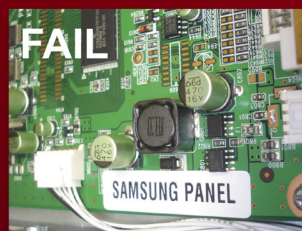


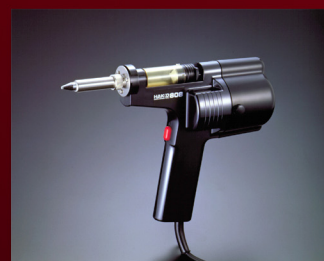
October 2009

SLOT TECH MAGAZINE

Slot Machine Technology for the North American Gaming Industry



LCD Video PCB Repair



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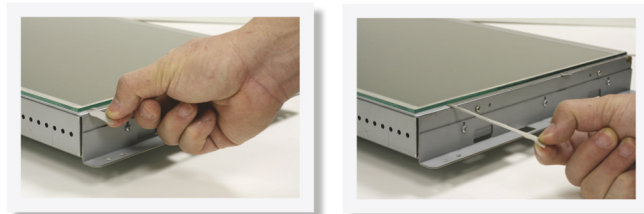
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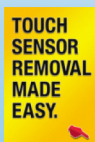
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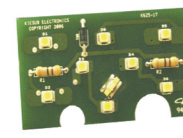
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October 2009

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Dear Friends,

Please welcome new contributing writer Chuck Lentine. Chuck is one of Harrah's cadre of excellent slot machine technicians. He works as a bench tech at the new Harrah's Chester Casino & Racetrack in Pennsylvania. In his first article, he describes an easy repair on an LCD monitor's video board. The failure itself is unremarkable; it's just a couple of bad caps. The point I am trying to make here is that just because you have limited electronics training or electronics knowledge, that does not mean that you can't fix stuff. In this case, Chuck will tell you the exact symptom and show you exactly which two parts to replace. All you have to do is know how to solder. It is the most important skill you can have.

To that end, let me introduce you to my new best friend, the Hakko Model 808 desoldering tool. I have seen this item advertised for many years and have always thought to myself "Boy, what a stupid idea to put the heavy motor in the pistol."

However, I wanted a portable desoldering unit that I could take with me when I taught classes on the road and it is relatively cheap at around one-hundred, fifty bucks so I bought one from Keisub Electronics. I couldn't be happier with it. It's actually very well balanced and I am as precise with it as I am with any other unit. However, the thing that really sold me on the unit is that it really sucks. I mean this thing will suck the (fill in the blank) off of a (fill in this blank too). It is the most powerful unit I have ever used, with very fast recovery time as

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well. Armed with this machine, and with Slot Tech Magazine to guide you, you too can effect repairs to casino electronics that will make your mama proud.

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



Randy Fromm's Slot Tech Magazine

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Randy Fromm

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Slot Tech Magazine is published monthly by Slot Tech Magazine
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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

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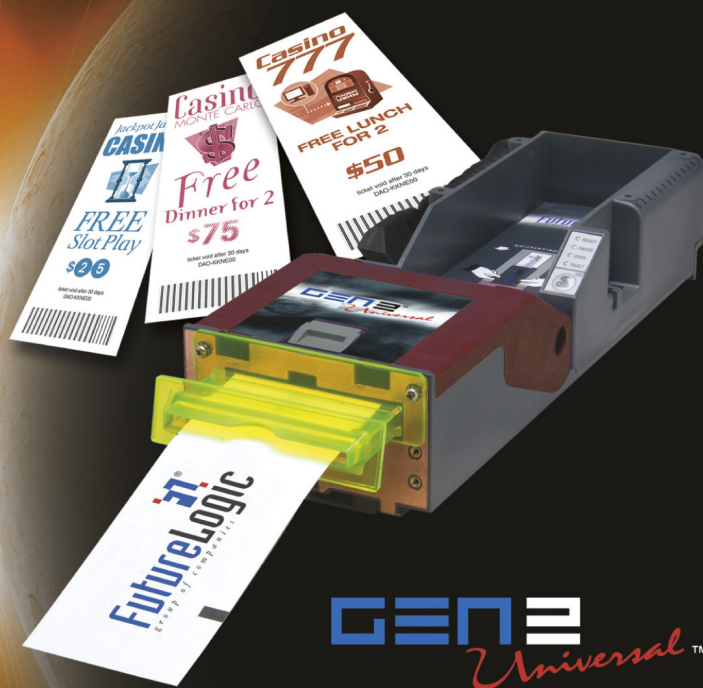
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Bally Alpha 7-Segment Display Disconnected

Symptom: Monitor displays "7 Segment display disconnected" tilt and/or some segments are missing from the LED display.

This board is located on the bottom of the reel door. It provides visual information via numeric LEDs for pay lines, line bet, win paid, credits, and total bet. The board tends to get bent if the locking pins for the monitor or printer doors are not seated properly when the door gets closed.

When the board gets bent, it puts pressure on the right side under the credit display, where ICs U11 and U12 reside. These are surface mount MAX7221s. Usually pins 1,12,13, and 24 will develop hairline fractures and drive the display bananas. These pins can be found by *gen-

Chuck's Repair Log

By Chuck Lentine

tly* putting pressure on the legs and they will lift right off the pads. Also in the same neighborhood, check C23, C24, and R32 as they also have occasionally developed fractures. Align pins back over pads and reflow solder.

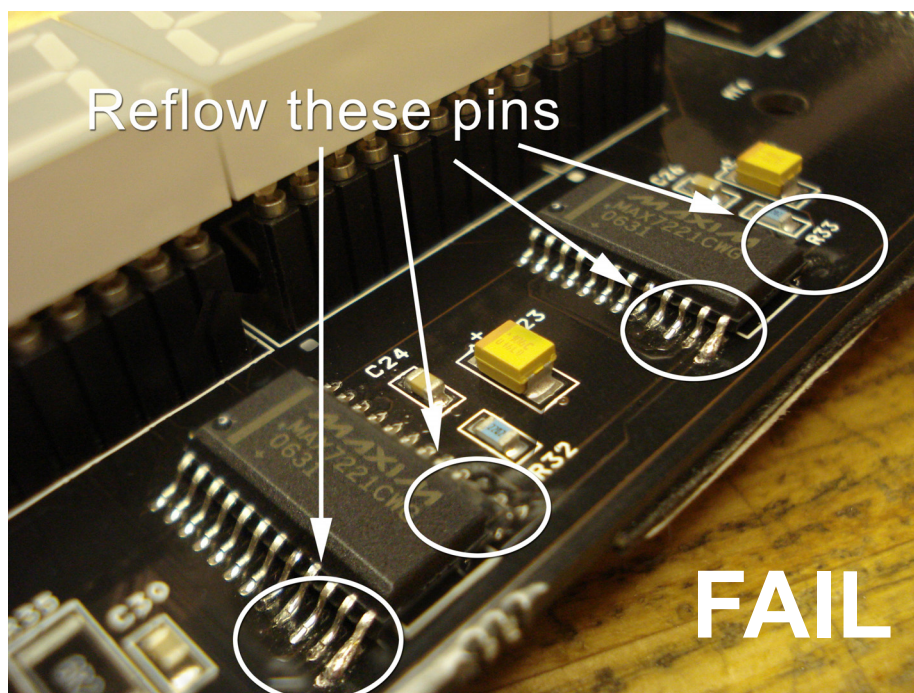
IGT S2000 Coin In Jam

Symptom: VFD shows "Coin In Jam" tilt

We have found this tilt is usually caused when the I/O card (IGT# 14930203/75427802) pops out of its connector. On our ma-

chines with the additional ten lines and coin bet buttons, this card is sandwiched between the belly glass door and panel that would hold the coin acceptor. Most of the time it can be corrected by simply reseating the I/O card (of course with the power off).

There have been occasions when the card has been reseated with the power on and fries the board. I have found it usually takes out U7, which is a surface mount CD40106B (NTE# 40106BT).





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

- #8650- Single cold cathode lamp assembly for Bally IView player tracking system 6.2 inch "IDW" LCD
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- #9080- Single RAW cold cathode lamp for 19 inch LCD monitor in Bally games

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- #9240- LED edge-lit panel for Konami K2V belly glass cabinet
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- #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
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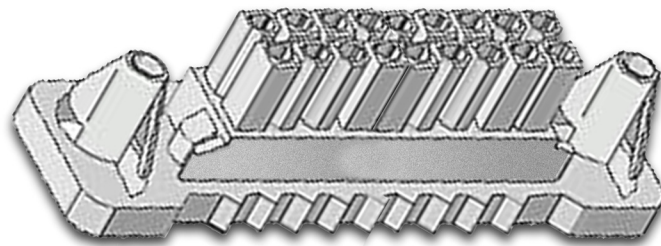
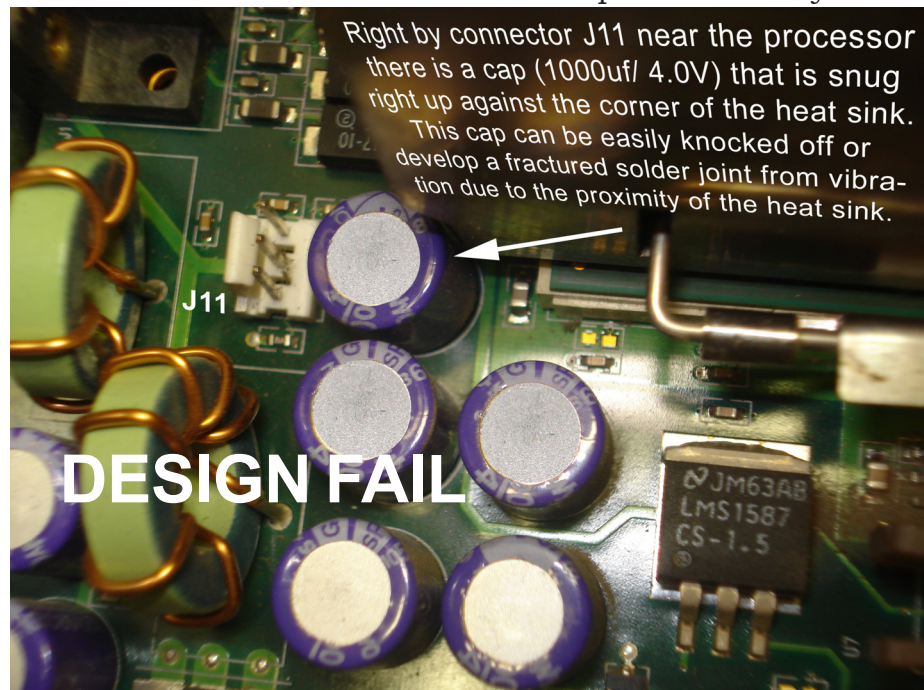
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IGT Trimline Brainbox 2.0 Lockups

Symptoms: "Board Temperature out of range" tilts, miscellaneous game lock-ups, or fails to fully boot up.

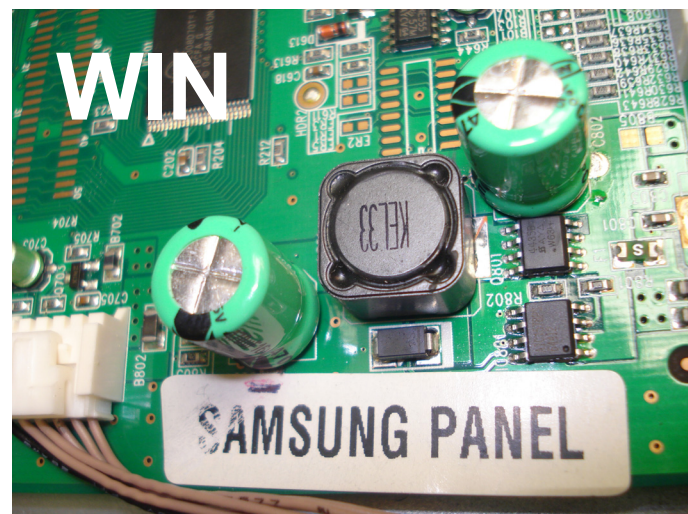
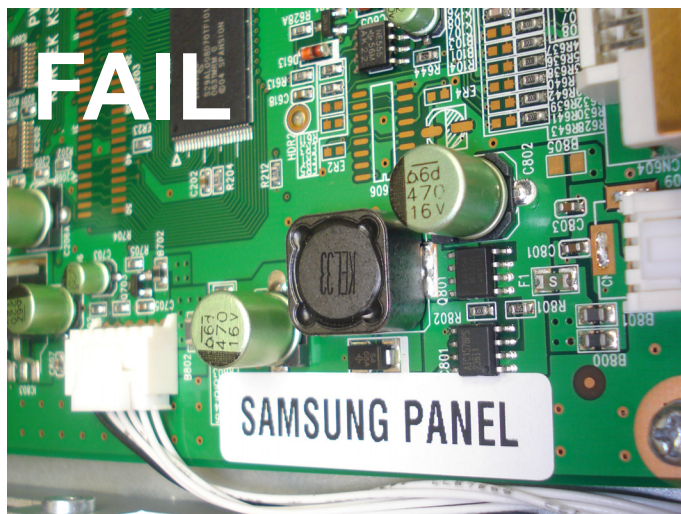
While we all have read about the video card fans in these things causing all sorts of mayhem, here are some more tidbits to check while you have the brainbox out.

1) Remove heat sink from the CPU (two clips on each side and one screw in the back). Flip it over and inspect the thermal compound (heat sink grease) to make sure it evenly covers the top of the processor and heat sink. There have been occasions when the heat sink has shifted and does not lay flat or fully cover the processor thus drying out whatever compound is exposed to the airflow. Apply fresh compound in a thin layer.



2) Right by connector J11 near the processor there is a cap (1000uf/ 4.0V) that is snug right up against the corner of the heat sink.

knocked off or develop a fractured solder joint from vibration due to the proximity of the heat sink.



Figures 4 & 5: Kortek KTL190ST LCD Monitor "Blinking"

This monitor is commonly found in the IGT Trimline cabinets. On the controller board surface mount caps C802 and C804 (both 470uf @ 16V) were found to be out of spec.



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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#3) The main power connector on the back of the brainbox gets brittle and the mounting ears break off causing a few pins to heat up and melt in the plastic housing. FYI, the replacement plastic housing is available from Mouser, part# 538-15-06-0180. Phone 1-800-346-6873.

Kortek KTL190ST LCD Monitor "Blinking"

Symptoms: Screen image and power LED flash on and off every second.

This monitor is commonly found in the IGT Trimline cabinets.

When I first opened the back of this monitor, I read the 12VDC supply was only putting out about 7 volts. It turned out the A/D controller board was bringing down the power supply. On the controller board (see figures 4 and 5) surface mount caps C802 and C804 (both 470uf @ 16V) were found to be out of spec. Replaced these two and the monitor came up nicely! There also are holes in this board for mounting low profile electrolytics if no surface mount caps are handy.

Chuck Lentine
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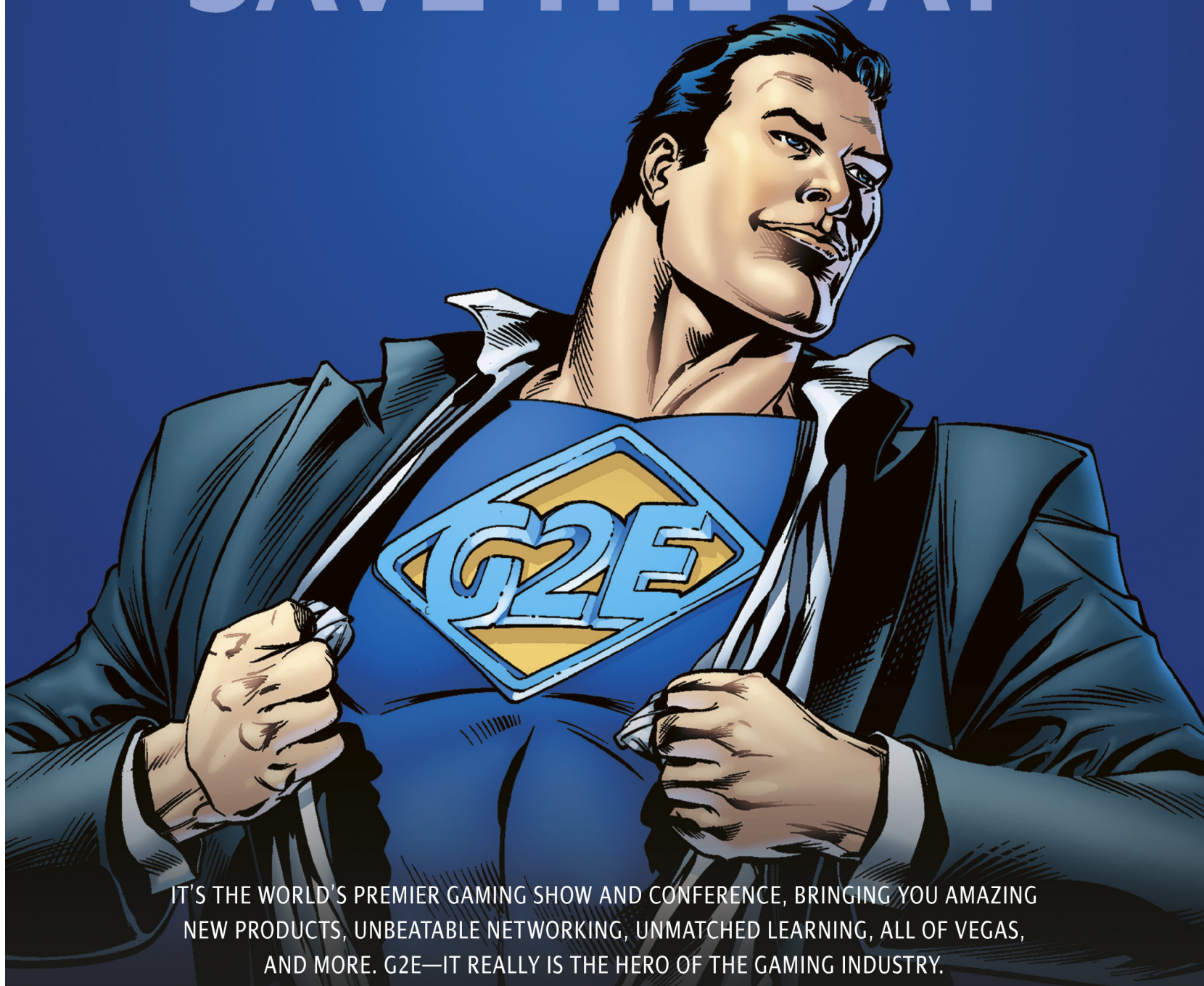
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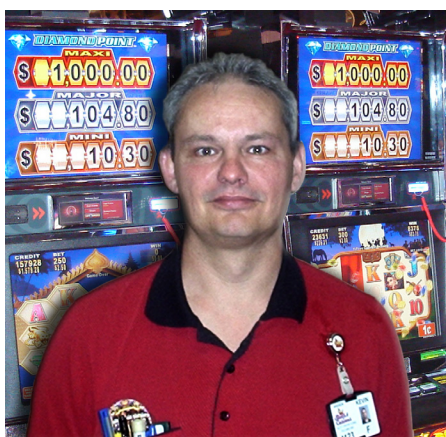


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A power outage continues to challenge my troubleshooting skills and allows for my tech log to grow.

IGT S2000 No VFD Display + No CPU Lights

This game survived the initial power outage that had lasted five minutes on our floor the night before. However when we switched back to normal city power, it fell victim. The power outage had claimed a casualty. This time, there was reel voltage and the games lights were on. I did notice no BV light, VFD was missing, and no CPU lights on the CPU board. I figured we were missing the SENET. I powered off the game and noticed that the BV did not cycle and the CPU lights were practicing to be a Christmas tree for a drag strip race. I unplugged the CPU and powered the game back up. This time, the BV did cycle and the display was back on. Just to verify, I placed the CPU back in and recreated the same

Stormy Weather in Ontario

By Kevin Noble

problem. The CPU was replaced, optioned and the machine placed back in service.

BALLY S6000 Responding / Not Re- sponding

Checking the TPE log after the same power outage, I saw that the game was “responding/not responding” since the early morning hours. I went to the game and observed that the fiber was bright red and not the CVT pulse. I had brought an extra fiber board along just in case so I did not have to go back to the shop. I did not notice on the game when I first went to it (because I was thinking about a fiber problem) but the CPU’s reset light was blinking along with a small LED shining through the UBA assembly. When I removed the CPU board and powered up the game, the bank of Atronic e-motion machines came online. When I returned the CPU to the game and powered up, the e-motion games started going off line. I changed out the CPU board but to much surprise, the exact same thing happened. I swapped out the power supply and placed the old CPU board back in the game, powered

up and the Bally S6000 stayed up as well as the e-motions.

IGT I-GAME Pixel EPROM CRC Error C0000824

We had an IGT I-Game go into Pixel EPROM CRC error. I have had this happen before and when checking my notes I saw that one of the four Pixel EPROMS had gone bad. I figured the same thing happened again so I had the Gaming Commissioner break the seals because I was going to order all four and replace them. I wanted



to verify to myself that this was correct so I decided to try a RAM clear. I was not going lose anything in trying. I completed the RAM clear process and placed the base EPROM back in the game. I was sort of surprised that the game then asked me to turn the reset key to in order to continue on with the process. The next procedure was the key chip menu. It allowed me to set all the options and then it allowed me to exit the set up. I figured placing the game in service would bring back the CRC error but it allowed me to place the game in service and continue on with my bill and ticket testing.

BALLY V7200
Frozen + Overlapping
Icons

This one Bally slant top was

moved down three spots on the same CVT. Because it is an old Bally 7200 machine, we realized that a RAM clear was necessary to change the poll number. We asked our Manager to keep the games with the same poll number avoiding the RAM clear. He wanted us to RAM clear the games, so we did. On this one game everything seemed perfectly normal, testing each game individually to make sure all games were enabled and the max credit was correct. The game cleared fine, the options set fine, the game even bill and ticket tested fine. When the Gaming Commissioner verified the EPROMS and started their final inspections they noticed on one of the Keno games you could only pick two spots but the game was looking for four at the least. It was the same two spots all the time. The

game would prompt you to select more. We also noticed on the touchscreen there were overlapping icons with "Help" and "Help/Pay table" on top of it. We repeated the RAM clear process and it went away.

3 reel to 5 Reel Conversion
IGT S2000
10-Button I/O Card Missing

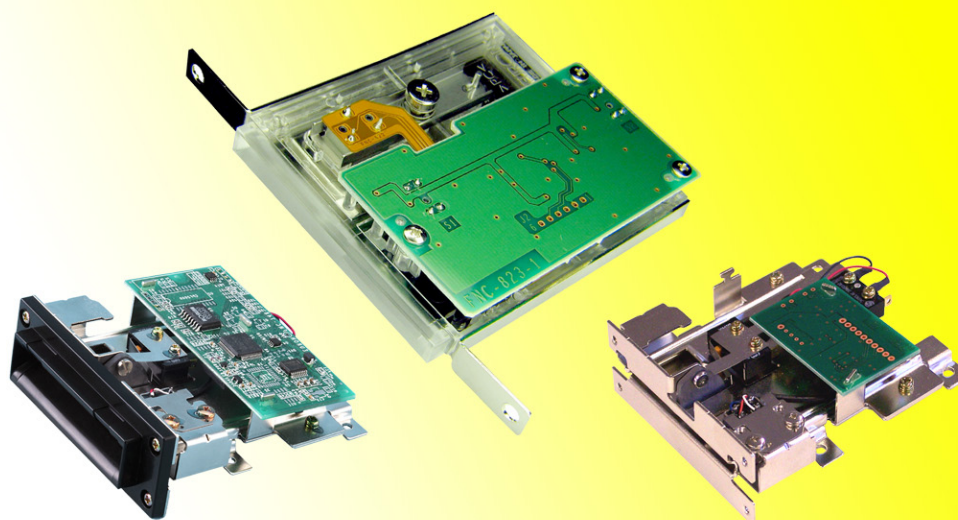
Our latest project is converting 3-reel IGT S2000s to 5-reel machines in the first phase of installing a new mystery progressive throughout Ontario. The process included converting top rounds top to chop tops, installing new button panels, reel trays and reels, and adding a new I/O card on the door just to name a few new items being done. We completed the conversions on all games and the next plan of action was to

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return to each game and RAM clear and set the options. The first problem we ran into was this "10-button I/O card missing" error. The game let us use all the buttons to perform a RAM clear and allowed us to set the options but the error would not disappear. With our experience in performing the conversion, we had the routine down to a science. We knew that the problem had to do with something that we had added or subtracted for the new themes. We further examined all the connections and found that someone had plugged the outside I/O card plug into the small display board mounted on the reel glass and vice-versa.

IGT S2000 Power Up the Reel Lights Flickered

On the same conversion project, after the game was converted we started RAM clearing each game. This time when we powered up we noticed that the reel lights flickered once and shut off. We knew this was not normal. We checked all the connections and found all the connections were correct. We went into the top box and noticed that when the new tower light was mounted, someone tightened the screws with the tower light wires being pinched. Once we loosened the wires and remounted the tower light, it worked properly.

IGT S2000 "No Display" Error That Would Not Clear

This was another conversion project reject that we had to troubleshoot. After the conversion, the machine was being RAM cleared again when the error message "No Display" was being displayed in the winner paid and credit meters. After checking all the conversion connections, we noticed that the wire that came from the Netplex board to the cabinet transfer plugs just below the board was not plugged into the Netplex board but looped back into one of the transfer plugs. Once the right plug was disconnected and reconnected on the Netplex board, the No Display problem disappeared and the game reset.

IGT S2000 SAS Secondary Down

This happened at another site at the same time we were doing our own conversions. When I returned their phone call, they had already solved this problem. When I asked what they did to repair the problem, Jim from Hiawatha stated they found a bad fiber board in the game. Once it was replaced, the machine was fine.

IGT S2000 No Hold Voltage on Reel #5

The game was a 3-reel game and since we now use 5 reels we had no hold voltage to reel #5. We

swapped reel #1 with reel #5 but the problem remained in the same spot. We swapped a new CPU with the game and the problem still existed. We changed out almost every part in the game until we ran out of ideas. The last thing that we did not touch was the entire reel harness assembly with the tray. We figured that all 15 worked and that they were a brand new part but we guessed wrong. The problem did move. I sent an e-mail to Dave Thomson who is spearheading this project and said another site was experiencing the same problem and when they turn the harness that plugged into the motherboard 180 degrees, the problem went away and the reels started to spin.

BALLY ALPHA REEL 4th Reel Device Error

A 4th reel error on a 3-reel game seemed like a silly error code. We first started troubleshooting this error by swapping out all the reels, COMM board, and the USB cable with another game but the problem would not go away. I had the seals broken and tried a RAM clear before the game would release the tilt but it went into 2nd reel not configured error that I could not clear until I reseated the COMM board.

IGT AVP EZ Pay and Mikohn Going Offline + Manual Jackpots

During a recent install at another site, they experi-

enced our “NO PROPS – NO DELTA – NO PROGRESSIVE” being displayed on the Mikohn. Lately this message has become quite frequent with the new virtual DCUs that were installed last year. Believe it or not, an urgent “SYSCOMM” reboot did not fix this problem. The machine that had the problem of no props, no deltas, no progressive was fixed by replacing the SMIB and the DID. The other game that had the dollar sign that wouldn’t go away was a wrong harness from the SMIB to the Comm board of the game.

CASINOLINK Mikohn Going Offline/ Online on Four Banks but Two Different DCUs

This problem started about a week ago when we needed to run a new homerun for our new Mystery Progressive banks. We had somebody come in and test the signal strength of our line when there was too much noise on the line to use. We needed a new line run from our MIS room out to the Mystery Progressive banks because the Mystery Progressive uses the CasinoLink just like the Mikohn system. There was an extra cable in the Wide Area Progressive bank just kitty corner to the Mystery Bank. They pulled the wire underneath the floor to the Mystery Progressive bank and hooked it up the next day. The following day we noticed that on four separate banks (two banks per DCU) one game would go

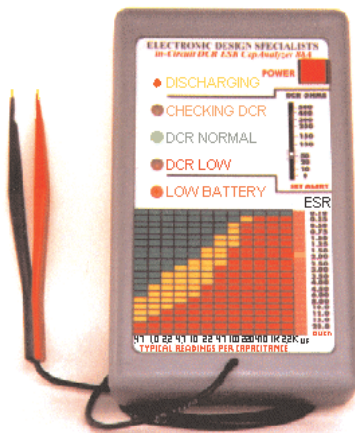
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offline for a minute and come back on. We did notice that there was a ~ (the tilde character) in the marketing banner on the Mikohn display just before the game would come back online. We had received reports stating the player points were not accumulating and run-away meters from Auditing were symptoms all associated with these four banks. We tried to RAM clear all the SMIBs and the player points had started to report correctly but games still went offline, one after the other. We tried removing banks one at a time but the problem still existed. We took the other bank off line and plugged in the bank we removed initially and the problem continued meaning that none of the games were bringing the system down. The only way we were going to solve this was go back in the MIS room and remove the jumper from one bank

to another. This way, we were eliminating the homerun line out to the floor. We were starting to trace our lines in the back of the patch panel when we noticed something really quite strange. A discontinued homerun was plugged into the existing DCUs. This meant that when we took a bank of games out of the loop, it was being picked up by another DCU. The ~ meant that the SMIB has been assigned an address but has been instructed by the virtual DCU not to send any messages so the game was stuck in a holding pattern. Once we removed the discontinued homerun, the games all stayed online, the player points were back to normal and most importantly, Auditing was happy and the massive service reports stopped.

- Kevin Noble
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Quick & Simple Repairs #54

By Pat Porath

IGT AVP Hard Drive Problem

This specific game, which was an IGT AVP, had a “suitcase” (a.k.a. brain box or main board) problem. To prevent reloading the game graphics, the original hard drive was changed over to the replacement board. The problem was when the game was turned back on, an error appeared, “Cannot find target hard drive.” What was going on? It didn’t appear that the hard drive was bad before, only the board. Another reboot was done and the same error appeared. Next, the suitcase was removed and the connections on the hard drive were checked. Somehow the connector was on wrong. It was connected properly and the game started to boot up normally. This time the game showed a “protocol error.” I noticed that the two “license dongles”

weren’t lit up. Are they suppose to be? The game next door was checked and sure enough they were lit. It appeared that the suitcase has lost some communication with the backplane board (a.k.a. motherboard). I checked the connections and all of them seemed to be nice and snug. There was a USB port on the suitcase that went from it to the backplane. I turned the game off and on the suitcase there was an unused USB port so I swapped ports with the cable and turned the game back on. This time the license dongles lit up like they were supposed to. Maybe the port went bad? I turned the game back off and tried it, and now it worked too. My concern was not to consider why the port didn’t work to begin with but to try to help get the game back up and running. We let the game fully boot up and it was fine.

WMS Slant Top-No Video

I received a call to a WMS 550 slant top “Jackpot Party” game that didn’t have any video. There was a light on the I./O board that would flash about every 20 seconds but no video would appear. I swapped I./O boards with the game next door and the problem

stayed the same. Next, I swapped main processor boards and the problem followed. It looked like the problem was somewhere within the board. They were swapped back to their original games and I thought maybe a RAM clear was needed to resolve the problem. I could see that the monitor had voltage, but it didn’t have graphics so to me it looked like it may be a software problem. By swapping the main boards it did appear that way. So, with the boards back where they belong, the game was turned back on. It was almost hard to believe, but the game came up ok. It printed the ticket that it was supposed to and it was fine. This was another “FM repair.” Freakin’ magic.

IGT AVP SAS COM Error

^^^ Editor’s note: Wins award for most acronyms in a sub-title.

I received a call on to an IGT AVP game that had locked up twice for payouts. The payouts were small amounts and the game was checked to see if it had paper and it did. Why did it lock up? When I inserted my tech card (a.k.a. mechanic card) and opened then closed the main slot door, the Oasis “DOOR OPEN” display didn’t

change. By it not showing OPEN and CLOSED when the door was physically opened and closed, this meant that there was a COM problem between the game and the Sentinel. I knew I had COM between the Sentinel and the Oasis system because I pressed the ENTER key twice when my tech card was inserted and the display showed a checksum. Basically, when the display shows a checksum with numbers and letters, it means that there is good COM between the Sentinel and Oasis. Anyway, it appeared that the game wasn't sending a signal to the Oasis. On the game COM board (to which the game interface cable connects) there are two small lights, a green one and a red one. Only the red light was flashing, not the green; both of them need to be flashing for proper communication. So the question remained, why wasn't the game communicating with the Sentinel? I reseated the COM board in the game and reseated the interface cable. Neither helped the problem. Next, I rebooted the Sentinel. This time within seconds, both lights started to flash on the game COM board. The slot door was closed but the Oasis display still read OPEN. What was going on? It appeared that communication had been established so what happened? When I opened and closed the door again I saw a lower-case letter s on the screen. This meant that there was another door that showed open, not only the

main door. The slot door was opened once again and I found that I had forgotten to put the cover back over the motherboard (IGT AVP upright game). When the cover is in place it pushes on two Cherry switches for a door closure signal. Now, with the cover in place, the main door was closed and this time the Oasis display showed CLOSED too. I opened and closed it a few more times just to make sure. Finally the game was working properly. Reseating the COM board in the game and rebooting the Sentinel did the trick.

IGT Game King Progressive Problem

I had a whole bank of Game King progressive games that lost communication somewhere. The screens on the games even showed a COM loss, they read "Progressive Link Down." First I tried rebooting the controller at the bank and no such luck. Next, the controller in our computer room was rebooted. No luck there either. The error remained. Now what? I started checking the fiber connections at each game (plastic fiber optic cable) and the first ones looked ok. I got to the second game on the other side of the bank and noticed a problem. A ribbon cable that comes from the power distribution/COM board area that goes to the motherboard was loose. I turned the game off and pushed the cable into its socket, then turned the game back on. It was looking like the cable may have

been the main problem so I was hoping that the Progressive Link Down error would disappear. No dice. Back at the computer room, I gave the progressive controller another reboot and walked back to the games. FINALLY the error was gone and they seemed to be running OK. The bank of games were back online.

IGT AVP Ebay Game Freezing Up In Bonus

We had an IGT Ebay game that was freezing up in the bonus round. The screen would freeze up and not allow the customer to play and the game would have to be reset with a door open/closure or a reboot of the game. Why was it "freezing up"? Come to find out, the video card cooling fan was fried. It was so bad that it would barely turn with your finger; it was totally shot. Instead of replacing the whole video card, the fan itself is easily replaced. There are only a few "plastic pins" and one connector, that's it. The fan was replaced and the game is working fine. If an AVP is freezing up or rebooting itself, there is a good chance that the video card fan is bad. Pull the brain box (a.k.a. suitcase) then remove the cover. Next, check the fan on the card. The video card can easily be identified by the 15-pin sub-D "VGA" type video connectors that it has on it.

- Pat Porath
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Monitors, or display systems if you wish, are available in different technologies. There's the good old fashioned cathode ray tube type which is abbreviated as CRT. There are liquid crystal displays which is abbreviated as LCDs. There are plasma displays (PDPs) and light emitting diode with the latter being abbreviated as LEDs. My favourite has been, still is and most probably will always remain, without a shadow of a doubt, the CRT type of monitor. Most desktop displays used to be a cathode ray tube (CRT) type, while laptops, notebooks and other portable computers incorporate the other types of displays. This is mainly because of their slimmer design and smaller energy consumption. Along with the passage of time, the advances in technology and with energy saving awareness, the highly respected CRT type of monitor is being sadly phased out. Whichever way you look at it, they certainly have come a long way from the monochrome types of displays of the 1970s.

A Hair Raising Experience

Understanding the Flyback Transformer and its Associated Circuitry

By James Borg

A CRT monitor has different areas which all do their bit. There's the power supply circuit, there's the RGB circuit, the vertical and horizontal deflection circuits, the degaussing circuit, the high tension circuits, the synchronization circuits etc. They are all important to the overall performance of the unit in their own right, but perhaps some are more important than others. The area which has the most stress is undoubtedly the high tension area. This is where a technician's heart usually misses a few beats and hair can literally stand on end...most shocking I would say.

The core, the hottest part, the very heart behind the high tension area is the 'high tension' transformer. This is also referred to as the 'flyback' transformer (FBT). Another term by which it is referred to it is 'LOPT', which stands for Line Out Put Transformer, or LOT. As its name implies, there's high tension involved, and high tension in the order of KV. This generates the high voltage needed as part of the supply of a CRT screen. The actual amount varies from

monitor to monitor but usually, the bigger the CRT, the higher the voltage would be. This voltage can even be as high as 50KV for large tubes. I shall be interchanging the words flyback, LOPT, and high tension transformer along the way.

The LOPT differs from a typical mains transformer or an audio transformer as it's not just designed to transfer energy. This is also designed to store energy for the switching period. This is achieved by using a ferrite core incorporating an air gap where the coils are wound on. Another point worth noting is that an LOPT usually operates at higher frequencies than mains or audio transformers. A typical frequency range would be between 15 KHz up to 50 KHz or even higher. Ferrite cores are made from iron alloys which can use zinc and manganese. They are extensively used in switched mode power supply and high frequency transformers because of their low losses at high frequency. One drawback is that they are brittle, so I don't really suggest you go dropping your transformers on the floor, just to see what happens.

Reluctance is increased due to the air gap and this means that it also increases its capacity to store energy. The magnetic reluctance, or magnetic resistance, is used to analyze magnetic circuits and is a very important parameter in the field of magnetism. One can easily compare the magnetic reluctance to resistance in an electric circuit. In an electric circuit, the field causes current to flow through the least resistance path. On the other hand, in a magnetic field, the magnetic flux will follow the path of least magnetic reluctance. Magnetic flux will always form a closed loop and the path of the loop will depend on the reluctance of the surrounding materials. This will be concentrated around the path of least reluctance. Air and vacuum offer a high level of reluctance while easily magnetized materials such as soft iron will have a low level of reluctance.

Just for the sake of mentioning it, there is also a slight but important difference between TV and monitor flyback transformers. Monitor flybacks have an internal capacitor built in. This would be in the order of a few nano farads. This improves picture quality when using high resolutions, unlike TV. Without this internal capacitor, there will be distortion of the picture on the sides.

The flyback transformer is basically an integrated transformer. This is because it has rectifiers, divider networks, a capacitor and low voltage windings all built in. In days gone by, the high voltage diode was designed to be on the outside of the transformer itself and was referred to as the tripler. If this tripler was to develop a fault, just have it replaced. A voltage tripler consists of a few internal components, namely diodes and capacitors.

The more of these internal components used, the more multiplication of

voltage is built up. They basically start from voltage doublers, then go on to triplers, quadruplers or even to voltage pentupler. Basically what happens in a multiplier is that an AC source of lower magnitude is converted to a higher voltage DC output. The ratio of the output to the

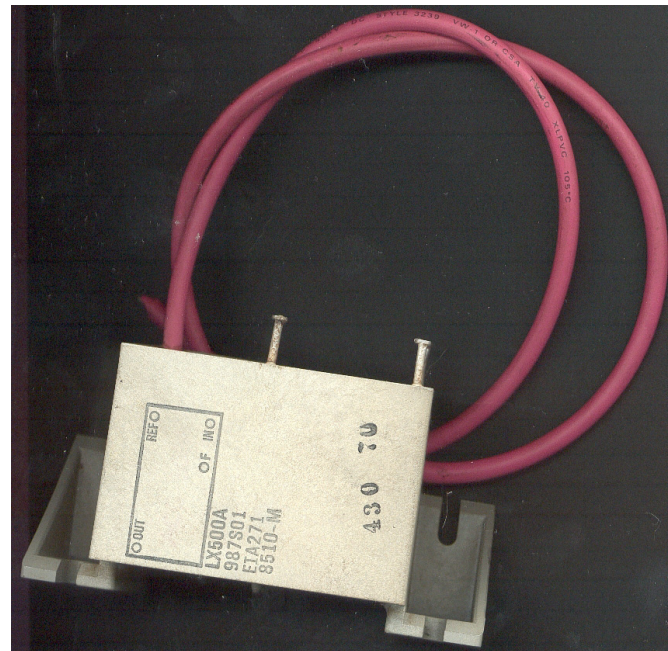


Fig 1. A Typical Voltage Tripler

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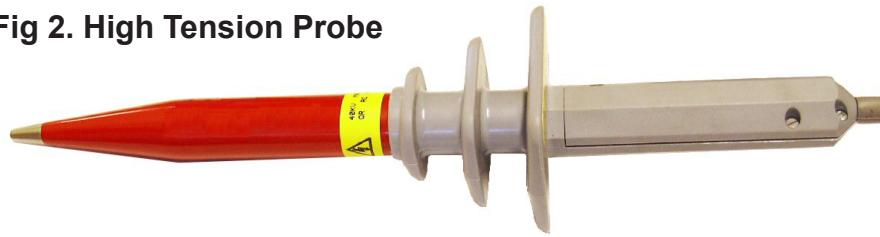
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input voltages determines what kind of multiplier the unit is categorized as. Using today's technology, flyback design incorporates the tripler as well, so the whole thing would need to be replaced should any part of it fails.

All this is very interesting as it gives one a very brief idea of the operation in general of flyback transformers, but in practice, during a moment of crises, when a monitor is down and you have the slots manager breathing down your neck why 'so and so' machine is still not working, and you're pulling your hair out and sweating, I'm quite sure that you don't really care a great deal about what the transformer's core is made out of and a little less about its magnetic reluctance, let alone the air gap. You wish you'd rather be in possession of a cloaking device to make yourself disappear instead...quickly! So, at this moment in time, we'll stop there about that particular topic and go to the nitty-gritty which is how to check out the system and if the flyback has gone to meet its maker, or in other words, FUBAR.

A very important start is to have a nice clean worktop to put your monitor on. At least enough space to put it on, anyway. Knowing me, I'll have to shove everything to the side to make enough room but that's me. I used to get told off for that, but

Fig 2. High Tension Probe



not any more now. Every cloud has a silver lining, or so they say.

With regards to tools, I usually use my multi-meter, a soldering iron, pointed nose pliers, cutters, some solder wick or a desoldering pump. Sometimes I have to resort to using my oscilloscope but not all that much. A schematic diagram would certainly come in handy, especially if the fault isn't a straightforward one and will have you going round in circles and ending up totally lost. An isolating transformer is also recommended when working on monitors, for safety reasons of course. A tool which I don't use all that often is my high tension probe.

High tension probes are 1000:1 voltage dividers.

They come in various shapes and sizes. They also are categorized by the maximum voltage they can handle.

These have three wires extending from them. Two are a pair and end up to banana

plugs which are inserted into a digital multimeter on the DC voltage range, typically on the 200V scale. The third, and most important, is the grounding wire, which ends up with a crocodile or an alligator clip. This is clipped on to the earthed body of the equipment you're currently working on. For the sake of measuring the voltage, you don't really need this Earthing wire, but I strongly suggest that you do use it as otherwise you might end up jumping up and down as there could be high voltage leaking from the probe into your hand and it will end up charging you up somewhat high. The metal tip unscrews off and a hooked tip comes with it. For the probe to work, the tip is touched to the metal clip under the second anode



Fig 3. Metal Clip under Anode Cap

cap while the monitor is working.

Reading the DC voltage on the multimeter will tell you exactly what that voltage there is. If you read 25V DC, then that would mean that you have 25KV present. If the reading is very low, then you could have a problem with the flyback transformer's generation of high tension. You could even have a reading which is very high but that's not usually the case. However, it's good to have one around when I need to actually measure the high tension being pumped out of the LOPT.

What is the Symptom?

If there's a horizontal line across, that means the frame's died a death which could be related to the vertical yoke or the vertical driver circuit's had it. If there's vertical distortion, it's probably a supply issue or a capacitor going FUBAR. If you have a vertical line, then that could be a faulty horizontal deflection yoke problem, however, a fault in the line circuit is most likely the case. I've come across inductors that break off their solder joints and show this symptom.

The picture could have a faulty colour, which would probably be related to the video driver circuitry, the cabling, or even a fault from the source of the signal itself. This means don't

start pulling the monitor to pieces before you are quite sure that the input colours to the monitor are actually arriving. There might be loss of synch, either vertical or horizontal, or both at the same time. There might be screen colour contamination, which means that there could be a problem with the degaussing section. If switching off the monitor, leaving it off for approx. 30 minutes, and turning it back on doesn't solve the problem, then roll up your sleeves.

The picture could be too bright, or too dim. These could be related to the LOPT. The picture could be out of focus. Again this could be related to the LOPT. The picture could be too wide or too narrow which also could relate to the LOPT. There might not be a picture at all, and this could relate to a variety of factors, but again, the LOPT might have a say in it. When the monitor is first turned on, the noise it makes (or it doesn't, as the case might be) can tell you



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a great deal as to where the problem could be originating. If it's completely quiet, then chances are it's a power supply problem. When carrying out the 'noise' test, it is highly recommended that the room you're working in is quiet. That means your ear drums aren't being blown to pieces by a Ghetto Blaster playing your favourite tune in a corner of the workshop.

A typical noise one can hear from a faulty monitor is a "tick-tick-tick" type which can be in the order of once every second or so. This could be faint and of an elevated frequency so you might not always hear it if you're not in tune to it. Another type of noise could be arcing. This type can either be seen, heard (obviously as it's a noise), or smelled (ozone?). If it's a good day, then all three at the same time can be experienced.

The first type of noise, the tick-tick-tick, could be a faulty power supply circuit, a faulty secondary circuit or it could be related to the LOPT itself. Usually it's caused by parts of the secondary circuits developing a fault, consuming excessive current, and sending the switched mode power supply into overload mode, hence the ticking noises.

The second type of noise, the arcing, could be be-

cause the transformer is slowly fusing inside and you won't see it, but you might smell it. The arcing could also be caused by the outer insulation being cracked and the high tension is actually leaking out and going to the closest earthed point it finds, probably the chassis. You can easily see and smell this. Sometimes this is happening but you won't be able to see it if the room is well lit. Ideally you turn the lights off in the workshop and, if it's dark enough, you'll see the high tension arcing all over the place. Depending on the availability and the time involved in getting a new one, I have, in the past, managed to patch up the crack with resin glue or applying layers of high voltage sealer. Insulation tape can help to some extent.

Araldite (epoxy resin) comes to the rescue here. Once applied to the crack, you'll have to leave it to dry and harden properly as otherwise the voltage would puncture right through it and you'll have to do it again, and this time letting it dry and harden properly. For the best finish, it's ideal if you bake this under a hot lamp for a while. If your luck has run out, the botch-up job would have worked wonders, only to find that another part of the transformer was cracked as well, and your supply of Araldite has run out, so you're back to square one.

Arcing could also be due to a dry joint, a faulty solder joint on one of the many pins of the flyback. This can easily be seen if you turn the monitor over, exposing the solder side of the board.

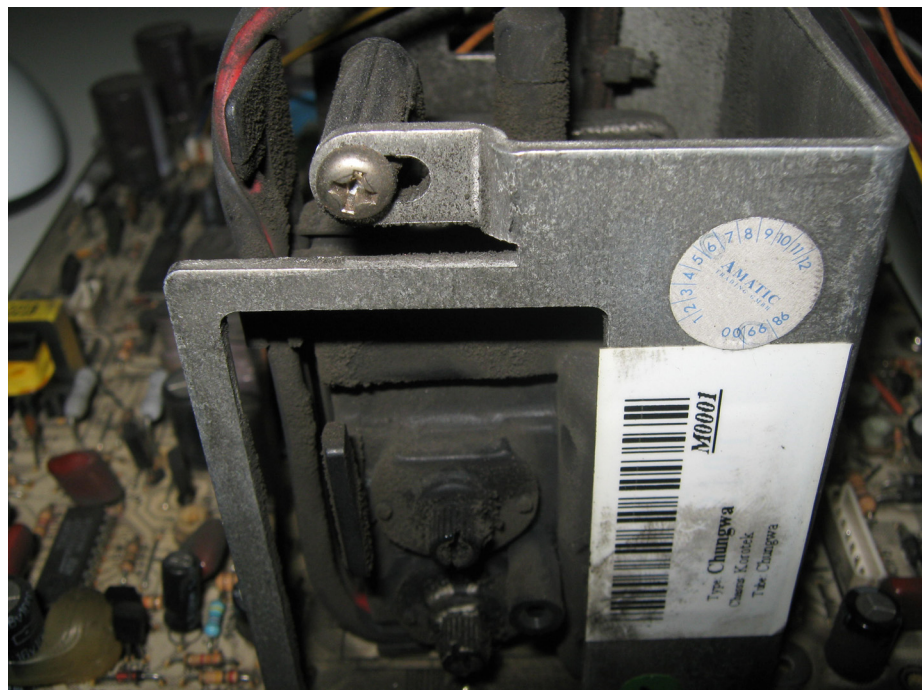


Fig 4. Mounting Screw on the Flyback Transformer.

Flybacks used to be notorious for developing dry/bad joints on their pins. Most of the time, the transformer is anchored down to the printed circuit board by screws or bolts. The reason being is that it's quite a heavy component and it doesn't like vibrations or the monitor being kicked as that sort of violent action can easily upset it and to get its back on you, it will dislodge a pin from the solder. It's recommended that when such a transformer is replaced, the mounting screws would also be put back where they originally were. This will save you hassle and downtime on a machine when it can easily be avoided.

The ultimate noise you want to hear is the crackling of the high tension building up. That is really the best noise you can hear. If your ears need cleaning and you can't hear the crackling, then don't despair as there is another simple method for checking out if the high tension has built up or not. It's called the 'Hair Test' which consists of moving your hairy arm close to the front of the screen. The static building up will make your hairs stand on end. If your arms aren't hairy, then use your imagination as to what you can put in front of the screen. Always remember the Safety First issue.

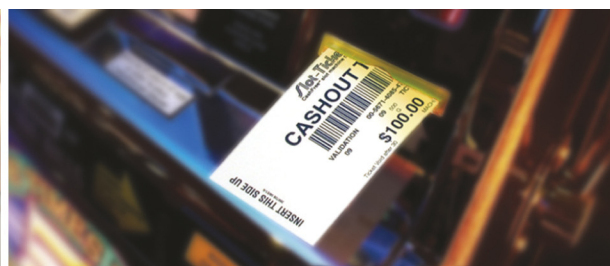
If none of these tests seem
October 2009

to show any sort of positive result, a little neon placed very close to the LOPT should start to glow. You hold the leads of a small, NE-2, Neon Lamp in your fingers and press the lamp against the core of the flyback transformer. With proper EHT present, the neon lamp will light. For some reason, this neon thing always makes me smile. It could be a case of 'little things please little minds' but I won't go into that. That neon test helps to show that a part of the transformer is working and is building up a high enough voltage to make the neon glow.

Another test, which is quite-how shall I put it?—

D-A-N-G-E-R-O-U-S—is to pull an arc from the second anode cap by using a screwdriver and a croc to croc jumper lead. One side of the croc would be clipped to the metal bit of the screwdriver and the other end to the metal frame of the monitor. Bring the screwdriver tip near the second anode, under the rubber boot. You should see (and hear) a spark. If the flyback is working and generating high tension, you should be able to see a spark in the order of about an inch, jump out of the cap on to the screwdriver.

Even though the monitor could have been left off for a long while, the tube could still be charged up so think



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fingers to try and pull the anode cap out of the CRT. Before pulling out the anode cap, a good idea would be to discharge it using the same screwdriver and a croc to croc jumper lead. Again, one side of the croc would be clipped to the metal bit of the screw driver and the other end to the frame of the monitor. It makes no difference if the monitor is earthed or not. You are not discharging the CRT to earth. You are actually shorting the inside of the CRT (the second anode is connected to the aquadag, a conductive, graphite coating that is sprayed on the inside of the bell of the CRT) to the outside of the CRT, which is likewise sprayed with aquadag, this time connected to the "chassis earth" or "chassis ground" of the monitor with a metal strap, held taught against the dull gray coating with a spring.

A good procedure before removing the cap is to probe with the screwdriver tip under it, making sure that you have actually made physical contact with the metal clip. You might hear nothing but you might hear arcing, which means that the tube would then be discharged and it will be fine to pull out the cap without any worries. That will save you saying some rude words in the process. Modern monitors incorporate a high-resistance bleeder resistor within the

flyback to discharge the voltage after just a few seconds. I would still be careful how I handle the anode cap though, even if the monitor is relatively modern.

The voltage is high, very, very high, but the current is low, very, very low ($>1\text{mA}$ – 15mA). This means that it won't kill you, even though it is D-A-N-G-E-R-O-U-S. The reason why it's dangerous is primarily because the voltage is so high. It can easily cause violent muscle spasms if it comes in direct contact. It's the spasms that can cause the actual injury. You have to also be somewhat careful, especially if your ticker's on the blink. A typical case of a poor soul that's come in contact with high voltage, and hence subjected to such muscle spasms, would be to have the point of contact, namely the hand for example,

thrown back with great force. Where the hand lands, is anybody's guess. If you're very lucky, your hand will not be hurt. If you're unlucky, it can be cut if it hits the monitor's chassis or some other undesirable place. If you're really unlucky, it can be thrown on to other parts of the monitor with hazardous potentials exposed, which means you can be electrocuted. If your luck has totally run out, (or has it?), your hand will smack your manager straight in the kisser while he's got his head stuck in and is busy looking at what you're doing and pretending to understand what's going on. I wonder just how many slot-techs would like to do that to their manager, and what better excuse could they possibly have? Force Majeure?

Having high tension build-



Fig 5. Anode Cap

ing up would mean that the problem with the monitor wouldn't be as bad as it originally might have seemed. I always enjoy tremendously the sound of the crackling when a monitor starts up, reason being is that most of the monitor itself would be working, which makes the repair job relatively easier to carry out. Having said that, this crackling noise doesn't mean that the transformer is good though, so don't go start checking out other areas yet. You still need to do some more tests before you can say that it's working fine.

If there is some sort of picture visible, whether it could be bright, or dim, or out of focus is a good start. It could be the case that the focus goes out of spec after a while, or it could come back into line after a while and you wonder if it's a side effect of the night before when you had that one drink too many. The screen could brighten up and dim after a while. The picture might start to jitter and arcing noises heard in the background. There could also be a problem with the picture being distorted, which can be somewhat misleading. A typical example of this could be a distorted frame. One would imagine that the problem is from the vertical yoke or the frame chip or somewhere in that area. However, the fault would be the flyback itself. This might

seem to be very strange, but however it's very true. The flyback has auxiliary secondary windings that produce lower voltages for driving other parts of the monitor. One such case would be to supply voltage to the frame chip. Another typical case would be to

supply the voltage to the tube's heater element.

Conclusion next month.

- James Borg
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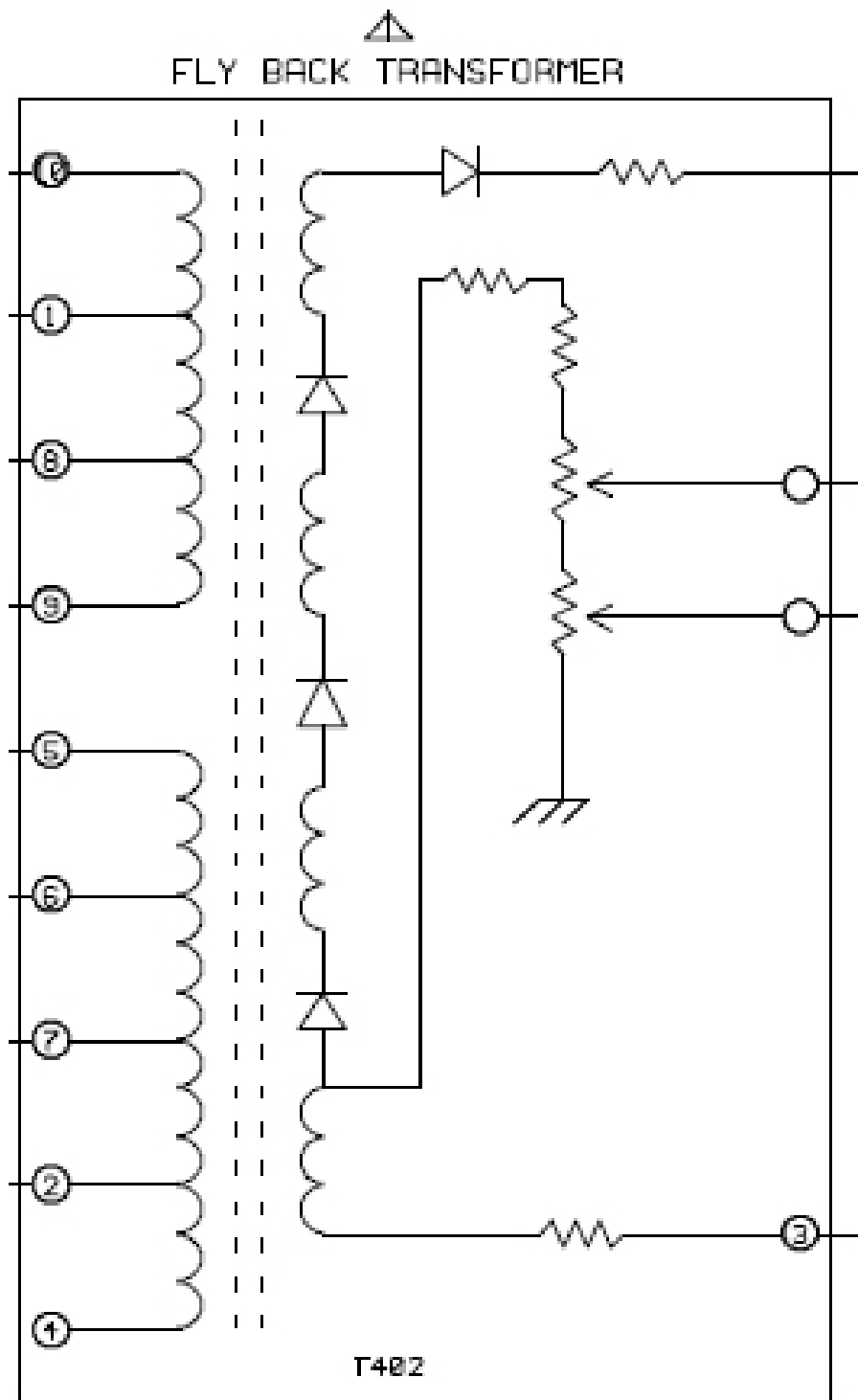


Fig 6. Flyback Internal Windings



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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

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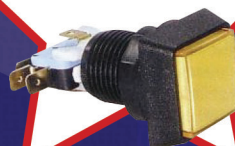
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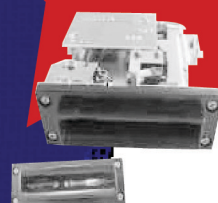
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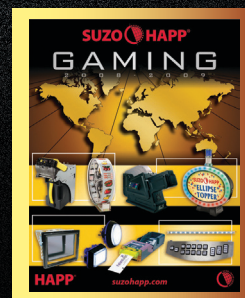


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