bottom edges of the panel.

The tubes are a major replacement item for LCD monitor repair. Operating in the 24/7 environment of a casino and at the high ambient temperature inside a slot machine, you can expect the lamps to last from three to five years (depending on the quality of the monitor) after which they will be dim, oddly colored a sort of reddish-orange or won't strike at all. The ends of the tubes (where the electrodes live) will be blackened and burned.

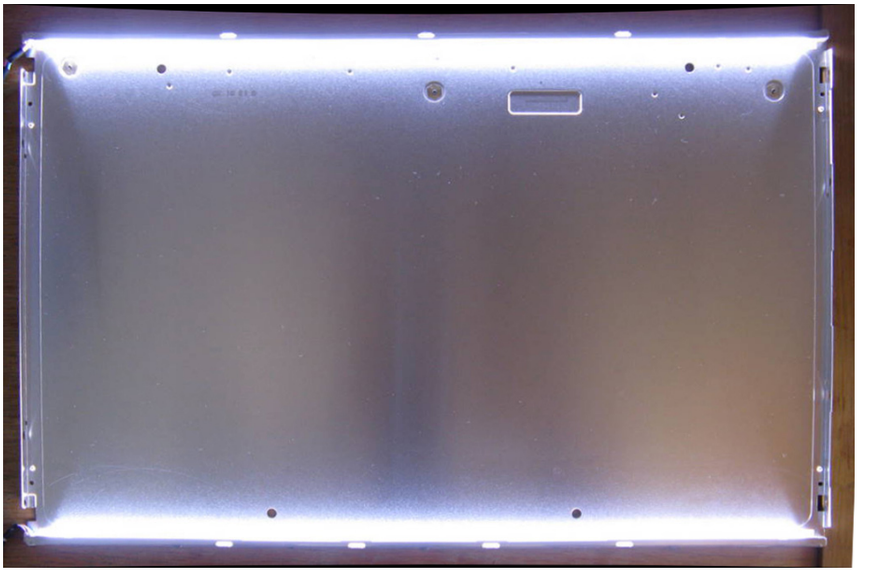
The CCFLs themselves are extremely fragile and are easily broken while handling. Of course, that's not a problem when you're removing a bad tube but not so good when you snap a brand new one (and you WILL snap one, I can all-but-guarantee you will eventually). Fortunately, they are relatively inexpensive and easily obtainable from many of the advertisers you see in the pages of Slot Tech Magazine (Pacific Illumination, Suzo-Happ, Patriot Gaming, Kiesub).

With a change in lamp type from standard to CCFL, there is a change in the system that drives the lamp as well. The traditional "ballast" type of system (including the "electronic ballast") is replaced by a much smaller "inverter" PCB. The CCFLs are powered by a high-voltage, alternating-current source. Typically, it's 1500-2000 VAC depending on the length of the tube. This AC is provided to the lamps by one or more inverters. An inverter is an electronic circuit that uses DC as an input and produces an AC output. In LCD monitors, it typically uses a +12 VDC input although at least one major manufacturer use a +24 VDC system (the subject of power supplies will not be discussed here. It's just some sort of standard power supply, whether it's an internal, open frame power supply that's inside the monitor housing or an external "brick" type or some other source).



Typical inverters

Inverter failure is not uncommon. Typically, the inverter is a small PCB that is inexpensive and manufactured with surface-mount devices. As such, it is generally considered to be "disposable" when it fails. That having been said, inverters often ARE repairable, requiring perhaps a single capacitor replacement or even a simple fuse replacement with no other



In order to make the LCD display as thin as possible, the CCFLs are mounted at the top and bottom edges of the panel, rather than behind.

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bad components. Replacing a few components is generally where I draw the line on something that costs twenty bucks to replace as a unit. Once the switching transistor(s) and associated components start wiping out, it's best to toss it. The inverter might drive two, four or more lamps. In large monitors, there may be (will be) multiple inverter PCBs as well.

If you are going to perform any LCD monitor repair, it is imperative that you buy or make a CCFL tester. It's just an inverter in a box with a connector so you can plug in a CCFL to test it. However, different lengths of CCFL tubes require different driving voltages and currents so it requires a really bodacious inverter in order to drive a variety of tube lengths. I HIGHLY recommend a CCFL tester that's available from Pacific Illumination (or, one of their distributors, I suppose). It's just called "Bench Top Cold Cathode Lamp Tester" part # 9220.

There are several things that make this unit so special. One is that it uses 120 VAC as its input so you don't need a separate power supply to operate the inverter. It comes in a petite, nearly indestructible metal box that you can toss into a toolbox. But most importantly, it uses a piezo ceramic transformer design, which has a number of advantages over traditional "Royer Oscillator" designs that use conventional transformers. From an engineering standpoint, using a piezo ceramic transformer means that the system uses mechanical magnification for energy conversion from a low voltage, high current source to the high-voltage, low-current AC output needed to drive the lamps. There is no magnetic flux at all and it creates an inherently balanced sine wave output with no harmonic current noise. Piezo inverters exhibit 90%+ efficiency and generate less heat which means longer LCD panel life.

All of that is well and good but what we are interested in more than anything else is that this design is universally adaptive. It is a "one size fits all" solution to CCFL testing. Basically, you can hook up just about any length CCFL (certainly any length that we use in gaming) to the device and it will light it up. The design inherently provides a constant current source with auto variable voltage for any CCFL. It will also support all types and lengths of CCFL, EEFL (external electrode), Flat FL and even Neon.

There is only one caution when using this device to test CCFLs and that is that it does such a good job, it can (and does) light up CCFLs that are actually bad and cannot be struck by the stock inverter in the monitor. Therefore, it is important to pay close attention to the color of the light being produced when you first turn fire up the CCFL. For the first fraction of a second (maybe longer, depending on the tube) if

A "must have" tool for LCD monitor repair is the CCFL tester.

Subject: TechFest 20
Date of Event: May 4-6, 2010
Location: Mystic Lake Casino Hotel

Schedule of Events

Events subject to change

Tuesday, May 4, 2010
9:00 am - 12:00pm
Power Supply Repair - Presented by Randy Fromm - Let's face it, we have a lot of power supply failures in slot machines. Some power supplies are more-or-less disposible due to their cheap replacement cost but many of the supplies we find in slot machines are custom-built units costing hundreds of dollars. For example, the ability to repair Aristocrat and IGT power supplies (actually manufactured by Setec and Win-Tact respectively) in-house will save your casino hundreds or even thousands of dollars in a year. We will cover the operation and repair of power supplies in detail during this session.

1:15pm - 3:15pm MEI - BV troubleshooting and repair - Suzo-Happ's Director of Training and Service David Oldham will discuss BV operation and service. Troubleshooting guides and handouts will be presented to help speed through troubleshooting in the shop.

3:30pm - 5:30pm FutureLogic Ticket Printers - Suzo-Happ's Director of Training and Service David Oldham will discuss FutureLogic printer operation and service.

Wednesday, May 5, 2010
9:00 am - 12:00pm CRT & LCD Monitor Repair - Presented by Randy Fromm - Video slot monitors are a lot easier to fix once you know how they work. Some understanding of electronic components will be helpful as this session will be somewhat more advanced than at previous TechFests.

1:15pm - 3:15pm 3M Touchsystems Touch Screens - Touchscreen Technology Presented by Paul Hatin and Mark Roberts - 3M Touch Systems Field Application Engineers - It is really amazing how touchscreens actually operate. During this session, touchscreen theory of operation will be presented along with diagnostic and repair techniques.

3:30pm - 5:30pm Incredible Technologies Slot Machines - Incredible Technologies has been credited by many operators as one of the most important and innovative manufacturers of video games in the world. Their "Golden Tee Golf" game revolutionized the online game tournament. Now, IT brings their team of manufacturing and design experts to the casino industry and to TechFest 20 with a close look at their IT slot machine. You will not want to miss this presentation.

Thursday, May 6, 2010
9:00 am - 12:00pm Ceronix CRT and LCD Monitor Repair - Presented by Troy Nofziger - Ceronix
Armed with a general knowledge of how monitors work (and how to fix them when they don't) it's time to look at Ceronix. The Ceronix design is unique in the entire world and requires a bit of specialized knowledge in order to be successful at repair. LCD Monitor repair will also be covered. Ceronix's most experienced bench tech, Troy Nofziger will instruct.

1:15pm - 3:15pm Transact Technologies Ticket Printers - Transact Technologies' Russ Wigé presents servicing and troubleshooting Transact brand, thermal ticket printers. These units are simple to understand and troubleshoot, once you know how they're put together.

3:30pm - 5:30pm JCM Bill Validators - This is arguably the best seminar of its kind in the gaming industry so we've saved the best for last. This presentation will be given by JCM's Jack Geller. This is your chance to ask the world's #1 expert about your JCM "issues."

To sign up for TechFest 20, visit the website at Slot-Techs.com
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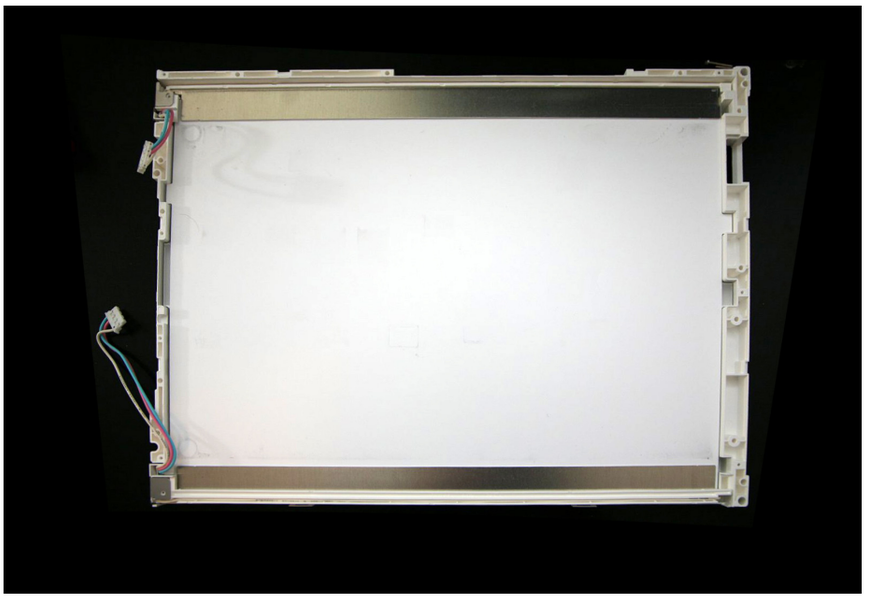
the tube glows pink/orange/red before warming up and glowing white, it is likely bad (or close to bad) and needs to be replaced.

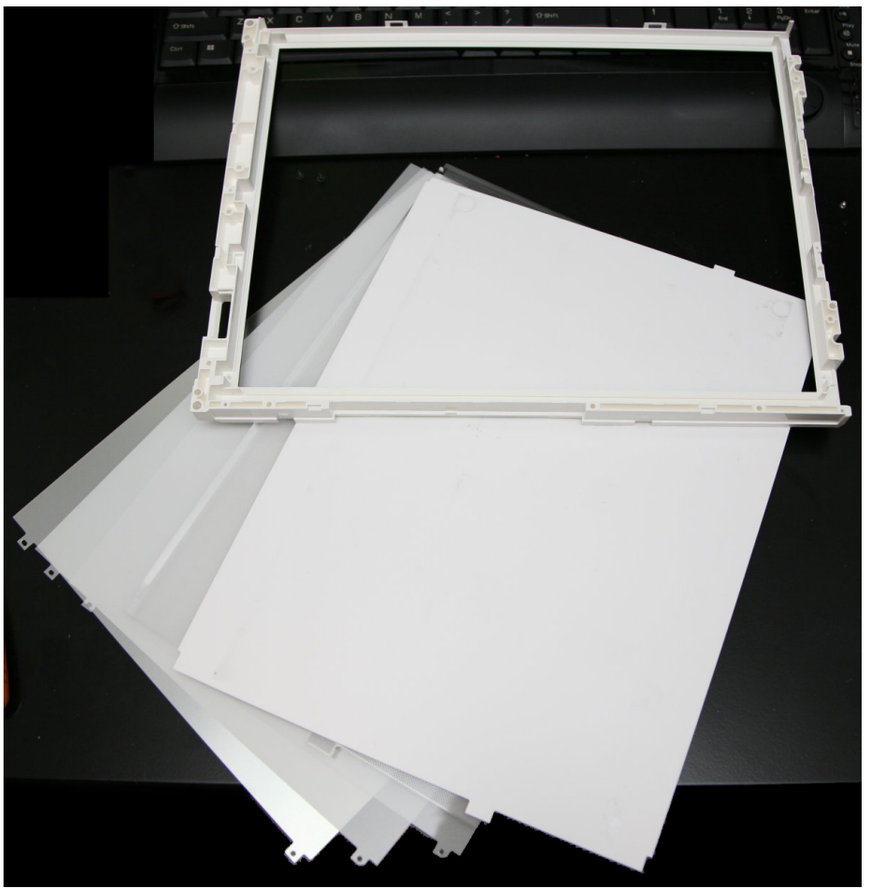
Reflectors, Light Guides and Diffusers

We now have two, wonderfully bright lighted strips, one at the top and one at the bottom of the panel. Typically, the lights are not behind the panel. Unless it is a very large display, the CCFLs are at the top and bottom edges, mounted in a couple of highly reflective metal channels that are themselves are mounted on the aluminum frame. Our next goal is to diffuse the light, as evenly as possible, over the entire top surface of our light box. The first step is to line the inside of the aluminum frame with a highly reflective, white plastic sheet. Any light that hits the white plastic sheet will now be reflected evenly, back toward the front surface of the display and eventually hit your eyeballs.

Next comes the heavyweight component of the monitor. It's the single most massive component, the acrylic light guide. No, it's not anything that can fail. In fact, it's the most indestructible part of an LCD monitor. Acrylic has a neat optical property, a phenomenon known as "Total Internal Reflection" or TIR. If you light up one edge of a sheet of acrylic, the light reflects



In order to diffuse the light as evenly as possible over the entire top surface of our light box, the inside of the aluminum frame is lined with a highly reflective, white plastic sheet. Any light that hits the white plastic will now be reflected evenly, back toward the front surface of the display.



A series of plastic films is used to redirect and diffuse the light so the surface is illuminated as evenly as possible and appears as bright as possible.

Bob Yabroff
President

"I have always supported Slot Tech Magazine"

"But to tell you the truth, the content of this magazine is gobbledygook to a seating guy like me."

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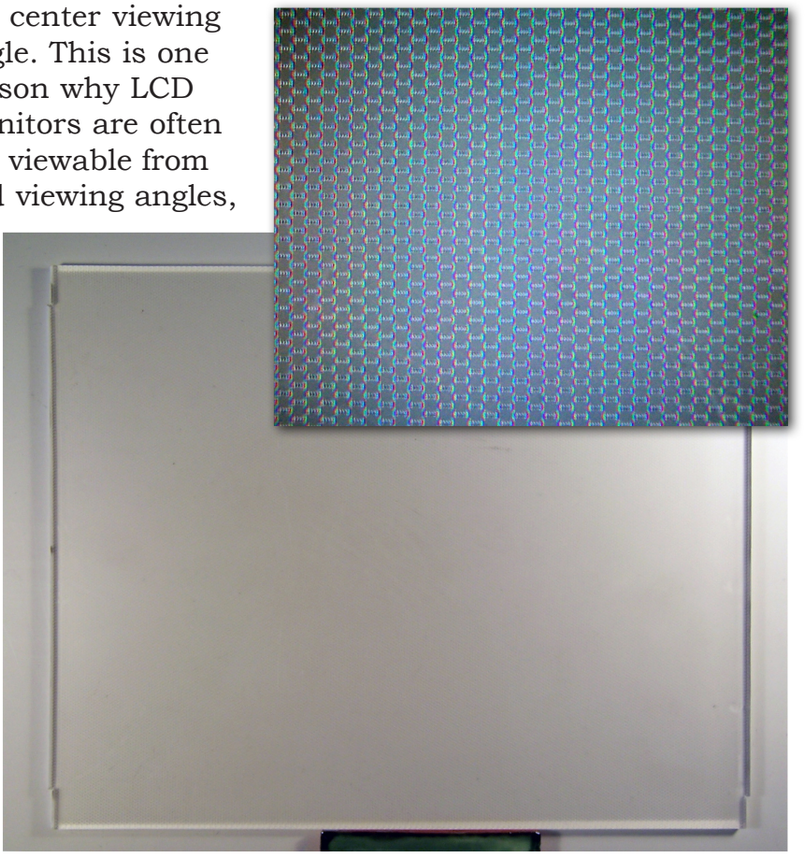
of the sheet pops out all the other edges. By etching small, angular pits into the surface of the sheet, more edges are created (they're actually little prisms at this point), throwing out the light.

But here's the really neat trick about the acrylic light guide. As we all learned in High School physics, the intensity of light (like all electromagnetic radiation) falls off by the square of the distance from the source so that anything that is twice the distance from the source receives only one-fourth of the light. That's bad. We want the light to be perfectly even across the surface. We don't want the surface of the light box to be super-bright in the area close to the lamps (at the top and bottom edges) but dark in the center. The acrylic light guide corrects this by having greater pit density at the center of the sheet than the top and bottom, where there are barely any at all. The pit density is inversely proportional to the light intensity and so one offsets the other to create a linear diffusion of light across the surface.

But we're not finished yet. Since most LCD monitors are meant to be viewed by a person looking directly at the display, there would be wasted light thrown out by the display above and below the normal viewing axis if we didn't do something to correct it. Why waste the light when we want the display to be as bright as possible? If the display is more efficient, it can operate with lower power consumption for equal brightness.

To correct this, there is a series of transparent plastic films that takes the light that comes out of the tiny pits in the acrylic light guide and redirects it toward the viewer. This is the brightness enhancement film" or BEF. Since we want the panel to be as bright as possible, the films take the light that would normally be wasted in the space above and below our normal viewing angle and redirect it toward the center viewing angle. This is one reason why LCD monitors are often not viewable from odd viewing angles, becoming extremely dim or even exhibiting a strange negative or inverse image. However, the display is very likely to be viewed from the left or right (except notebook computer displays) so the films also direct light to the sides.

In fact, there actually is a bit more to it than this and one or two of the films (called "compensation films") also correct for other anomalies in the transmission of light through the liquid crystals as well. As you might imagine, the proper orientation of these films is critical to the proper operation of the monitor. Fortunately, the



The Acrylic light guide takes the light from the CCFLs at the top and bottom edges and throws it up toward the upper surface of the display. The surface of the light guide is etched with hundreds of tiny prisms.

films are keyed with notched edges that make it impossible to assemble them incorrectly, even under the sometimes challenging work conditions found in a typical casino slot shop. On top of this series of films is yet another plastic film. This top film is translucent and white, the final stage in producing an evenly lighted surface.

Slide!

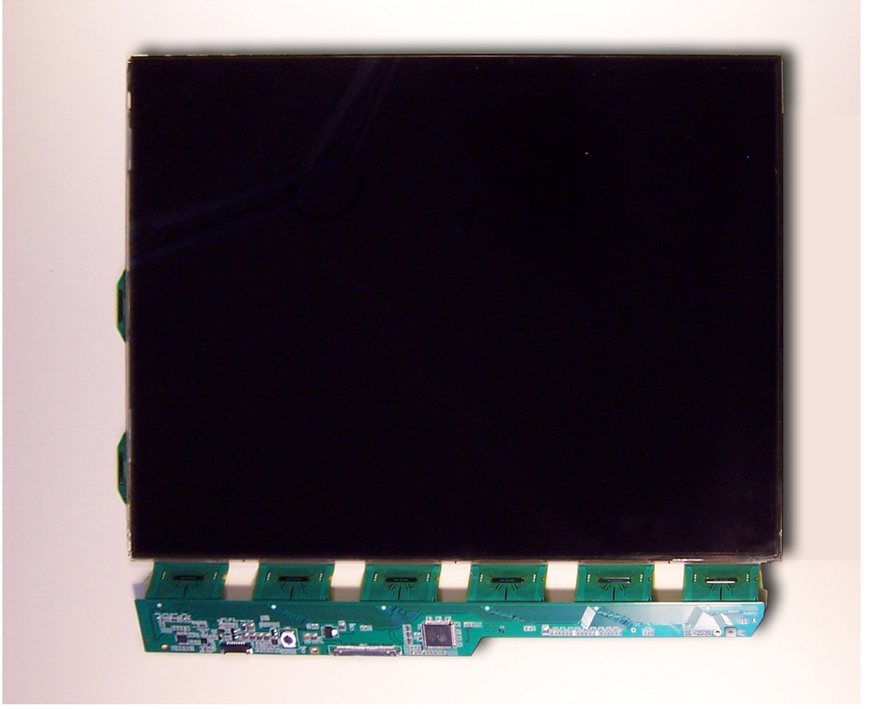
Now we have a completed light box. It's really pretty simple, isn't it? You just plug the inverter(s) into a +12 Volt DC source and it lights up, a flat, white, evenly-glowing surface. You could put a durable piece of glass on the top of it and use it as a viewing table. You could drag out your old collection of 35mm Kodachrome slides (the ones your (grand)parents took on your 1958 family vacation to the Grand Canyon), lay the tiny transparencies on the luminescent surface of the light table and examine them closely with a magnifying glass. Alternatively, you can put one giant slide on top of it that's as big as the light box itself and view it, unaided, from a comfortable distance and that is the next component of the LCD monitor.

The LCD Panel

The image itself is really a transparency. It's like a 35mm slide but way bigger. It's an "electronic slide" that can reproduce any image and can change the image 60 times a second. But because the image is a transparency, it doesn't generate any light of its own. You have to "hold it up to the light" to see it. When the transparent LCD panel is placed on top of the glowing white backlight, we can see the image. This panel is the only real magic in the monitor. Fortunately, it is very reliable. Unfortunately, it is not practical to repair it and it is not intended to be a replacement component. When this part fails, the entire LCD panel (including the light box part of it) is replaced as a unit. Fortunately, the LCD panels themselves are now a commodity and are readily available at a reasonable price. Unless a monitor has suffered physical damage or a massive failure due to a lightning strike or other power-related phenomenon, it will always be practical to repair an LCD monitor in a modern slot machine as opposed to replacing the entire monitor.

How It Works

The LCD panel works by taking advantage of light polarization and controlling the polarization through something known as "twisted nematic crystals."



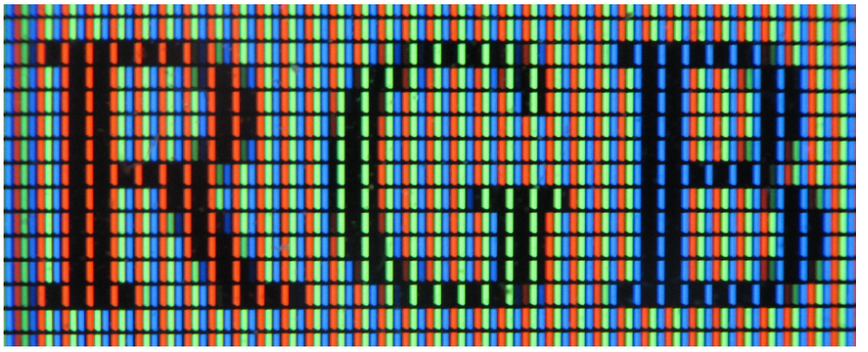
The LCD panel uses two thin sheets of glass that are sandwiched together, each covered on the inside with hundreds of transparent electrodes. There is a tiny gap between the two sheets of glass. The void is filled completely with a small quantity of liquid crystals. Polarizing filters form the remainder of the system, creating thousands of tiny light valves that can be controlled to allow or block the light from the CCFLs.

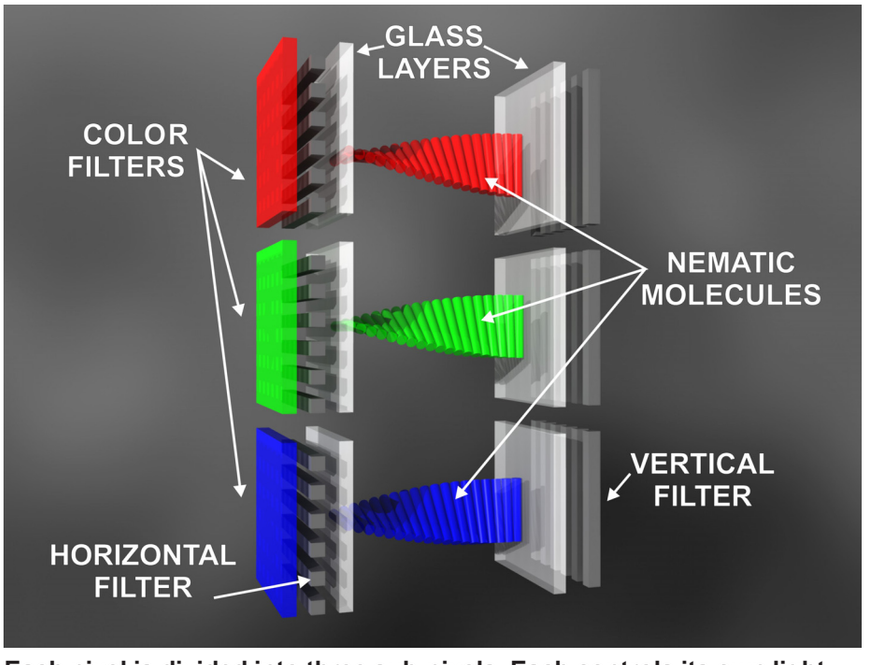
hundreds of transparent, Indium Tin Oxide (ITO) electrodes for the application of an electric field. The electrodes are arranged in rows and columns. There is a tiny gap between the two sheets of glass. The void is filled completely with a small quantity of liquid crystals. Liquid crystals are organic substances that combine the physical properties of liquids with those of solid crystalline materials. Unlike "real liquids" in which the molecules all sort of bounce around and never line up in any way that's not totally random, the elongated liquid crystal molecules have long axes and can be made to line up with each other. By applying an electric field (through the transparent electrodes) the alignment can be controlled.

Crystals refract light. They bend it. In this case, they can be made to bend it by 90 degrees or more. By applying voltage to the electrodes, we actually twist the long, skinny liquid crystals and as a result, they will either bend the light 90 degrees or allow it to pass straight through. We can do this at every intersection of the hundreds of transparent columns and rows that cover the screen. Each intersection controls its own tiny square or rectangular region of the screen. Each of these is referred to as a "picture element" or "pixel."

By itself, bending the light does absolutely nothing that we can see with the naked eye, which is not sensitive to light polarization. Unaided, you cannot tell by looking at a light source if it's polarized or not but by adding a pair of polarizing filters, one on each side of the liquid crystal glass sandwich, we can see what's going on.

Without an image, an LCD monitor is dark. Naturally, the backlight CCFLs are always on, but the light is blocked from reaching our eyes by the combination of the polarizing filters and the liquid crystal sandwich through which we must look in order to see the light coming from the backlight. When we want the light to shine through one of the pixels, we address it by its respective column and row and change the orientation of the liquid crystal at the intersection, either bending it or unbending it as necessary in order to block or unblock the light. Partial rotation is used to obtain "gray scale." By rotating the crystal in .35 degree increments, 256 shades of gray can be ob-





Each pixel is divided into three sub-pixels. Each controls its own light valve, one for each of the three primary colors, red, green and blue.

In order to add color to the display, each pixel is further divided into three sub-pixels. Each of these sub-pixels is really its own liquid crystal area, one third the size of the entire pixel. Each can be controlled independently by a tiny, "Thin Film Transistor" (which is where we get the term "TFT" for this type of LCD monitor) that is visible with a microscope as a tiny dark spot at the intersection of each column and row. A colored film filters the white light's wavelength for each sub-pixel. Naturally, these are the three primary colors, red, green and blue. Please note that these are not phosphors. They are just colored filters. Remember, the light comes from the CCFLs only.

The Video Processor

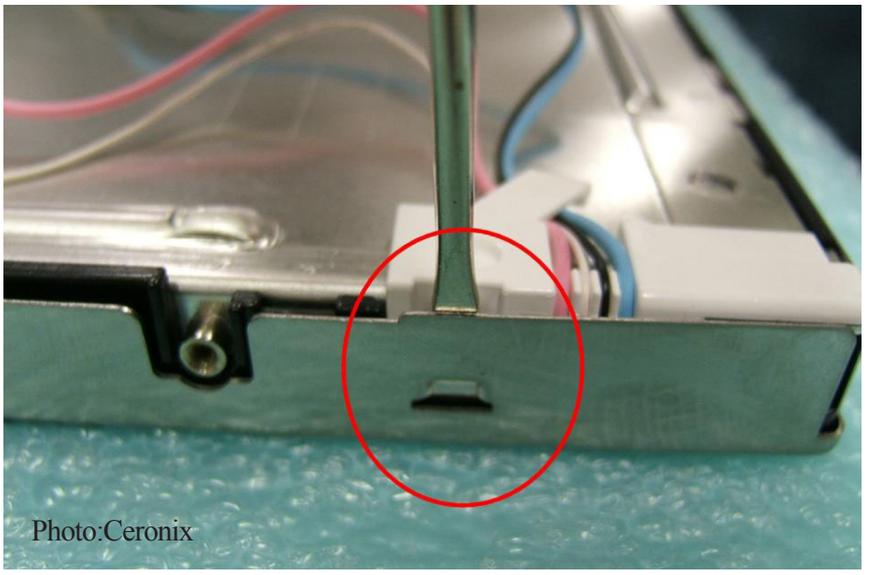
The electronics that control the panel (essentially the column drivers, the row drivers and the sub-pixel control) are typically mounted on a PCB connected by flexible ribbon cables that are a permanent part of the glass assembly. It is typically not repairable as mentioned. The assembly is typically connected with a pair of ribbon cables to the circuit that drives it, which is typically referred to as the "video processor" board or the "video" board or the "A to D (analog to digital) board."

It may also be referred to as the "scalar" board (although that really sort of describes one of the ICs) as it can take in a video signal of many different resolutions and scale it up or down to produce a proper display. LCD monitors each have a certain "native resolution" which is the number of actual, physical pixels that make up the display. As an example, the monitor I am looking at right now has a resolution of 1440 X 900. The first number is the horizontal resolution, the second is vertical. That's 1,296,000 pixels. But if the video signal is not 1440 X 900, the scalar will convert it. Conversely, I may also choose to set my monitor for a lower resolution, producing a "blown up" or "zoomed in" display. The scalar will perform this conversion as well, assigning one pixel of video to more than a single pixel (including fractional pixels using a technique known as "anti-aliasing") on the display itself.

The video processor takes the video signal in from the video source (can be analog video, such as comes from the standard 15-pin, sub-D video connector we find in legacy computer systems-including slot machines, of course-or the DVI "digital" video used in newer systems), processes it and sends the digital information out via ribbon cables to the LCD panel so it knows which columns and rows to activate and which sub-pixels to turn on.

Repair

So, at this point, you can see that an LCD monitor is pretty simple. It doesn't really require any elec-



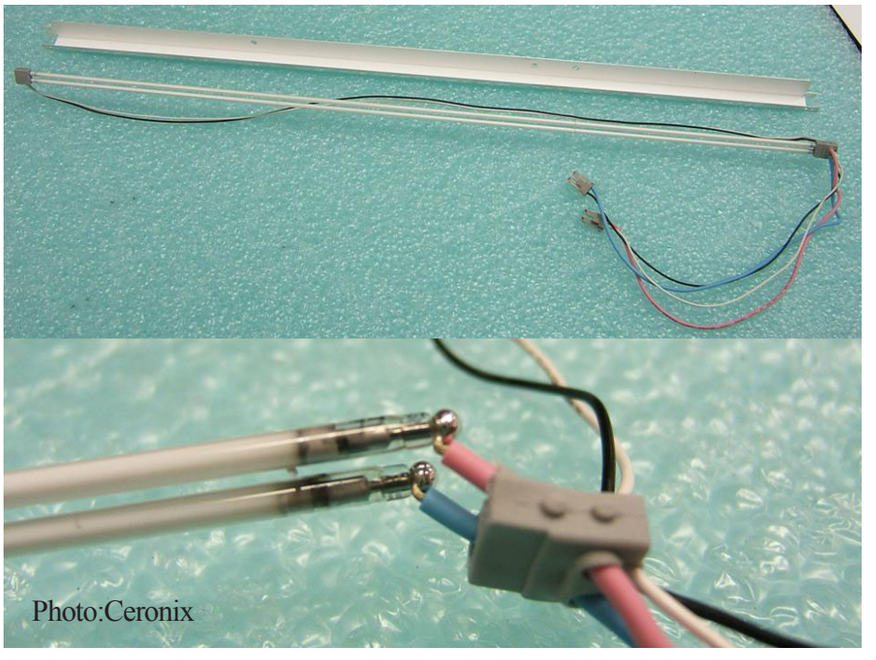
Pop open the panel by prying it open with a little screwdriver. There is a series of small latches around the edges. You just pry them open and work your way around the panel.

lamp. Wearing white cotton gloves to prevent getting fingerprints on the films or diffusers, you just pop open the panel by prying it open with a little screwdriver. There is a series of small latches around the edges. You just pry them open and work your way around the panel and sort of open it like a clamshell, splaying it open on the CLEAN AND DUST FREE workbench, one layer at a time until you get down to the CCFL assembly, the "channel" at the top and bottom. Typically, a single, tiny, oval-head, Phillips head screw holds this in place. You will need a high-quality "jewelers" screwdriver, preferably magnetic. Remove the screw, unclip the wires that are simply tucked under a plastic retaining clip, and the channel, typically containing two lamps, can be removed from the frame.

Replacing the lamps is a simple matter of popping them out of the channel (they are held in place with a little silicone rubber boot) unsoldering the bad lamps (contains mercury. Should be treated like any other florescent lamp for disposal. Your local/state/tribal environmental protection regulations apply) and soldering in the new ones. If one CCFL is bad from an age-related failure, it would be idiotic to not replace them all. Take care that your solder joint is a nice, smooth ball on the end of the electrode and does not have any sharp wire ends or other pointed protuberances. Pointy conductors at high potentials can produce arcing and/or something called a "corona discharge" which can overheat the CCFL and/or overload the inverter, leading to damage.

And speaking of the inverter, as mentioned previously, inverter failure is not uncommon. If the CCFLs aren't lighting up, perhaps the inverter is to blame. Certainly, if the CCFLs light up properly with your CCFL Tester but not in the monitor, that's a good possibility. The easiest thing is simply to toss in a new inverter and see if that fixes the problem. Be advised that bad inverters and bad CCFLs may go hand-in-hand requiring replacement of both before you see the light. Another way to test the inverter is to touch it (touch the transformer) with your finger. If you receive a mild shock, it's working (duh). Alternatively, in a working inverter, an NE-2 Neon lamp, held against the transformer, will light up just as it does when held against the working flyback transformer of a CRT monitor. If there is no output, move to the input and test the +12 VDC (or whatever) input. If the DC input is there but there's no output, either bad CCFLs are preventing the inverter from functioning or the inverter is bad. Substitution is the best test.

And just to reiterate, I'm not going to include any



When replacing burned out CCFLs, take care that your solder joint is a nice, smooth ball on the end of the electrode and does not have any sharp wire ends or other pointed protuberances. Pointy conductors at high potentials can produce arcing.

power supply diagnoses/ repair in this discussion of LCD monitors. Yes, there is a power supply. Yes, it fails. Yes, you can repair it (generally speaking). Yes, it's mostly bad electrolytic capacitors.

And that is pretty much the extent of what you are likely to do most of the time, not just because you have likely reached the limit of your abilities but because that is what fails the most: Lamps, Inverters and power supplies.

And that's good because the next step up is to repair the video processor PCB which is a whole lot more complex than a florescent lamp! That having been said, it's all straightforward (although fairly advanced) electronics troubleshooting and totally doable by a bench technician with sufficient skills, a good oscilloscope (and other component-testing equipment) and SMD rework capability. With those requirements, it is not surprising that, other than replacing the bad electrolytic capacitors we've outline in previous editions of Slot Tech Magazine and perhaps a voltage regulator, there are not many casinos that will be able to pull this off (Mystic Lake Casino-the paradigm of slot operations in the world, as far as I have seen-and a small handful of others excluded).

However, as common issues with the video processor boards arise, we will certainly present them here in Slot Tech Magazine. Once the "troubleshooting" part of the repair has been done, all that is left is to change out the bad part so, as usual, good soldering skills are the most critical aspect of this type of repair. It doesn't take an electronic genius to fix the video processor board but you do need good soldering skills.

So there you have it, the complete LCD monitor is six things: The CCFLs themselves (common failure-replaceable), the inverter (common failure-sometimes repairable/ always cheaply replaceable), the acrylic light guide and diffusion films (zero failure, zero maintenance), the liquid crystal assembly (reliable-not repairable/not replaceable except as part of the entire LCD panel Assembly), the video processor PCB (reliable-repairable) and the power supply which, as with all power supplies, can suffer from heat-related capacitor failure and is, in general, a common failure item.

Because some LCD monitors have built-in, open frame power supplies while others use an external, enclosed "brick" type of power supply, the definition of "monitor failure" is sort of skewed when we talk about an LCD monitor's power supply. If a monitor's internal power supply fails, it is most certainly a "monitor failure" but if the monitor uses an external brick power supply and it fails, can it be really considered a monitor failure? When you know the answer, Grasshopper, it will be time for you to repair LCD monitors. **- STM**

Cost Saving
Bench Repairs

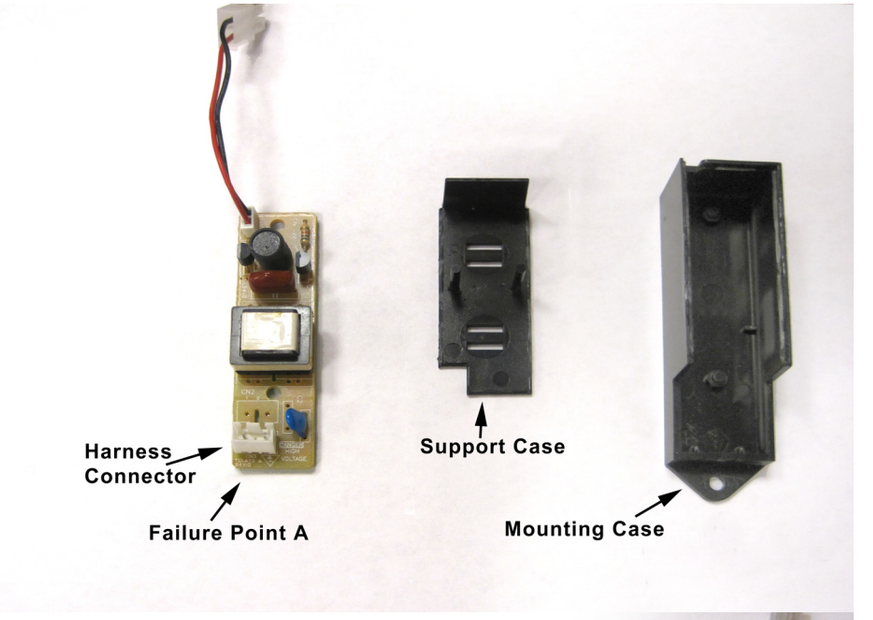
By Dean Auger

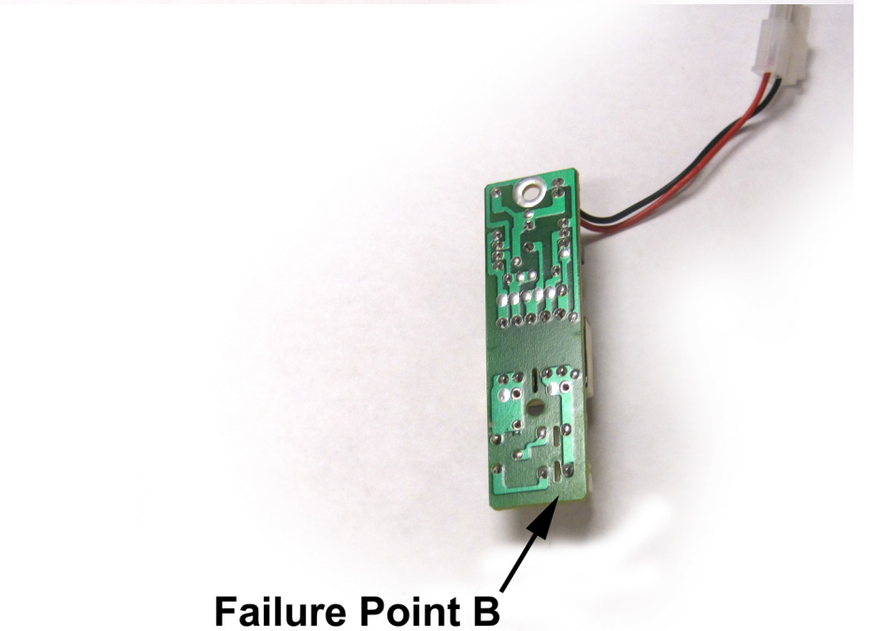
Dean Auger is the Slot Manager for Kewadin Casinos. He has an extensive background and education in mechanical and electronic repair that began in the mid-80s with a Zenith dealership and progressed to certification in HVAC and refrigeration repair. He has been in the Casino Slot Department for nearly nine years and in his current position for four years.

"I hope I may be a valuable resource to your magazine and its growing reader base," said Auger. "I do realize this is a short and to the point article but then, so was the repair."

ID Interactive CCFL Side Light Inverter Board Problem

We added to our casino floor, 20 ID Interactive slot machines. This was a new game to Michigan starting the 2007 year. They have a sleek profile design that is attractive, with innovative games. During the past couple of years, we began to experience problems





Failure Point B
Fractured solder joint
Lack of conformal coating

with the CCFL side light inverter board located inside the door, latch side, that powered the CCFL light in the door. After we went through several of these boards (we had one of these boards catch on fire!) we began to look at the part much closer (for obvious reasons).

We found the failure was always in the same location, at the harness connection site indicated as failure A on the picture labeled Side A. After the damage had been done, it was difficult to isolate the exact problem. We then did a close inspection of these boards that were functioning in the machine. We found that there was a fractured solder joint on both pin connections, indicated as failure B on the picture labeled Side B. It also appeared that the conformal coating was lacking in this area.

As we all know, replacement parts are costly to stock and costly to replace. The cost of this part is roughly $65.00 and the whole CCFL assembly had to be purchased. We decided to rework these boards on our bench. We cleaned and unsoldered the pins and then proceeded to re-solder them back in place. After a thorough inspection of the repaired area, we then added conformal coating.

Any time that a part can be repaired, the machine down time is decreased with obvious beneficial results and the cost of repair has been decreased significantly. We found nine out of ten of these boards still functioning in the machines with the cold solder joint problem and made the repair prior to the board failing. We have enjoyed the results with no failures since. Just doing some simple math, you can see the obvious financial benefit.

I sincerely hope this will assist technicians in avoiding a costly repair as we experienced and avoid future costly replacement parts.

Dean Auger, Slot Manager
Kewadin Casinos

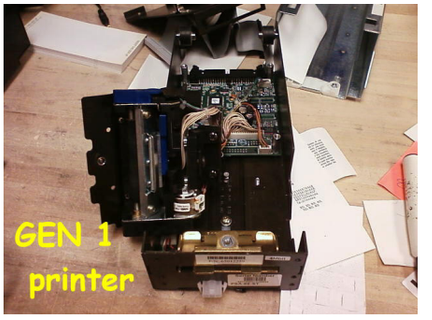
Quick & Simple Repairs #60

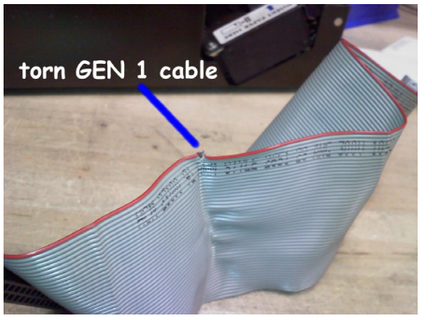
By Pat Porath

GEN 1 Printer Problem

Every so often I work on a pile of ticket printers that are piled on the printer bench. I've seen printers with bent parts, broken parts, dusty printers, fried, and even "blank" printers (They are blank because they haven't been programmed.). This particular GEN 1 (brown, metal ticket printer, also known as a "Seiko") had a tag in it that read something on the order of "Only prints on one end." There are many things that could be wrong with it, so why not give the unit a quick inspection? Is there anything obvious that could be causing a problem? Quite a few times there will be a printer not working correctly and after it is torn apart, an internal optic has a layer of dust on it. Obviously that would cause a problem.

On with the "quick inspection," it has some dust on the interior near the thermal board but nothing really major. What about the condition of the ribbon cable and the ribbon cable connection to the motherboard? There was the problem; the cable had been pinched and had a small cut in it. It was enough of a cut to go through three wires in the cable. Upon further inspection of the cable, in a different location, four wires were bare. I was very sure this was the problem. How did it even print anything at all? I always clean a printer that goes across the bench if it needs it. This particular one did in fact have some dust so it was taken apart and cleaned. Afterward, a replacement ribbon cable was installed and the printer tested OK on the bench. It fed numerous tickets properly and printed several "self test" tickets. The unit was now ready to be tested in a game. I'm quite sure that it will test just fine and the cable was indeed the problem.





Cashbox Stuck in an Upright Konami

As soon as I got to work on this day, I was told I had a game to work on right away. It was a newer upright Konami that is a very popular game. Somehow the cashbox had gotten jammed inside the game, so we thought, and the "TR stand" (also known as the "JCM UBA housing") had to be destroyed to get the cashbox out. To replace the bill acceptor "housing" was pretty easy other than one cable that went from the back of the bill acceptor all the way to the bezel on the door. There wasn't a connector to disconnect it anywhere that I could see except right on the bezel itself. No big deal though. Other than that, a few connectors and a few small screws and it comes right out.

After the replacement bill acceptor housing was installed, it was time to put the bill acceptor back in and the box. Of course I wanted to make sure that the replacement was functioning properly, so I grabbed the cashbox to remove it. What in the heck? This box was stuck too, and it was REALLY stuck. What was causing this to happen? The original theory that someone had forced the box in the game didn't seem to be the case because I hadn't forced it at all and the original problem happened again.

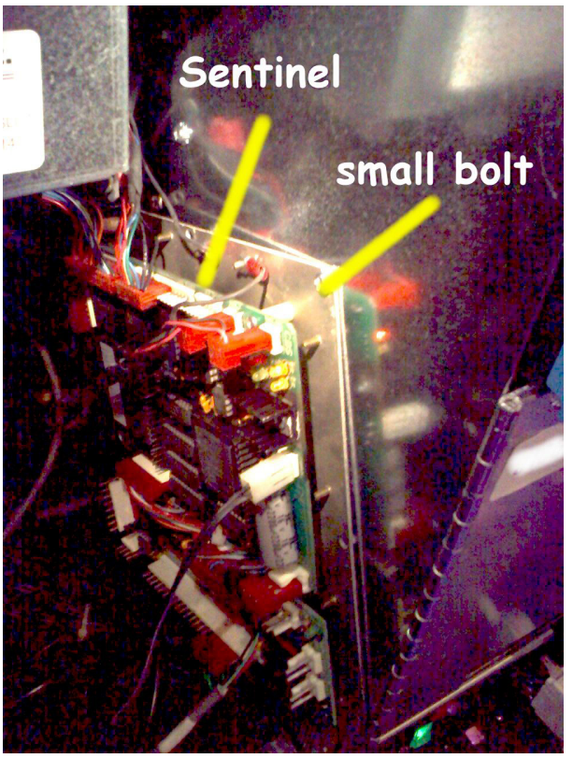
I needed a cup of coffee to think about this ordeal. This row of games is almost brand new; they have been on the floor for less than two months. What could the problem be? What were the last few things that were done to the game that might cause this problem? I knew that the cashbox has been changed out by the count-team, but what else? Sometimes when troubleshooting games it may be a good idea to think what was done to the game before you got there, such as a bill acceptor not working after the count-team goes through. There is a good chance they were the last in the game and that the box only needs to be reseated. Or if a technician was in a certain game, what did they swap or replace? Come to find out on the upright Konami game that the cashbox was stuck in, the problem was found. The only thing that didn't appear to be "original from the manufacturer" near the bill acceptor area, was that the Oasis Sentinel bolted to the side of the bill acceptor assembly. One bolt went into the assembly to hold the Sentinel in place. How could this be a problem? I also knew that technicians were checking games to make sure that Sentinels and cables were snug and properly grounded. When I removed the bolt that held the Sentinel, it first looked to be ok. I didn't think that it was very long at all. How about trying to take the cashbox out now? This time it was removed from the game with ease. Now that it was out, I took a closer look at it to see what could possibly cause it to get stuck in the game. Here is something unusual! A small indentation with the outline of a bolt was pressed into the box. When the bolt was removed, the box was very easy to remove and install but with the Sentinel and bolt in place, the box would not come out. Finally the problem was found. The bolt that held the Sentinal onto the side of the bill acceptor assembly was a bit too long therefore pressing into the cashbox causing it to be stuck. A bit shorter bolt replaced the longer one and the bill acceptor assembly was fine. I had to scratch my head a bit on this one but I figured it out.

Bally Top Box Light Assembly Problem

Why am I writing about fixing a florescent lamp assembly? Because to get it working didn't make any sense at first. Instead of skipping this paragraph, please read on. Basically a slot machine light assembly (once again, basically) consists of a power source, a wire harness, a ballast, connectors and a florescent tube. On this Bally slant top "Hot Shot" game, the top light assembly has two F15 tubes and two ballasts instead of the single lamp up top as seen in the IGT S-plus and some S2000s. On this Bally, the top glass light was out and it looked like crap. We don't like having lights out on games. I looked at it and didn't know what the problem was. There was power at the power connector, different ballasts were tried and of course different florescent tubes were tried. Nothing worked. I inspected the wiring for the light assembly and it looked to be ok. I didn't see any pins that were pushed in and I didn't see anything unusual. So, the complete top light assembly was swapped with the game next door and a known working assembly was installed in the game. The suspected bad one did not light up in a different game and the known good one did light up in the original game. This told me that something, somewhere, was wrong with the original light assembly, possibly in the wire harness. A replacement was ordered and I was asked to install it. No problem. When it arrived I noticed that it didn't include the "main power harness." The wiring that goes FROM the power source TO the input of the ballasts. Absolutely no big deal at all. A couple of wire ties and a couple of connections and the harness was put on the new assembly in minutes. Once it was installed into the game it was time to plug it in. What in the world? The darn thing didn't light up! The only thing that was original was the main power harness. Everything was brand new but it didn't work! Well, back to the drawing board. Since the power side of the wire harness seemed to be the problem, it was swapped with the game next door. Indeed it was bad and I took a closer look at it. Still, I didn't see anything obvious that was wrong with it so it was time to use a meter to check continuity. There was an open at one pin of the connector. It was replaced and the "Hot Shot" game top area lit up perfectly.

IGT Upright S2000 Reel #1 Tilt

Originally, I was using the S2000 to test a printer to make sure that it worked in a game. I had worked on the printer on the bench where it properly fed paper and printed a "self test" ticket but I wanted to make sure that it did in fact work in a game. I tested the printer out and it worked fine. The problem was, when I closed the door on the game, a reel 1 tilt occurred. I thought this was kind of interesting. What would cause a reel tilt? I wasn't aware of this game having a lot of tilts, what was causing it? I opened and closed the door once again and noticed that the number one reel was rub-



The bolt that held the Sentinal onto the side of the bill acceptor assembly was a bit too long therefore pressing into the cashbox.

Don't replace
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Buying Replacement Units!

Is your casino totally self-sufficient in repairing monitors, power supplies, bill validators and ticket printers or are you throwing away hundreds or thousands of dollars purchasing replacement units? While it is not exactly a "hidden" cost to your department, some slot managers simply accept the price of replacements as the "cost of doing business" while it progressively nibbles away at the casino's bottom line. IT DOESN'T HAVE TO BE THIS WAY.

"In just five days, your slot techs can learn to repair Power Supplies, CRT Monitors, LCD Monitors and more. It's easy and it's fun. Let me show you how. "- rf

In truth, most electronic repairs are pretty easy. Often, it's just a matter of testing and replacing a small handful of inexpensive, off-the-shelf electronic components. Sometimes, it's just one. For example, it costs less than 25 cents in parts to repair the most common failure in Bally power supplies. The entire process takes about five minutes.

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You will see an immediate savings to the casino, starting with the in-house repairs that will be performed during the class!

About Randy Fromm: I am the publisher of Slot Tech Magazine. First published in 2001, Slot Tech Magazine is a monthly trade journal focusing on casino slot machine repair. I have been repairing electronics for the gaming industry since 1972. I really enjoy what I do and I love showing others how easy it can be. ***No previous knowledge of electronics is required.***

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bing on the door. Why was this happening? It looked like it was rubbing for a while too because there was a slight groove worn into the plastic on the door area. Like I said, it wasn't a major problem that I was knew of but it sure looked like a problem. When I looked at the left side of the reel shelf, a bolt was missing. It happened to be one of the bolts that hold the reel shelf securely in place. Since it was missing, the shelf had moved closer to the door, causing the reel to tilt. The missing bolt was replaced and the game was fine. It was kind of weird that the bolt was totally gone.

Atronic e-motion Stacker Removed Error

I had received a complaint that one of our Atronic e-motion "Cash Fever" games had a "stacker removed" error that wouldn't clear. Once at the game and with the cashbox removed, there is a large "cherry switch" that is located in the back of the bill acceptor assembly. When I felt the wires on the switch, one of them were a bit loose so I made sure they were nice and snug. The cashbox was put back in and the "stacker removed" error went away. This game had another problem too. The main LCD wasn't nice and clear like it should be, it was a little distorted. I checked to make sure the video cable was secure in place. There are two, one toward the front and one toward the back of the game. The front cable is for the bottom LCD and the back is for the top one. Making sure it was snug, I checked the LCD once again. Now it was nice and clear. It was simply a loose video cable.

IGT Game King-No COM From Game to Sentinel

I fielded a complaint that a Game King had locked up for a small payout. Why didn't it pay out a ticket? That is what I wanted to find out. When the slot door was opened, the Oasis display still showed that the door was closed. An indication of game communication to the Sentinel is when the slot door is OPEN and CLOSED, it is supposed to show the same on the Oasis display (when a floor or tech card is inserted, that is). Since the display didn't show correctly, we had a problem. I checked the RS232 connection on the Sentinel (the game interface cable plugs into this) along with the connection at the game end. Both of them looked fine. Next, the Sentinel was rebooted and the game was too. That didn't help either. After that, the RAM was cleared on the Sentinel but no go there either. Maybe it was a game option problem? Software was checked and everything looked good in that area too. SAS channel 3, address 1, SAS secured enhanced, etc. Now what?

I took a look at the motherboard of the game and saw the problem right away. A large ribbon cable wasn't seated correctly. Power was turned off and the cable was pushed into the connector correctly. With power turned back on and after a minute, the Oasis display now showed that the slot door was OPEN and CLOSED like it was supposed to. The loose ribbon cable on the motherboard was the problem. Why did I look at the motherboard? Because the game interface cable goes from the Sentinel to a board on the side of the game and plugs in. Then a large ribbon cable goes from that board to the game motherboard. Without the cable connected properly, the Oasis system can't receive a signal from the game.

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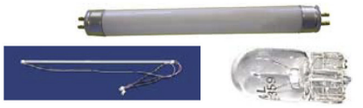

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