June 2009

SLOT TECH MAGAZINE

Slot Machine Technology for the North American Gaming Industry

Ceronix CCFL Replacement

Save $$$ Through CCFL Backlight Dimming

Slot Tech Magazine

$10.00

The New Las Vegas Strip.

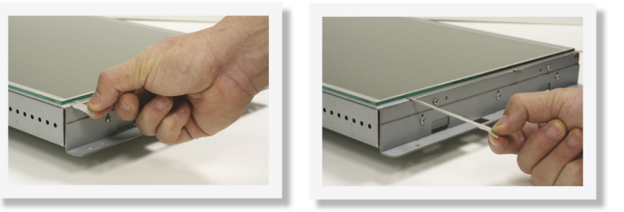
Command™ Strips for Touch Sensors

Quick Removal and Easy Integration

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.

Quick to Remove

When a touch sensor needs to be removed, use Command's "stretch release technology" by pulling the "pull tab" at a 90 degree angle so the sensor pops free in seconds. And, these "no mess" strips don't leave an adhesive residue that can be difficult to clean up.



1 Pull Tab at 90 Degrees

Easy to Integrate

Using "peel and stick" Command Strips, a touch sensor can be easily integrated to a display in minutes and quickly put back into service.

1 Apply First Four Strips

2 Apply Next Four Strips

3 Mount The Touch Sensor

Watch Video

See how easy it is to use Command Strips for Touch Sensors to integrate sensors and to remove sensors at www.3m.com/touchstrips. Seeing is believing.

www.3m.com/touch

Command™ Strips

NOTICE: Command™ Strips for Touch Sensors were developed for use with the 3M™ MicroTouch™ System SCT3250EX (previously known as the 3M™ MicroTouch™ ClearTek™ II System). Customers must determine whether Command Strips are suitable for use with their particular touch sensor and in their intended application.

3M

CASINOTECH

kortek authorized service center

Your one stop shop for IGT's new game monitors!

Parts and Service for:

IGT · Bally Technologies · WMS Gaming · Konami · Aristocrat · Gi innovations · kortek

We provide the parts and service needed to help with ALL of your video monitor needs.

Free warranty Service for all Kortek LCD, CRT, and PDP Monitors	Low cost out of warranty service on LCDs and CRTs
Expedited Services available	Service Info for all Kortek Monitors
CRT Chassis Boards, Touch Screens, and Controllers	Low Cost replacement LCD and CRT Monitors
Retrofit LCD monitors	LCD Panel Repair and Backlight Replacement
Player Tracking System Displays, Touch Screens, and Backlights	Cold Cathode Fluorescent Lights for Panels and Slot Lamps

Now offering Command™ Adhesive strips from 3M! Remove your touch screens in just under 5 minutes!

TOUCH SENSOR REMOVAL MADE EASY.

3M

The Original Authorized Kortek Service Center
P: 702.736.8472
P: 281.255.4388
F: 702.920.8678
SALES@CASINOTECH.COM
WWW.CASINOTECH.COM

NEW!

Kiesub Spring Flyer

Visit our Website Today to View and Order Online 24/7

- **Over 1000 Products Available Online**
- **New Items for Slots Added Daily!**

www.kiesub.com

Free Shipping on Qualifiying Online Orders Over $200
1/2 Price Shipping on Qualifying Online Orders Over $100
See Website for Details!

4 Easy Ways to Order from Kiesub: Call, Fax, Click or Email!

Kiesub Winter/Spring Flyer

KIESUB ELECTRONICS

Electronics Distributor and Full Service Contract Manufacturer

Our Services Include:
• Cable Assemblies • Wire Harness Manufacturing • Design/CAD Services • Turnkey Projects • Electro-Mechanical Assembly

These Products were All Manufactured In-House by Kiesub Contract Manufacturing:

Wire Harnesses · Custom LED Signs · Battery Packs · LED Replacement Boards · Automated Crimp Machine · Turnkey Builds · Cat6 Shielded Patch Block · Slot Harnesses

Tools • Cases • Soldering • Chemicals

STATIC PROTECTION

ESD Grounding Wrist Strap $5.25

Anti-Static Mat w/Ground Strap
900-114 24"x 48" $32.73
900-116 20"x24" $20.00

Magnifying Lamp
VTLAMP2WNU
$59.95

Caig DeoxIT FaderLube
The Cure for Sticky Buttons!
F5S-H6 $16.95

Caig DeoxIT Contact Cleaner/Rejuvenator
• Cleans, Lubricates, Protects
D5S-6 $14.95

PowerSquid Outlet Multiplier
S100632111806
$9.94

KIESUB Stocks Fiber Tools
Also Fiber Jumpers & Consumables

Fiber Polishing Disks 2.5mm
ST/SC $14.44

Fiber Optic Crimper
8PK-301F1 $49.98

Ideal Bucket Bag Tool Carrier
(Tools & Bucket Not Included)
35-665 $9.95

Hakko 808-Kit Desoldering Gun
This Handy Portable Desoldering Tool Features a Built-in Vacuum Pump and Thin Grip that's Easy to Hold. Comes Complete with .039" I.D. Desoldering Tip, Filters, and Cleaning pin.
For More Information, Visit Our Website: www.kiesub.com
808-KIT $159.94

KIESUB ELECTRONICS Ph (702) 733-0024 Fax (702) 733-0026 www.kiesub.com info@kiesub.com
Store Hours: M-F 7:30 am to 5:00 pm SATURDAYS 9:00 am to 3:00 pm

Don't Miss Out on New Products and Great Specials!
Sign Up to Receive Kiesub Flyers by Email
Here's How:
Visit our Website-
www.kiesub.com
Scroll Down on the Home Page
Enter Your Email Address into the Sign-up Block

ELECTRONIC PARTS AND SUPPLIES
CONTRACT MANUFACTURING
TEST EQUIPMENT & METERS
TOOLS & TOOL CASES
SOLDERING STATION & TIPS
DUSTERS • CHEMICALS
LED REPLACEMENT BOARDS
CUSTOM LED & DIGITAL SIGNS
BATTERY PACKS
CABLE HARNESSES & MORE!

KIESUB ELECTRONICS

3185 S. Highland Dr. Las Vegas, NV 89109
Call: 702-733-0024 Fax: 702-733-0026
www.kiesub.com info@kiesub.com

Inside Slot Tech Magazine

June 2009

Randy Fromm

Dear Friends of Slot Tech Magazine,

I received a short contribution from our old friend Herschel Peeler this month. He submitted it with a humorous title. As a writer myself, I have always hated it when an editor changed the title of one of my stories so his title "Problem: Cocktail Waitresses With Skirts Too Short and Necklines Too Low" stands. Yes, I DO realize we have many female slot techs but here at Slot Tech Magazine, we try to make technical articles just a wee bit more interesting and funny and I would ask that you accept a little light humor in the spirit it was intended. I'll try to include something that might be mildly offensive to cat lovers, the disabled or a religious group in a future issue.

Moving on . . . This issue contains some very important information. The knowledge in this issue will save your casino thousands of dollars a year, starting the instant you read the article on page 13, put down the magazine, open a slot machine with an LCD monitor and make a simple adjustment. Do this 1000 times and you will save your casino over six grand!

We also have an excellent contribution from our friends at Ceronix on the topic of CCFL replacement. In older LCD monitors, this was sort of a pain in the brain as you sometimes had to disassemble all the films to get to the lamps. Now, it's a bit more straightforward. This article shows you how. Replacement lamps are available from CI Innovations or Ceronix, both supporters of Slot Tech Magazine. Thanks.

We also have some coverage of a couple of slot tech training events as well as two excellent contributions from Malta's James Borg and homeboy Pat Porath.

That's all for this month. See you at the casino.

Randy Fromm

Randy Fromm - Publisher

Printed back issues are available for only one year from the date of publication. All single issues of Slot Tech Magazine are $10.00/ea.

For further details on the contents of each issue, please refer to the website at slot-techs.com. To order, fax a PO or e-mail a note listing the issues you need.

Complete archive (2001 to present) available online. Visit slot-techs.com for details.

Randy Fromm's
Slot Tech Magazine

Editor
Randy Fromm
Technical Writers
Ted Befus, Kevin Noble, Herschel Peeler, Pat Porath, James Borg

Slot Tech Magazine is published monthly by
Slot Tech Magazine
1944 Falmouth Dr.
El Cajon, CA 92020-2827
tel.619.593.6131 fax.619.593.6132
e-mail editor@slot-techs.com
Visit the website at slot-techs.com

SUBSCRIPTIONS
Domestic (North America)
1 year - $60.00
2 years - $120.00
International
1 year - $120.00
2 years - $240.00

Subscribe online at slot-techs.com

Slot Tech Magazine is an official publication of

global G2E gaming expo

Evolution
in gaming printers

Ready for Promotional Couponing

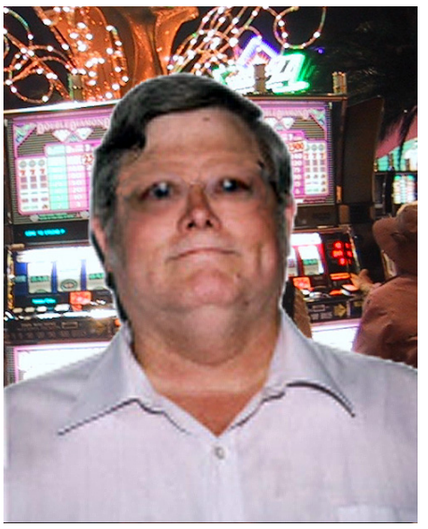
Designed for existing platforms as well as server-based games, the multi-function GEN2 Universal™ printer can be used to implement targeted promotional campaigns *today*. Configurable to handle 3 communication ports – USB 2.0, RS232 and NetPlex – a single printer can be specified for an entire property.

Reliable Performance Yields Maximum Uptime

Intelligent Ticket Handling™ and IntelligentBezel™ technologies virtually eliminate player interference and ticket jams. Industry's largest standard ticket capacity can save up to $200/printer annually in paper replenishment costs alone. And, when combined with a proven track record of reliability, over one million (1,000,000) FutureLogic printers are helping operators maximize playtime and reduce operational costs worldwide.

FutureLogic®
group of companies

futurelogicinc.com



Problem: Cocktail Waitresses With Skirts Too Short and Necklines Too Low

By Herschel Peeler

Yes, I know that has nothing to do with the problem but I figured that headline would get your attention quicker than "No Comm on an Acres Accounting System" or "Spilled Drink Kills the Casino." So here's the real problem, two banks of games on the sides of a bar shows no communication with the Acres system, no welcome message. One side is location 030101 to 030114, the other side is location 030201 to 030212. Both are on one channel of the same bank controller. Five minutes before it was my time to go home, they both decided to die at once.

The Acres event monitor shows that this bank is dead. All I show is a white dot that should be green. Only that one string seems to be bad. At the bank controller, LED segment "G" is out, indicating no communication on line OL1. So far this agrees with our symptom. After considering our options, with the new casino manager looking over our shoulder, the tech and I decide to try switching to our backup cable. Most of our banks have two CAT5 cables running from the patch panel in the computer room to the floor banks. We swap cables at both ends. Still down.

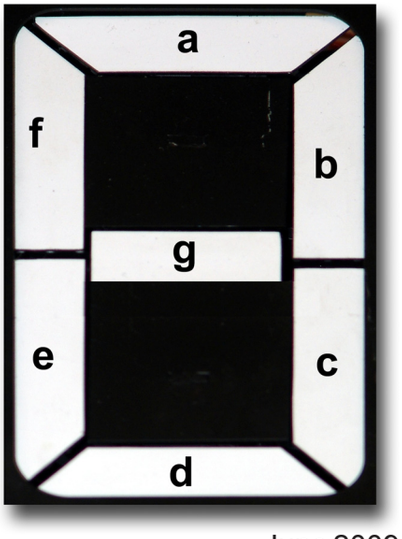
Trying to make a good impression on our new manager, we next try power cycling the Bank Controller. The "G" segment comes on for a minute then dies again as the Bank Controller tries to communicate with the banks but stops trying after a while. "G" stays out. It isn't a certain conclusion but the best guess is that it isn't the Bank Controller. The tech and I throw techno-babble back and forth for a few minutes, the manager looks lost (that was the intention). We decide that it must be one game dragging down the whole string. "Can that really happen," asks the manager. "Can one game being down take out all of the games?" "Sure," I say. "All the games are hooked in parallel. If one shorts out it can take down all of the games on that line."

The tech and I break the string about half way through at game 030114, one end half way around the bar. Half the games come up, 030101 to 030114. Our bad game is somewhere on 030201 to 030112. The game is afoot. Thankfully the manager gets called away and the tech and I can get down to business again. Continuing our half-at-time line breaking we get the problem down to the game at 030204. When that game is removed from the line all other games come up. The manager comes back through looking for a progress check. The tech hands him the board covered with goo from a spilled drink, maybe two or three days ago. "Spilled drink," says the tech.

"That took out all the games?" The manager looks at all the other games up and running and seems satisfied. "Do we have another board?" "Not in house, of course. But we can get one quick," he says.

The next day our new board arrives from IGT. We plug it in, clear it and configure it with the new location and asset number. Still down. Luckily the new manager wasn't around. The tech and I take a good look at the new board. EPROM version AE-02, versus AE-01 on the old board. An EPROM swap and the board and the game comes up. With the Welcome Message on all the displays, the "G" segment blinking as it should, green dots on the Event Monitor, all is right with the world and I finally get to go home, just a little bit late. Log out on the system, turn off the light, say good night, Gracie.

- Herschel Peeler -
hpeeler@slot-techs.com



Here at CI Innovations we make COLD CATHODE REPLACEMENT LAMPS for all LCD MONITORS in all slot machines and video poker machines in your casino. We also make TOUCH SCREENS and protective Mylar sheets for PLAYER TRACKING SYSTEMS that use an LCD display.

See below for the replacement cold cathode lamp parts that we make for various types:

FOR IGT GAMES

#8500- Single cold cathode lamp assembly for IGT NexGen player tracking system 6.2 inch Hitachi LCD #TX16D11VM2CAA

#8560-4 wire touch screen for IGT NexGen player tracking system 6.2" Hitachi LCD #TX16D11VM2CAA

#8610- Protective Mylar sheet with copper tape attached for 6.2" Hitachi LCD in IGT NexGen player tracking system

#8570-6.2 inch Hitachi LCD #TX16D11VM2CAA with 4 wire touch screen for IGT NexGen player tracking system

8480-Single RAW cold cathode lamp for 10 inch LCD monitor in IGT games

#8920- Single RAW cold cathode lamp for 15 inch LCD monitor in IGT games

#9670- Single RAW cold cathode lamp for 15 inch LCD monitor in IGT games

#9290- Single RAW cold cathode lamp for 19 inch LCD monitor in IGT games

FOR BALLY GAMES

#8650- Single cold cathode lamp assembly for Bally IView player tracking system 6.2 inch "IDW" LCD

#8950- Touch screen kit for Bally Iview player tracking system 6.2 inch "IDW" LCD (includes 5 wire touch screen & metal housing)

#9190- Mylar protective sheet (peel & stick) for the touch screen on Bally Iview player tracking system 6.2 inch "IDW" LCD

#9080- Single RAW cold cathode lamp for 19 inch LCD monitor in Bally games

FOR KONAMI GAMES

#8700- Dual cold cathode lamp assembly & 12 volt inverter for Konami belly glass that is edge-lit with cold cathode

#9240- LED edge-lit panel for Konami K2V belly glass cabinet

#9780-"L" shaped cold cathode lamp assembly for Konami 7 inch bonus screen LCD

#8600- Dual cold cathode lamp assembly for Konami slot machine with 17" LCD monitor

FOR WMS (Williams)GAMES

#8520- Triple cold cathode lamp assembly for WMS slot machine with a 18" LCD monitor

#9300- Single RAW cold cathode lamp for WMS games with 19 inch LCD monitor

#8470- Single cold cathode lamp assembly for 6.4" LCD LG #LB064V02 in WMS BlueBird bonus screen

8490-6.4" LCD LG #LB064V02 for WMS Bluebird machines bonus screen (does **NOT** come with touch screen)

FOR ATRONIC GAMES

#8690-Dual cold cathode lamp assembly for Atronic slot machine with 17" LCD monitor

#9790-4 output Piezo cold cathode inverter with cable adapter for 17 inch Atronic E-Motion LCD monitor (includes 5 year warranty)

MISCELLANEOUS

#9220-Bench top Cold Cathode Lamp test unit 110 volt with on/off switch

REPAIR SERVICES FOR COLD CATHODE LMAPS

#8930- Single lamp assembly - extract old CCFL from reflective channel & install new lamp (price includes new cold cathode lamp)

#8880- Dual lamp assemblies - extract old CCFL from reflective channel & install new lamps (price includes new cold cathode lamps)

#8890- Triple lamp assemblies - extract old CCFL from reflective channel & install new lamps (price includes new cold cathode lamps)

For more info or to place an order contact us or one of our distributors

SUZO HAPP MCM AG&E CasinoTech

Patriot Gaming & Electronics Inc.

harry@ciinnovations.com

Phone 949-542-4188

www.ciinnovations.com

Ceronix CCFL Replacement

CCFLs-Cold Cathode Florescent Lamps-AKA Cold Cathode Florescent Tubes (CCFT). If you notice your LCD panel flickering or turning on then shutting off or even no picture at all, you will, most likely, have to replace the tubes. The cost of the tubes is a fraction of the cost to replace the complete LCD panel and an even smaller fraction of the cost of an entire replacement monitor.

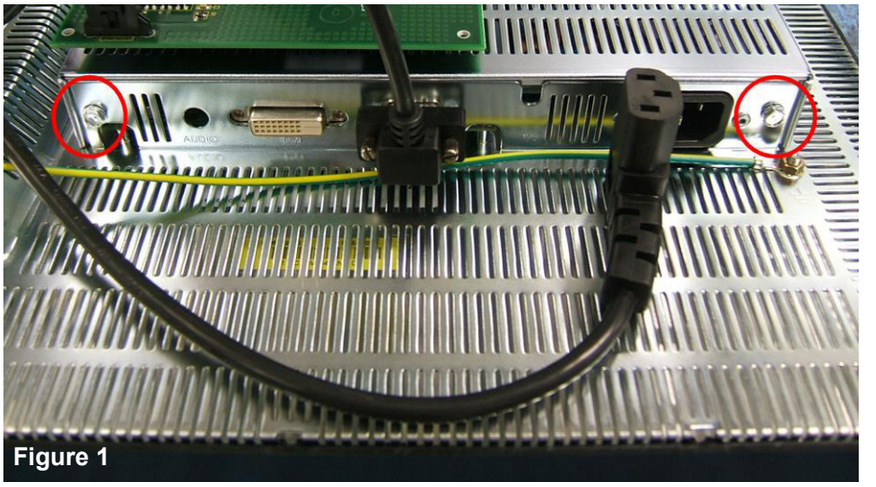


Figure 1

Please read this article completely before starting this project. When working on LCD panels, make sure the work surface is clean and free of contaminants. A piece of cloth or foam is recommended. The panel described in this article is a Samsung 19" TFT LTM190E4 Ceronix PN-CPP1701. The Samsung 17" TFT LTM170E8-L01-L Ceronix PN-CPP1700 panel will follow the same procedure as the 19" panel. The Samsung 15" TFT LTM150X0-L01 is too simple to address here in detail. Simply remove the two screws holding the tube assembly, then slide the assembly out .

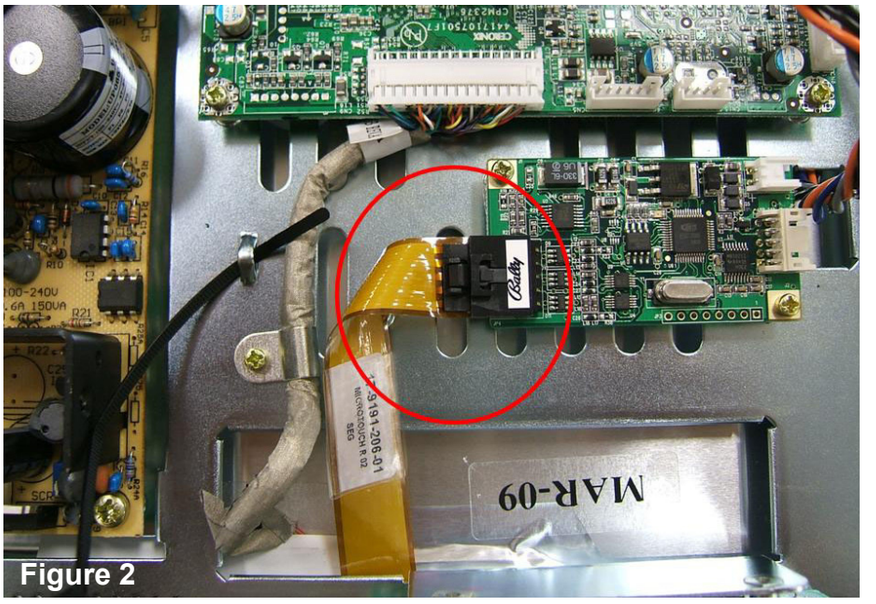


Figure 2

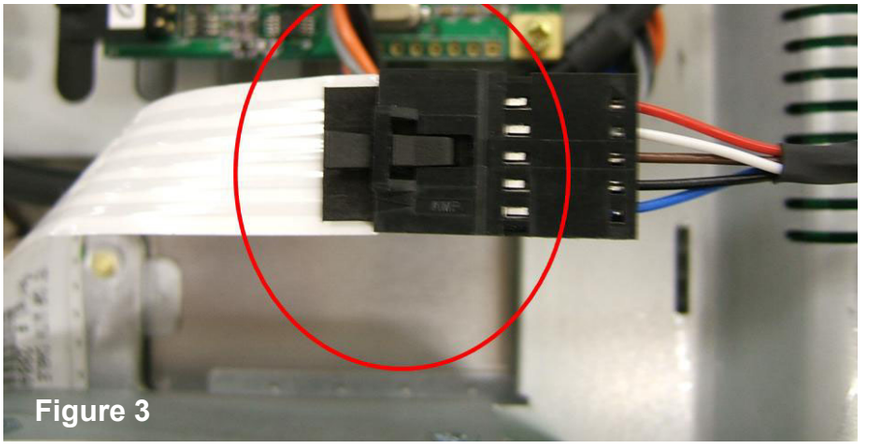


Figure 3

The first step is to remove the LCD panel from the frame/ electronics. Remove

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."

SLOTS · POKER · TABLE GAMES

GARY PLATT

PERFORMANCE CASINO SEATING

800.969.0999 · garyplatt.com

the electronics cover from the rear of the unit held in place by the two ¼" drive screws, on the plate where the VGA cable and AC cable are attached (see figure 1).

Slide the cover back to unlock and lift out. If the unit has a touch screen (most of them do), unplug the ribbon cable from the extension cable or controller board. Use caution as the ribbon cable is fragile (see figure 2 and figure 3).

There are four Phillips screws securing the panel to the frame and bezel. Once the four screws are removed the bezel needs to be unclipped from the frame. Use caution. The touch screen ribbon cable is fed through the frame and the CCFT cables need to be unplugged.

Separate the bezel and Touch screen/glass from the LCD panel.

A warning first! The ribbon and PCB board are fragile. Use caution whenever working around them. Remove the three small Phillips screws securing the PCB and ribbon to the back/plane. To remove the back/plane, unclip the sixteen clips around the outer bezel (See figure 5).

Before you remove the back/plane, it is important to note the order of the layers. Contamination will be a high risk so do not separate the internal layers when removing the backplane. Once the backplane is separated, remove the two small screws holding the lamp assembly. Gently remove the rubber ends and lamps from the assembly. After extended use in the 24/7 environment of the casino, the rubber ends may have fused to the lamps. Be careful not to tear. Pull the rubber back and remove the wires with a soldering iron. It will be easier to replace one at a time. This way the orientation will be correct.

Now you're ready to reassemble the panel. Screw the tube assembly to the back/plane and route the

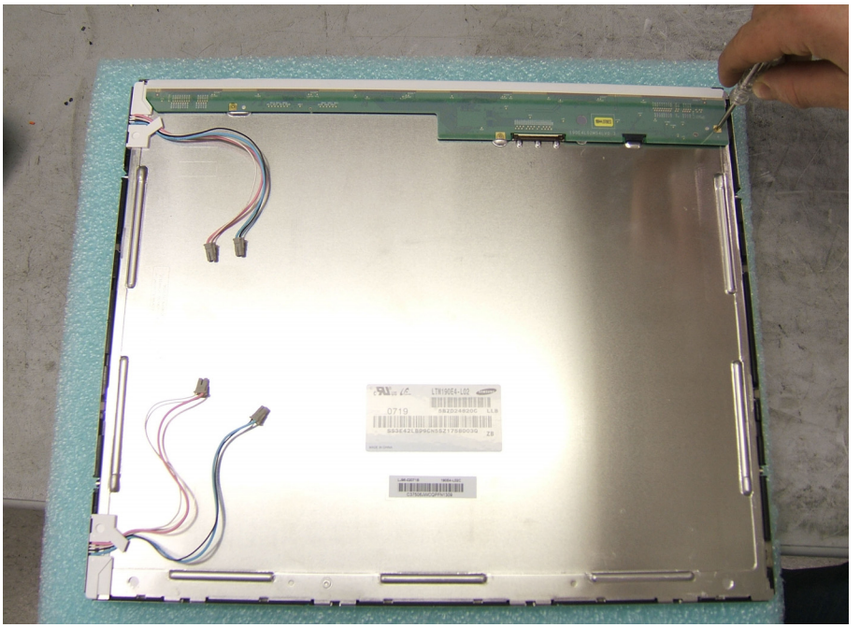


Figure 4

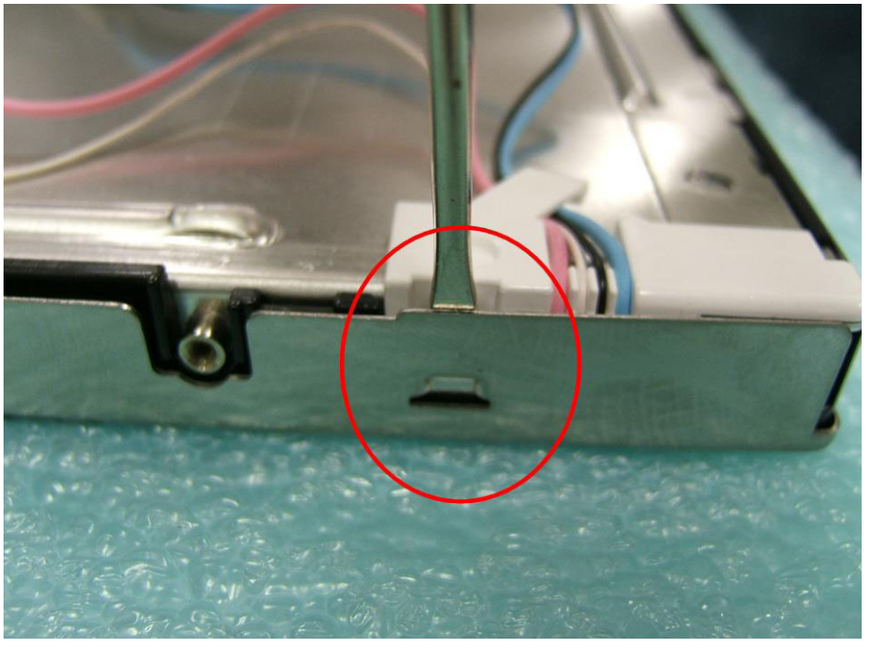


Figure 5

wires in their holder. Snap the back/plane back into the panel. If you encounter any resistance, do not force. Simply tap the opposite side on edge and the layers will line right up.

When all the clips are snapped in, screw the PCB to the panel and reassemble.

The two most common problems seen after changing the tubes are solid color lines running top to bottom and inverter flashing on then off. If the lines are present, the ribbon to the PCB was nicked. If flashing on then off, the rubber or wire shielding is broken on the tube wires.

For more information, contact Ceronix distributor Suzo-Happ or your local Ceronix distributor. For a list of distributors, please visit the website at ceronix.com or contact Ceronix at 530-886-6400.

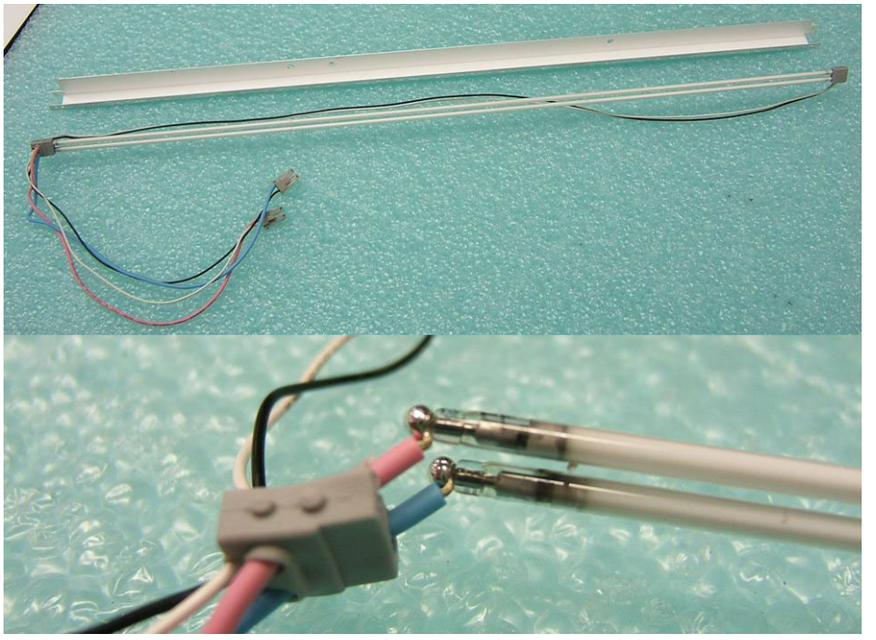
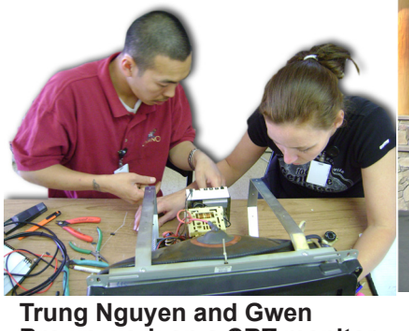


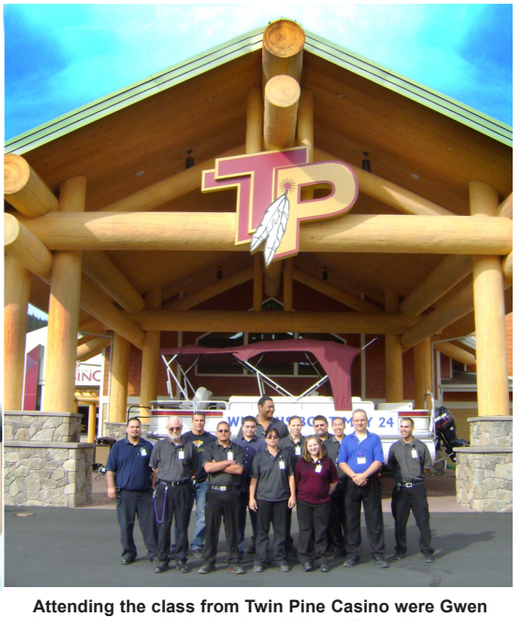
Figure 6. Here you see the CCFL tubes removed from the channel (top) and a close-up of the worn tube ends with the rubber boot pulled back to expose the solder points.

Slot Tech Event - Slot Tech Training at Twin Pine Casino

Some of Indian Country is so darned beautiful, it makes going to work each day a real pleasure, even if it means working inside a double-wide trailer, parked outside the brand new Twin Pine Casino in Middletown, California. This is in Lake County. You've probably never heard of Lake County but I'll wager that you've heard of neighboring Napa and Sonoma counties. This is the heart of California's wine country and it's a beautiful place to visit in the spring which is when Slot Tech Magazine's team of technical instructors spent two weeks working with a baker's dozen of the casino's slot techs. I (Randy Fromm) did the bulk of the training, including power supplies, CRT monitors and LCD monitor repair. We were lucky to have a Konami machine's LCD monitor fail while we were having our hands-on repair lab. We snagged the monitor out of the machine, replaced a single (obviously bad) electrolytic capacitor on the inverter PCB and had the monitor back in the machine in about 20 minutes. That's what I'm talkin' about! Component-level electronic repair can be pretty easy and this was a good example. Also included in the class was a day of Futurelogic Ticket Printer repair (presented by David Oldham of Suzo-Happ) and a day of JCM bill validator repair, presented by Jack Geller.



Trung Nguyen and Gwen Brown work on a CRT monitor during the hands-on repair lab.



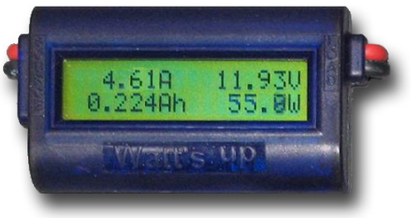
Attending the class from Twin Pine Casino were Gwen Brown, Serena Velarde, Darrell Yee, Trung Nguyen, Felipe Leon, Jan Albertson, Dan Buck, David Stevens, Shawn Arson, Manuel Ledesma, Richard Russo, Tony Jackson & Katie Marks.

Save $$$ Through CCFL Backlight Dimming

Sencore's Don Multerer gave a presentation at TechFest 19. He was his usual, high-energy self, with a splendid presentation on LCD monitor operation. If you ever wanted to learn way more than you need to know about LCD operation, Don crammed it into a two-hour, pedal-to-the-metal presentation. But for me, the best part of the presentation wasn't the theory of operation. It wasn't the A to D conversion. It wasn't the Royer oscillator. It was a simple demonstration of an experiment that I was actually all set up to perform but I was looking for something else and I totally missed it. It is important and will have an immediate impact on your casino's energy consumption.

The demonstration was a discussion of using Pulse-Width Modulation (PWM) to control the brightness of the backlight CCFLs in LCD monitors. We were using an oscilloscope to look at the 2kV sine wave that drives the lamps. Don also had a small digital ammeter/wattmeter (called "Watt's Up") in series with the +12 VDC power supply. We were drawing around 4.6 amps for a total power consumption of 55 Watts.

Using the OSD menu, Don reduced the brightness from 100% and as he did, we watched the waveform on the oscilloscope's dis-



play become chopped up at a rate of 300 Hz. Little pieces of the sine wave began to disappear. When we were at around 75% duty cycle, the display still looked plenty bright but the meter showed a reduction from 4.6 to 3.4 Amps. That's around 25% less current, which makes sense since we were at around 75% duty cycle.

I haven't tested every monitor in use today but the numbers seem fairly consistent across the board for the units I have tested. You can reduce the brightness and easily obtain a 20%-25% reduction in power consumption. I cannot say what this might do to the life expectancy of the lamps themselves. Logic dictates that they should last longer but I have no empirical evidence to back up that assumption.

The issue of "attractiveness" comes into play. It's easy to argue that brighter is better but that's a subjective evaluation so I cannot speak to that other than to say that it looks perfectly fine to me to run at this slightly reduced brightness. Heck, maybe it's easier on the eyes and the customers might like it better!

I would only state the obvious and that is that all of the monitors in a bank of identical machines (video poker or Game King for example) should be adjusted to precisely the same level of brightness. To assist in that endeavor, Sencore makes a nifty photometric gizmo they call the CP6000 'ColorPro' Color Analyzer. Using the USB puck and a laptop computer, you can adjust each monitor so they are all exactly perfect. Contact Sencore Inc 3200 Sencore Drive Sioux Falls, South Dakota 57107 United States Website: www.sencore.com Phone: (605) 339-0100 Fax: (605) 339-0317

The Numbers (You Might Be Amazed)

It is very easy to save from five to ten watts per LCD panel. I am going to use 7.5 watts saved per LCD panel as my average. The United States Department of Energy pegs the average cost per kilowatt at around a dime and there are 8760 hours in a year. That's 65.7 kWh per year that is not being consumed for a savings of $6.57 per LCD panel. That may not seem like much but if you have 1000 panels, it saves you $6,570.00 per year. It is likely that you have far more than 1000 LCD monitors at your casino. Do the math yourself! Measure the current reduction yourself! Connect an ammeter in series with the 120 VAC input to the monitor's power supply or in series with the +12 VDC power input to the monitor. As you adjust the brightness using the monitor's on-screen menu, you will see for yourself EXACTLY how much you are reducing the power consumption.

For an in-depth look at backlight dimming, we turn to our new friends at inverter specialists ERG. Read on.

Dimming Methods

Common methods of controlling display brightness involve manipulating the backlight power supply.

The selection of the dimming method is primarily based on the end-product requirements. System considerations that may influence the selection include the ease of providing a pulse width modulation (PWM) control signal from an existing processor or the availability of a potentiometer for analog dimming control.

There are two basic methods for controlling the brightness of a cold-cathode fluorescent lamp. One method controls the drive current amplitude (analog dimming), and the other controls the duration of tube operation (PWM or burst mode). It is also possible to combine the two methods.

Analog dimming involves controlling the tube's brightness in response to a reduction in the amplitude of the drive current (see Fig. 1). Probably the simplest form of dimming, it requires a simple potentiometer as the controlling element and is applicable to the most basic inverters by merely controlling the input voltage to the inverter. Many inverters include a provision for accepting an analog voltage input at a low current level to control the amplitude of the output.

Although analog dimming is the simplest, it is also the most limited method in terms of dimmable range. As the current to the tube is decreased, the tube reaches a point where it no longer provides uniform consistent light because the temperature of the electrodes is reduced to a point where flickering or a "worming" pattern begins to occur in the tube. Analog dimming is generally adequate for dimming to no less than 30% of full brightness in new condition. In addition, it is generally not possible to start the lamp in a dimmed state when using the analog method. It is best to start the lamp at full brightness and then dim down to the desired level. In PWM dimming (see Fig. 2), the fluorescent tube is actually turned on and off at a frequency that is higher than

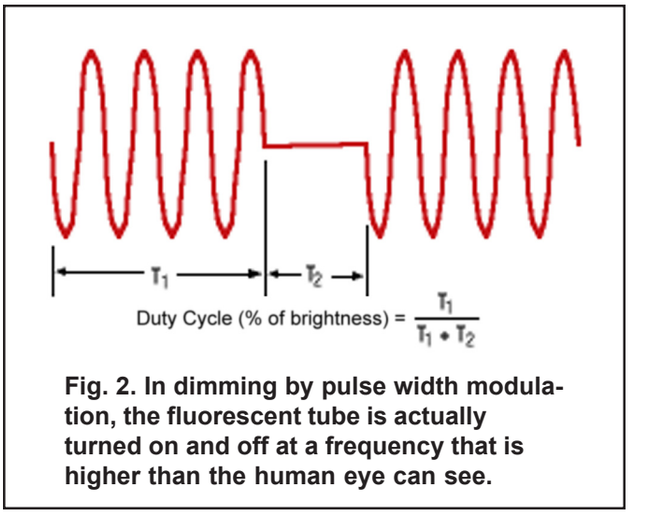


Fig. 2. In dimming by pulse width modulation, the fluorescent tube is actually turned on and off at a frequency that is higher than the human eye can see.

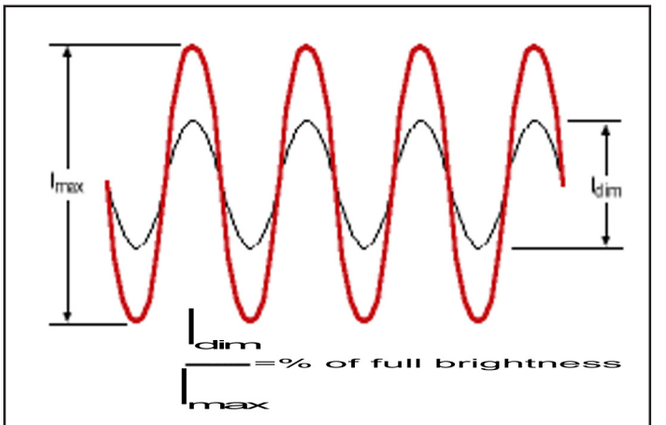


Fig. 1. In analog dimming, the tube is dimmed in response to a reduction in the amplitude of the drive current.

the human eye can see. The level of perceived brightness then depends on the proportion of time that the tube is lit. If the tube is on for 50% of the time, the eye will perceive a constant level of brightness that is 50% of the on-period brightness.

A wide range of dimming is possible using the PWM method. For most applications, dimming to 200:1 or 0.5% is readily achievable. In many cases, depending on the backlight assembly, ratios of greater than 1,000:1 can be achieved.

A number of special considerations are relevant to PWM dimming. First, the frequency of the on-off cycle must be high enough so that the human eye perceives a continuous lighting--above 50 Hz generally satisfies this requirement.

In addition, the cycling of the lamp must not interfere with the refresh cycle of the display. A frequency multiple of 2.5 times the refresh frequency is generally found to be very effective in eliminating interference. If this is not possible, it may be necessary to synchronize the PWM with the vertical refresh cycle to prevent interference.

Finally, noise--both electrical and acoustic--may be a consideration with PWM dimming. While a constantly running inverter producing a sine wave current to the tube is reasonably quiet, turning it on and off in the PWM mode can create electromagnetic interference.

In addition, the inverter oscillating at 30 to 60 kHz produces no acoustic noise since it is above the audible range. Introducing PWM at 250 Hz is well within the audible range and can produce acoustic noise.

It's In the Backlight

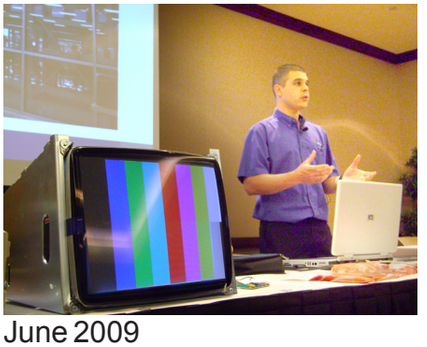
These considerations are factors in the choice of an inverter to power the fluorescent tube. It should be understood, however, that the ability to dim the display to low levels without flicker is ultimately controlled by the characteristics of the fluorescent tube rather than the inverter. A fluorescent tube's brightness, even with precisely controlled drive current, starts to decrease from the moment it is first switched on and continues to decrease throughout its useful life.

In addition, the brightness changes drastically with temperature, decreasing by as much as 75% with drops in temperature from 25° to 0°C. However, if the temperature rises from 25° to 40°C--not unusual within a slot machine--the brightness may likely increase by 30%. - **STM**

Fifty slot techs attended TechFest 19, held at Mystic Lake Casino

TechFest 19 - Mystic Lake Casino

TechFest 19 was held at Mystic Lake Casino May 12-14 2009. This was the sixth time that the three-day event has been held at Mystic Lake. Presentations were made on power supply repair, CRT monitor repair, LCD monitor repair, touchscreens, printers and bill validators. Clockwise from the right are presenters David Oldham (Suzo-Happ), Paul Hatin and Mark Roberts (3M Touch Systems), Troy Nofziger (Ceronix), Don Multerer (Sencore) Russ Wigé (Transact Technologies) and Jack Geller from JCM.



If you are interested in sponsoring TechFest at your property, please contact Slot Tech Magazine for details.

- STM

Quick & Simple Repairs #51

By Pat Porath

WBA Stacker Box Problem

While a co-worker was checking out and repairing some WBA stacker boxes (a.k.a. cash boxes, cash cans) the individual actually found a paper clip jammed near the pusher assembly. It had jammed and didn't allow the pusher plate to move downward. The box was marked "BV keeps cycling." I guess this would have to go into the casino "Unsolved Mysteries" files. I've run into a few ticket printers on the bench that when examined closely, were found to have had a small piece of paper jammed near a roller. Hmmm, could that be the problem? It's kind of nice when problems are obvious once in a while.

Bally EVO Wouldn't Boot

I took a look at a Bally EVO game (this one has an LCD up top plus the regular reels) and it didn't want to boot up all the way. On the "Brain Box" (located just below the reels) there is a CD drive. On it, there is usually a light that indicates if the CD is being read. If so, the light will flash rapidly. This particular drive didn't have the light on it so I couldn't tell if it was reading or not. On the LCD (during the boot process) it seemed that the "checking CD" icon wasn't loading properly. Also the game wouldn't boot up all the way. I grabbed a spare Brain Box that was marked "should be good" and made sure it had the light on the drive. Once it was installed in the game, it appeared that the CD was reading but the game still wouldn't boot up. I reseated the main processor which didn't help either. The CD itself was checked to see if it was clean. I have run into a few games in the past that the only problem was a dirty or badly scratched CD. This one looked OK. Subsequently, a known good replacement Brain Box was installed and the game fully booted up.

Editor's Note: IMHO, this is a bad practice. Returning untested parts and sub-assemblies to stock (at least this one had a tag, even though it was actually bad, it implied that it was untested) is just asking for trouble. Look at how much time was wasted here.

Atronic e-motion No Video and Making a Beeping Noise

I thought that I would take a look at an Atronic e-motion game that was turned off. When I turned it on, neither of the LCDs lit up and the game was mak-

ing a beeping noise. I had never heard this kind of beep from an e-motion game before. What did this mean? Where should I even start? It appeared that there was a power problem because the LCDs were black. To start off, I replaced the video card but that didn't help. Next, the power supply was replaced. It still didn't have any power or graphics to the LCDs and it was still beeping. Maybe the main processor board had an issue? I swapped it with a similar game with still no change in the problem. I thought about changing the motherboard but being that I was the only tech on duty, I'd best not tear too much into it. The following day I came in and the game was up and running. Awesome! I read our log book and saw that the motherboard had been replaced and that was the problem. So, if you have an e-motion game that doesn't have any video and is making a beeping noise, the problem just may be a bad motherboard.

Aristocrat MKIV Power Problem

I came upon an older Aristocrat that had a power problem. The main power switch was turned on and the Oasis display had power but the game didn't have any power. This is usually an indication of a bad power supply. Once in a while, if you let the game cool down and turn the power switch back on, the game will come back up. Also, once in a while when you unplug the main power cord for a minute or so, the power will come back. If it does, more than likely it will need to be replaced later on. They are quite simple to replace. One of the hardest parts (on an upright game) is removing the bill acceptor assembly. The trick is, there are two small screws under the cashbox door. With the screws removed and the small metal plate taken off, the assembly is pretty easy to remove. Of course there are the bill accepter connectors and the power supply connectors but it looks worse than what it actually is. With this particular game, I replaced the power supply and turned on the power switch. Bingo! The game was back online.

Aristocrat SPC Board Losing Power

Have you ever had an SPC board lose power? You reboot it and a while later it

loses power again. It took me a while to figure it out. I kept getting called to this game and the power LED on the SPC board was going out. I would reboot it and about an hour later or so, it would lose power again. I checked all of the connections, even the connections on the motherboard. They were all snug and in place. I also tried a few RAM clears on the SPC board but that didn't help either. Maybe it was a bad SPC board? I replaced it and the board wasn't the problem either. On the main processor there is a small board that looks similar to a memory stick for a computer. It was swapped and I haven't heard a problem from the game since. So, if there are power problems or sometimes other problems with the SPC board, try swapping the small board on the main processor.

Konami Progressive With a Communication Error That Wouldn't Clear

I received a call for an upright video Konami game that had a communications error that didn't want to clear. I wasn't sure if it was on the Oasis end or the game end at first. The Sentinel was rebooted along with the game. Next, I reseated the main processor board and communication board up top but neither one helped. It still had the error. Maybe the game options had been lost? I checked them and they were OK too. One thing that was kind of unusual is I still had my main door "OPEN" and "CLOSED" on the Oasis display. This meant that I did in fact have communication FROM the game TO the Sentinal. Also on the Oasis display I had my Sentinal ID number and the DPU number which meant that I had communication FROM the Sentinal TO the Oasis system. What was going on? So far everything is checking out OK. Next, I checked in the lower part of the game and bumped a wire on the small progressive board (also known as a SMIB) and the lights flickered on it. This was very interesting. I wiggled the wires again and the power to the board came on; it was simply a loose connection. Now that the board had power, I closed the door on the game and the error cleared. Since the board was located in the back lower part of the game I didn't notice it until I had looked further into the problem. This was simple but not so quick!

- Pat Porath
pporath@slot-techs.com

Kingbright Releases New Optoelectronics Catalog 2009-2010

Kingbright Corporation, a TS 16949, ISO 9001, ISO 14001 certified LED manufacturer, has released its 2009-2010 optoelectronics catalog featuring a complete line of ultra-high efficiency LEDs with optimized performance. The full-color literature contains detailed specifications, diagrams, and process recommendations for Kingbright's diverse range of LED products including low profile SMD Displays, Multi-Color LED Lamps and High Brightness SMD LEDs. This comprehensive solution guide is specially designed to achieve ultimate LED design requirements. An eCatalog version and 3D specifications are available on **www.KingbrightUSA.com** with quick downloading feature. Kingbright offers full custom LED options in packages with any desired shape, form, and color to enhance engineers' design solutions.

The Chicken or the Egg?

By James Borg

Have you ever found your self in a situation where you've happened to notice a fault on a piece of equipment, a monitor for instance, and somehow you weren't sort of psyched up to tackle it for one reason or another? It could be a question of time or perhaps not quite sure where to start on this particular fault. It could also be related to the fact that you might not be able to trace the fault hence destroying your long and very proud list of monitors that haven't been made to go and meet their maker, thanks to your intervention. I enjoy a challenge. I enjoy it more if it's calculated and logical. There was nothing calculated and logical about this fault, originally at least anyway, so I sort of kept putting it off... until it had to happen eventually...and it did.

This monitor was a bit wonky for quite a while and left like that since it was still working-ish, but lately, it was sending people somewhat cross-eyed and the possibility of the company being forwarded optician's bills wasn't really a pleasant thing to look forward to. That wouldn't really be nice of them at all, so something had to be done about it, especially since it seemed to get worse and worse.

It was brought over to the workshop for surgery to commence on the little devil. As luck would have it, it worked fine. Oh dear! That's not a brilliant start especially since it was wonky for ages before. Could it be because it was removed from its original machine, taken for a spin and brought over to me? Did its new surrounding suddenly give it a new sense of freedom, a new lease of life perhaps? Did the trip do it a world of good and hence the patient was cured? Nah! That was too good to be true. There had to be another reason for it working in my workshop. I was about to deduce the answer in the course of my diagnostics and hair pulling procedure.

Ideally, when something like this occurs, it's usually a good idea to just let it work on its own, just let it be, while occasionally taking a little peek to see if the picture was still fine or if it got distorted.

I quick cup of tea and a smoke were called for while things were being processed. The wait for the fault to surface seemed like an eternity as I was dying to sink my fangs into this new monitor. It's a challenge tackling a model, the likes of which I had never had the pleasure of dissecting

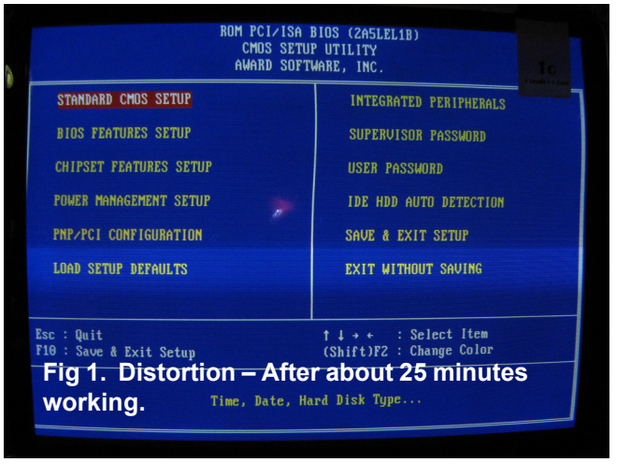


Fig 1. Distortion – After about 25 minutes working.

before. The challenge becomes total frustration half way down the line when all seems lost and hopeless and you wonder why on Earth you decided to become an electronics technician in the first place. Then, if all goes according to plan, not forgetting lady luck in the equation, things start to finally look up with the climax, the peak, the ultimate thrill (if you're into thrills, that is) being a repair job, namely, another job well done, while the champagne is downed by the gallon and a band plays tunes of joy and happiness in the background.

After about 20 minutes or so in, the picture started distorting, slowly but surely. That's good. I could actually see the fault. No point in tackling the problem if I didn't see the fault in the first place. I needed to know all the details, like how long it took for it to display the fault, how long the actual process took, if there was a change in the fault changing different resolutions and other bits and pieces of the jigsaw puzzle needed to get the whole picture clear in my mind to work out an action plan where to tackle first. Even though a monitor's basically one board (excluding the CRT neck board that is) it has so many different circuits in it that one wrong move and you'll end up miles away and quite lost too. This monitor happened to be digital and these babies can be very complex indeed. The patient was a Wells-Gardner D9100.

The OSD was perfect, being nicely rectangular and had no distortion at all while the actual picture started to look like a deformed 'S' on a very bad day. That was somewhat misleading. If the fault was in the horizontal drive, in the horizontal scanning coils circuitry, why wasn't the OSD being distorted too in some way? I didn't lose a lot of sleep over this detail and I let that lead go for now. It was not an operational monitor and that was the major issue. The OSD can wait for a bit.

It seemed like the problem was certainly heat related. The distortion had become somewhat worse after approximately 30 minutes after which it stabilized. Freezer spray is a good tool to use. However, it's never a good idea to soak the equipment in the stuff as excess use can be the cause of corrosion. Ideally this should be sprayed on the suspicious component while trying to avoid the copper tracks as much as possible.

"This repair job shouldn't really take all that long."

Somehow I had heard myself saying those words many times before and many times before I had to end up eating those very words. I wondered if this was going to be another disaster. I was hoping it wasn't, I mean it certainly seemed obvious that the fault was surfacing after the unit got warm, hence it seemed to be a heat related fault. Simple. And raising one eyebrow just to make a point.

So, armed with my freezer can in one hand and making sure that the other hand's fingers were crossed, I started merrily spraying here there, each time running to the front of the monitor to see if the picture had become straight again as it was when initially turned on. After several attempts were carried out, I was well and truly disappointed. Crap! Nothing! The picture remained a load of rubbish. When all else fails, push the RED BUTTON. This consists of panicking and starting to talk to yourself and even saying some rude words. A simple fault I thought?

I had used up quite a bit of the freeze spray and nothing had shifted. Oh dear. It seemed like I was really going to eat those famous words by the looks of things. When controlled squirts don't work, then set phasors on kill and exterminate anything that moves. That usually manages to create a few waves. I eventually arrived at the mains input circuitry and something did happen. It wasn't exactly what was expected as the picture became even worse than ever! That wasn't supposed to happen. That's not what I was taught at school! The distortion had become really pronounced, so much so, that it seemed like the monitor was going to lose the horizontal synch at one point. It wasn't making any sense.

I had to leave it on and play the waiting game while gradually the distortion was back as it was originally, before the freezer was applied to this section. I wasn't sure what had happened so I decided to try again. I sprayed on the mains filter capacitor (the reservoir capacitor) and nothing shifted. I sprayed the chopper circuitry and nothing shifted. I sprayed in the general area one more time and the distortion got even worse yet again. This really wasn't making any sense at all. Some head scratching and face pulling actions took place. I looked hard at the monitor but it didn't utter a word to assist me in my quest. Fat lot of good that did!

To further add to the confusion already present, turning the monitor OFF and then back ON again within the span of a couple of seconds, the picture was fine, no distortion whatsoever. It couldn't have cooled down in two seconds flat, no way. There just wasn't enough time. The picture then gradually deteriorated again within seconds. That was also a clue indicating that something sinister was afoot. Original indicators made it seem like the problem was heat related, but was it really after all? Was this phase one of a merry-go-round? No wonder I wasn't getting anywhere with the freezer spray. However, the freezer did do

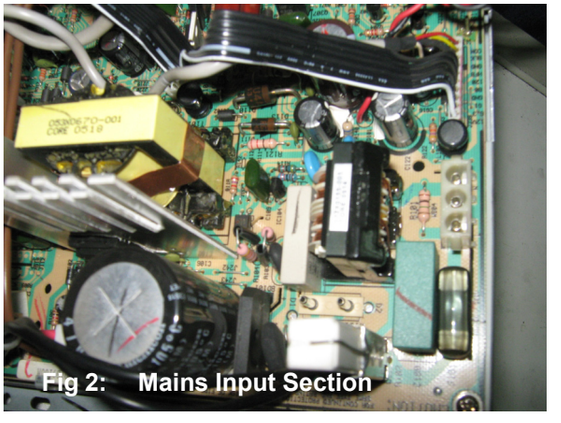


Fig 2: Mains Input Section

something. It made the picture go really bad. Why? Didn't I simulate the monitor being cold by freezing it, so logically thinking, it should have eliminated the distortion, just as if I had just turned the monitor on from cold. I left it on all alone and went for a smoke and a cup of tea.

Break time was over and the beast was still there, silent and waiting. This was becoming quite fascinating. It's amazing how time flies when you're wresting with such a weird situation. Ideas from nowhere and everywhere start streaming, some confusing and leave you at a lose end. Some actually help. Some vital clues surface when you're least expecting them.

Purely by chance, I happened to turn the monitor off while standing in front of it and having a good view of the picture at the time. Just for a fraction of a second, as soon as it was turned off, the distortion got slightly more pronounced, then the picture went completely. Hmmmm. Was that yet another clue, Holmes? With that train of thought, that new lead, I decided to have a look at the supply rails at this point since the freeze spray issue was a complete disaster and a waste of time.

Gurus in this field would have probably shot me down for not checking out the power supply rails in the first place but I have to admit that the picture distorting after 'heating up' had led me totally astray.

Checking on connector W102 at the back of the monitor with reference to ground was quite handy as there were the 12v, 6.3v, 80v, and the 120v rails all waiting there for me. Much better than having to go to the secondary diodes and check them out individually.

If the fault was related to the juice shifting (even if for only a couple of seconds) I should be able to locate it and take it from there so I had to have as many points monitored as possible in an attempt to locate which rail, or rails was going FUBAR on me.

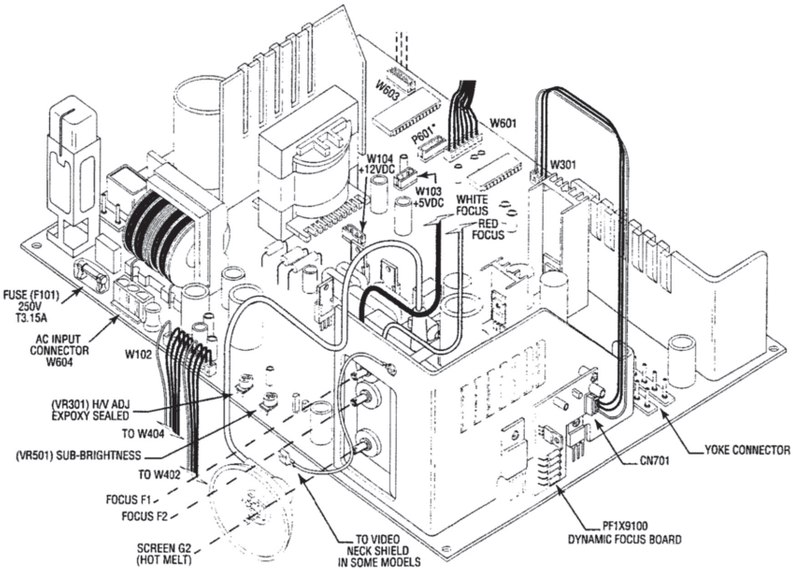


Fig 3: W102 Located at the back of the monitor

Expected:	Distorted:	Off/On (go lower after seconds):
12v	10.25v	11.09v
6.3v	6.04v	6.5v
80v	69.5v	82 quickly dropping to 77v
120v	109v	110v
5v	5.02v	5.03v

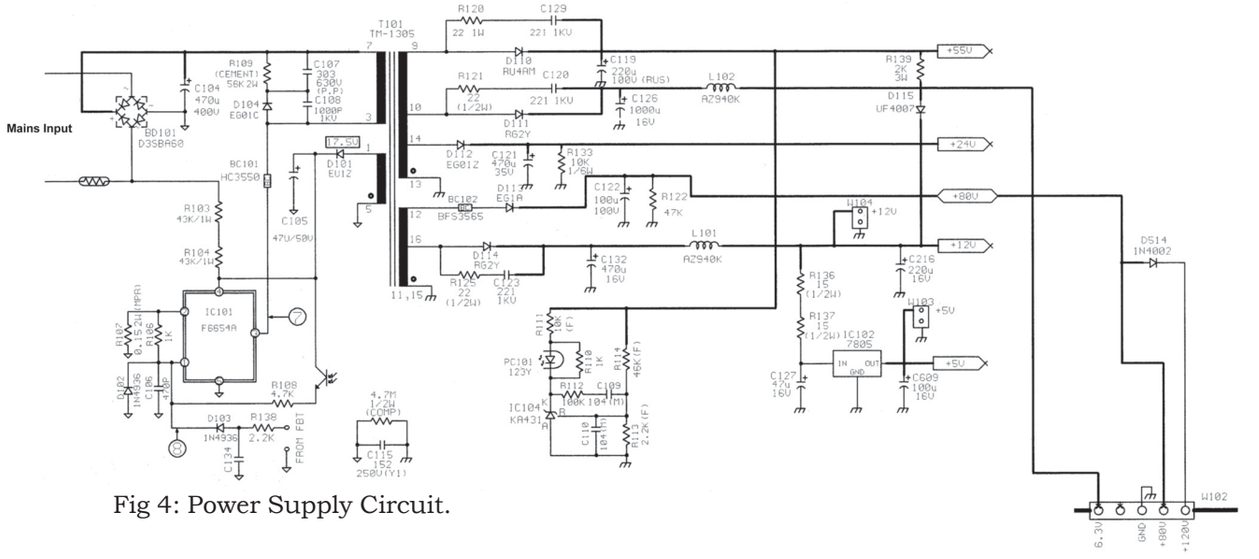


Fig 4: Power Supply Circuit.

I originally made a note of what the voltages should be according to the schematic. Once done, I checked the same points when the distortion was in full swing. The final readings taken were as the monitor was turned OFF and then ON, after which the distortion would take place right in front of my eyes. Something would surely be shifting and I was in high spirits that I was going to at last find out just what was going on of course, with the help of my multi meter that is. From the readings taken on this connector, the distortion on the screen seemed very well directly related to voltages going FUBAR on me. The most pronounced shifts were the 12v, the 80v and the 120v rails.

This called for a detailed look at the schematic to see what is going on and where. While at it, I checked on D110 cathode and instead of reading 55v, this was showing 46.4v and also checked D112 cathode, where this was showing 20.8v instead of the expected 24v. These readings were very important as I very well could have something not quite right on the voltage regulation circuitry somewhere along the line.

The 5v remained near enough the same because it's only an output from IC 102 which is a 5v regulator. As long as the 12v input doesn't drop way too much, this will still give 5v as output. The 12v however wasn't close to what it should be at only 10.25v and this was another major No-No. However, following the schematic, this rail didn't play a direct role in the regulation process. The culprit was the definitely the 55v rail. This voltage, through R111 (10K) and R114 (46K) fed photo coupler PC101 (123Y) and IC104 (KA431), a Programmable Shunt Regulator.

Oh HELP!!! It seems like I'm going to get stuck in a loop at this point. Chicken and eggs came to mind. If I thought that what I did so far was difficult, then I had to think again. This is where the going gets tough, really tough. And no, it's not a question of the tough get going, that's a load of crap! It's a question of putting on your thinking cap, stock up with horse-shoes and start reciting a couple of your favourite prayers in the meantime. I had found myself in a loop, a vicious, never ending loop which can be the cause of my downfall.

The problem is (or seems to be) a fault in the regulation/feedback circuitry. The major problem is that any component along that circuit can upset the delicate balance and throw you completely overboard. A fault in the photo coupler can pump the wrong levels to IC101 (F6654) which is an SMPS. The receiving end of the coupler feeds the SMPS via pin 1 (Over Current Protection/ Feedback) through R108 (4.7K). Any component going marginally out of spec around the coupler and the SMPS components will upset the circuit easily. If the actual 55v rail went low through a fault in its own rectifier/ smoothing circuit, this will also upset the coupler (PC101) and the Programmable Shunt Regulator (IC104) and the SMPS chip (IC101). It's not a pleasant situation to find yourself in and the only thing left to do is to start checking individual components and keeping your fingers crossed it won't take you forever.

I decided to start checking around IC104, which is basically a good place to start off from like any other. Just for the sake of it, I applied a short squirt of freezer spray on it and the screen got worse (just like when I originally sprayed around the mains input circuitry). I must have sprayed on this chip and affected its operation. That was a good move. I wonder if this could be the faulty component. I wasn't convinced though so once the monitor had stabilized, I then sprayed the photo coupler. Unfortunately, this also sent the picture haywire. Just to add to the confusion, I sprayed R114 and this too sent the picture crazy. Oh Gawd! I felt like having a smoke but didn't want to let go of it now, not now that I was so close to nailing the bugger that was poncing me about. I took voltage reading on the KA431 as follows:

K-Cathode (during distortion) was 34.84v
R-Reference (during distortion) was 2.12v

A-Anode is grounded.

Turning momentarily OFF and then back ON the monitor and reading the two points while the distortion was taking place showed:

K was 37.6v and going lower within seconds to 34.84v.
R was 2.26v and going lower within seconds to 2.12v.

This was it, nothing else to do. I had exhausted basically every idea and used up all the tricks in the book… so I had no option left but to start pulling out individual parts and checking them out.

I had already checked R112, R113 and R114 and all were in spec. A good move was to actually change the Programmable Shunt Regulator. If that didn't work, then it was going to be the photo coupler next and probably the SMPS chip and carry on from there. The Programmable Shunt Regulator was replaced and the 55v rail from 46.4v shot up to 54.2. On the other hand, the 24v rail from 20.8v shot up to 24.1v. The voltage on R (Programmable Shunt Regulator) shot up from 2.26v to 2.46v and that on K shot up from 38.84v to 43v.

I couldn't quite believe that it was this component which was the culprit in this saga, but all the voltages stabilized beautifully, and just to make sure that nothing else was wrong, or that I had actually located the faulty component, I left the monitor on for a whole day…and the result after all those hours was a straight picture without any worries.

A similar fault can be slightly worse than a nightmare if not tackled properly. A logical approach is a must. The less experienced would have probably given up ages ago, or even worse, caused damaged to the circuitry after which the monitor might end up being severely hurt. This can also be quite a hair-raising experience for the person working on it as hazardous voltages are present very close to the area concerned, so caution is always recommended. A fault like this is

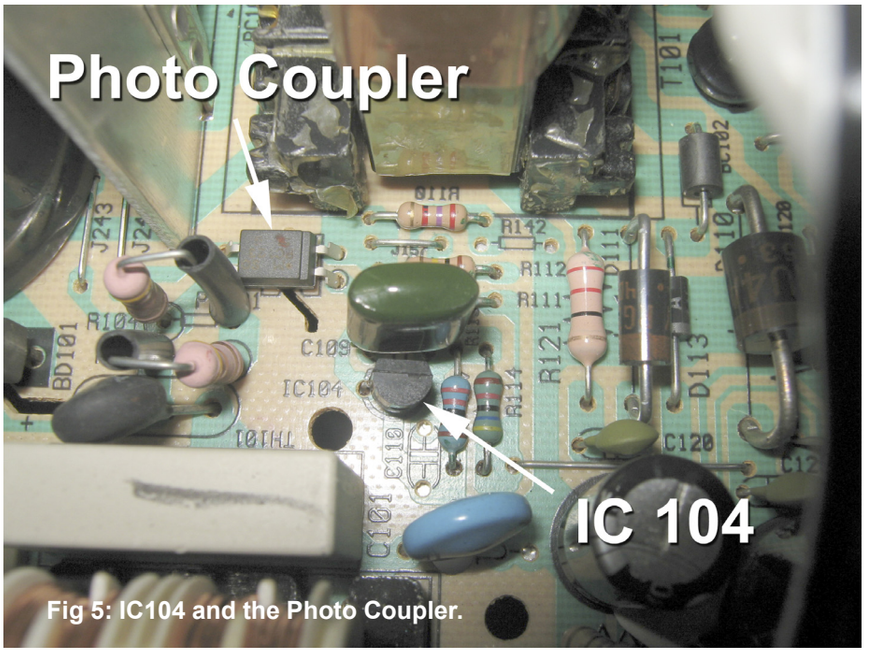


Fig 5: IC104 and the Photo Coupler.

a lovely challenge to get ones' ideas and tactics up to trim. It helps pump up the adrenaline levels.

The actual dilemma here was that the problem was in a loop. Being caught in a loop can really get you down. Any component within that loop can effect the whole operation of the circuit, and there are quite a few components involved. You have no idea what is going on basically and one component going out of spec will really turn the tables on you. The uncertainty which component will effect the next is great. It's a bit like which came first, the chicken or the egg? I think I'll leave that puzzle for somebody else and go and enjoy a nice juicy hot chocolate and mediate about the meaning of life for a while…

- James Borg
jborg@slot-techs.com

Don't replace
REPAIR IN-HOUSE AND SAVE!

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.

My Two Week Slot Tech School Brings the Training to Your Casino

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.

LET ME SHOW YOUR SLOT TECHS THE QUICK AND EASY WAYS TO REPAIR CASINO ELECTRONICS
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.***

For more information, including course offerings and complete pricing information, please visit the website at slot-techs.com

Slot Tech Magazine 1944 Falmouth Dr. El Cajon, CA 92020-2827
tel.619.593.6131 fax.619.593.6132

We Buy and Sell Used Machines and Gaming Parts

LCD Retro Kits

Remanufactured
Bill validators
Monitors
Printers
LCD's

Touch Screens
3M
Touch INT

Lighting & LED's

Buttons & Switches

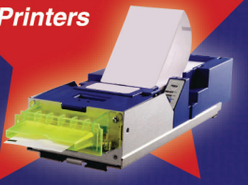
JCM AMERICAN CORPORATION

Bill validators

Patriot Gaming has product solutions to fit every budget.

We focus on you the customer. To provide the very best service and products to fit your ever changing needs. Our pride rests on the fact that we offer a wide variety of products and alternatives, lower cost solutions and top notch repair services.

TRANSACT
Technologies Incorporated
Printers

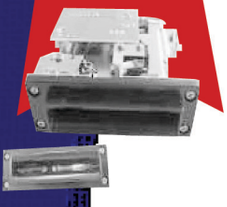


Monitors
Ceronix
Tatung
Kristel
WG
Tovis
Kortek

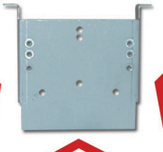
Cleaning Supplies

Repair Center
Bill validators
Monitors
Printers

Used OEM
Slot parts



Seating



Metal
Fabrication
Brackets

One Call...One Voice... One Choice!

Call Patriot today for your FREE Catalog!

Service Center

- All repairs have a 90 day warranty

PATRIOT GAMING & ELECTRONICS INC.

217 N. Lindberg Street • Griffith, Indiana 46319 • Office: 219-922-6400 • Fax: 219-922-6466

SUZO HAPP

TOPPERS

Order 3 ways:
Toll free phone: 888-289-4277
Toll free fax: 800-593-4277
Online: *www.suzohapp.com*

ask for a full color catalog