

January 2014

Slot Tech Magazine

Slot Machine Technology for the International Casino & Gaming Industry

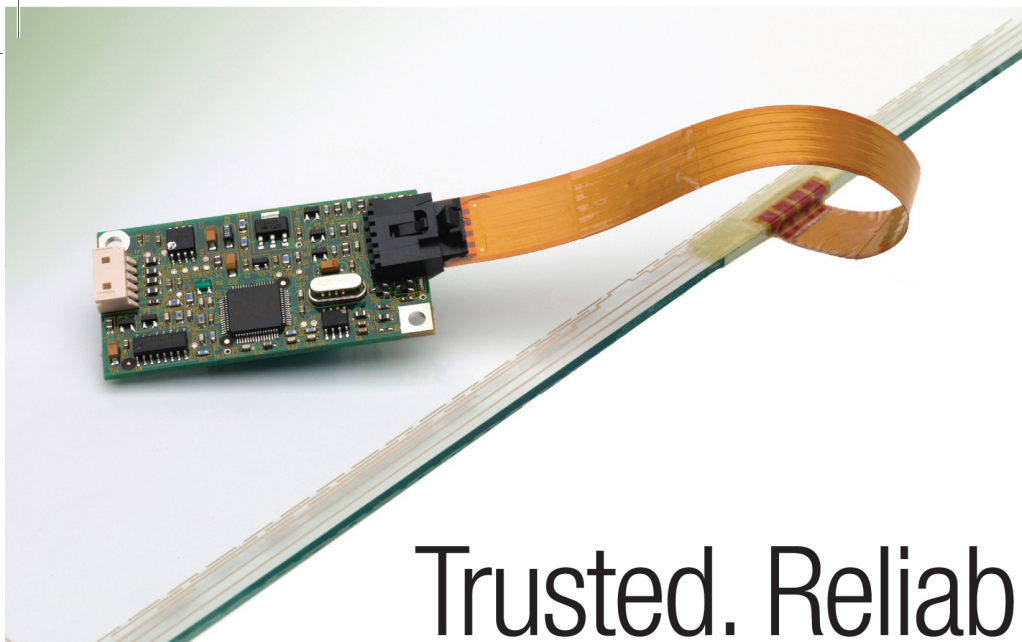
Anode? Cathode?
Who Names These Things?
CRT Monitor Obituary
Quick & Simple Slot
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Slot Tech Magazine

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Dear Friends,

I don't often ask Slot Tech Magazine's contributors (slot techs like YOU) to write about anything specific; I don't give them assignments. They write about the stuff that breaks the most (We don't seem to hear a peep about Konami games. Why is that? Hmm . . .).

But for this month's issue, I asked my fellow CRT monitor "enthusiast" and Slot Tech Magazine contributor James Borg if he could give us some parting words and officially say goodbye to my old friend (and money-maker) the CRT monitor. To paraphrase legendary American folk singer Woody Guthrie, "So long, it's been good to know you, your CRT dust is a-gettin' my lungs and I got to be driftin' along (to LCD repair).

Goodbye old friend. Thanks for some very interesting repairs and an outstanding body of repair knowledge.

Randy Fromm
Publisher-Slot Tech Magazine



Randy Fromm

Randy Fromm's Slot Tech Magazine

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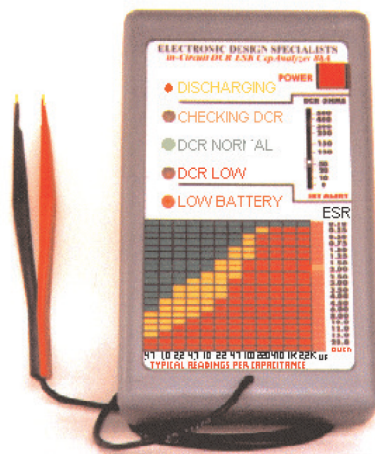
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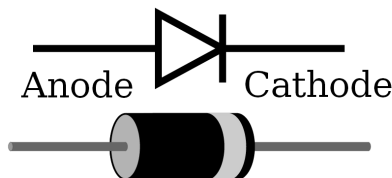
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Cathode? Anode?

Who Names This Stuff, Anyway?

The terms “anode” and, especially, “cathode” are used quite often in the world of electronics. The commonly used diode (rectifier) has just two terminals; they’re called the cathode and the anode.



Since their invention (and still in use today) video games have used a “Cathode Ray Tube” as a display. New games use LCD monitors instead of CRTs but there are still “cathodes” lurking about inside as the LCD’s backlight is typically generated by “cold cathode fluorescent lamps” or CCFLs.

In order to understand the true meaning of the two terms, we need to start small-very small. Let’s start off by taking a look at the atom.

The smallest part into which an element can be divided is called the atom (from the Greek word *atmos* for “indivisible”). The atom consists of a nucleus and one or more orbiting

electrons (fig.1). The electrons orbit in a sort of “cloud” around the nucleus. For the sake of simplicity, they are illustrated here as a simple, circular orbit. The orbits of the electrons are known as the “electron shells” and they are sort of stacked in discrete layers (energy levels) as they orbit the nucleus. You can kind of compare this to the orbit of the planets around the Sun (it’s not precisely the same). A electron has a negative charge.

The atom’s nucleus is actually made of two types of particles. One type, the proton, has a positive charge. It is the proton that is responsible for the positive charge of the nucleus. The other particle in the nucleus is called the neutron. As the name implies, the neutron is electrically neutral. It has no electrical charge at all. Neutrons do not enter into this discussion and will not be mentioned further.

Electrons stay in orbit due to an attraction between the positively charged proton(s) in the nucleus and the negatively charged electron(s) moving in orbit around it. This is called an

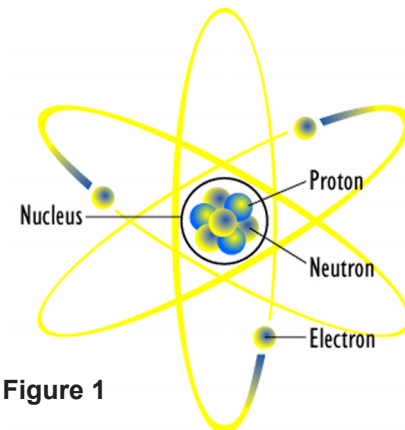


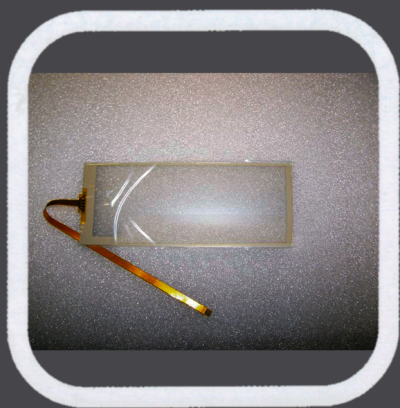
Figure 1

“electrostatic force.” Just as the planets are held in orbit around the sun by long-range force of gravity, this close-in, electrostatic force holds the electrons in orbit around the nucleus.

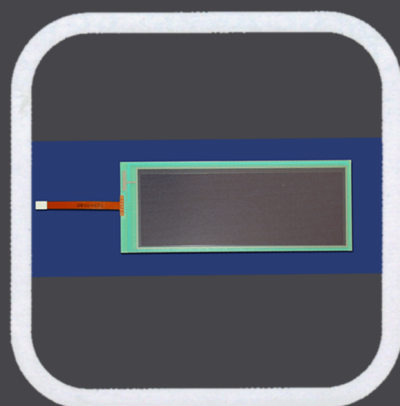
1st Law of Electrostatics . . .
Opposite charges attract and like charges (two charges that are alike) repel

This simple concept is the basis for . . . Well, EVERYTHING! The universe is held together by (among other forces) electrostatic forces, without which everything would be flying apart in an ever-expanding cosmos. The concept is simple: Opposites attract. If a positively-charged thingy is placed near a negatively charged thingy, they will be attracted toward each other, proportional to the amount of charge on each body. If two similarly-charged thingys are placed near each other, they will repel away from each other, again, proportional to the charge.

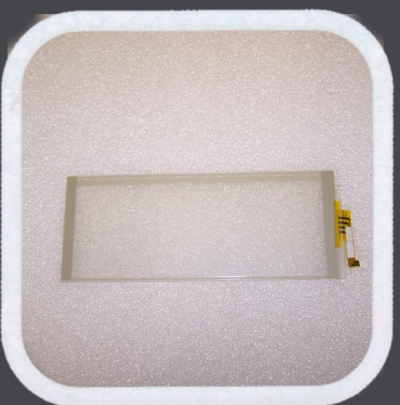
Player Tracking System LCD Display Parts



5 wire touchscreen Bally Iview
Hitachi LCD



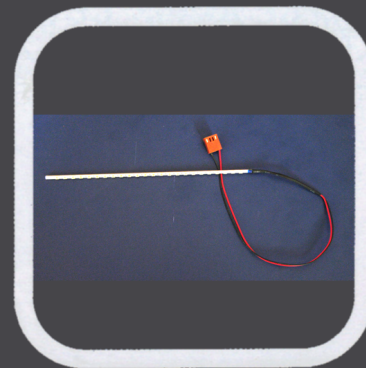
5 wire touchscreen Bally Iview IDW
LCD



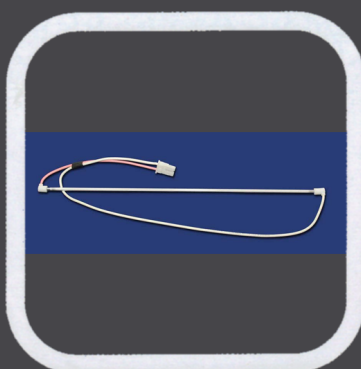
4 wire touchscreen IGT NexGen
LCD



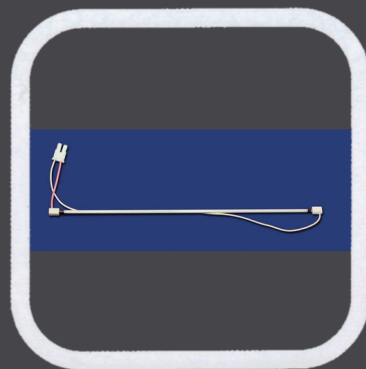
LED Strip for Bally Iview LCD



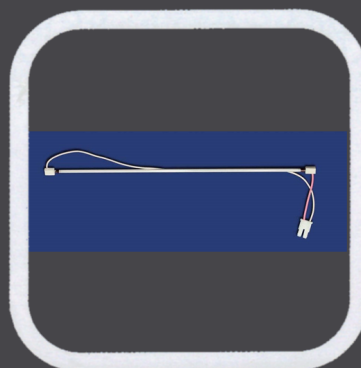
LED Strip for IGT NexGen LCD



CCFL assembly for Bally Iview
IDW LCD



CCFL assembly for IGT NexGen
LCD



CCFL assembly for Bally Iview
Hitachi LCD



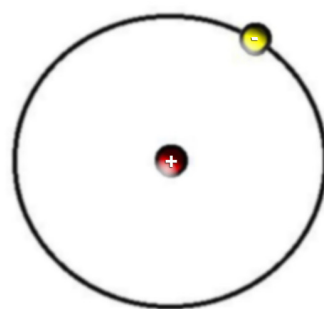
Protective Mylar for IGT NexGen
LCD



It is interesting (and important) to note that the positive charge of a proton is precisely equal (in “strength” I suppose) to the negative charge of an electron but with opposite polarity. In other words, if we could somehow mash the two particles together into one (we cannot) they would completely and totally neutralize each other leaving no remainder.

It is the number of protons in the nucleus that determine what the element is (fig.2.) The atom on the left has just one proton. This is hydrogen. The atom on the right has two protons. This is the element Helium. Notice that there are the same number of electrons in orbit as there are protons in the nucleus. This atom is said to be balanced, meaning that it is electrically balanced with an equal number of positively-charged protons and negatively-charged electrons.

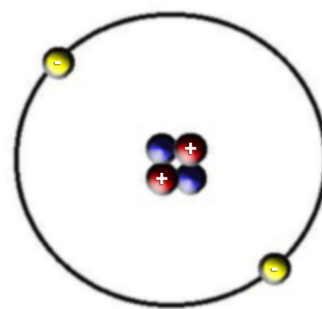
Figure 3 shows the lithium atom. Lithium has three protons in the nucleus so we need three electrons in orbit in order for this atom to be balanced. However, each electron shell is limited as to the number of electrons it can hold. This makes sense as there is less room in a smaller, closer shell than there is in an orbit that is further away from the nucleus. The maximum number of


Figure 2 Hydrogen



 **PROTON** (positively charged)
 **NEUTRON** (neutral)

Helium



 **ELECTRON** (negatively charged)

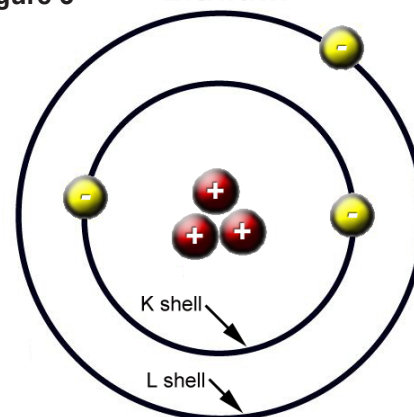
electrons for the inner shell is just two, (the next shell out can hold eight, the next 18, then 32 and so on) so the third electron is bumped up to a orbit that is outside the first shell.

From the Wikipedia: The electron shells are labeled K, L, M, N, O, P, and Q; or 1, 2, 3, 4, 5, 6, and 7; going from innermost shell outwards. Electrons in outer shells have higher average energy and travel farther from the nucleus than those in inner shells. This makes them more important in determining how the atom reacts chemically and behaves as a conductor, because the pull of the atom’s nucleus upon them is weaker and more easily broken. In this way, a given element’s reactivity is highly dependent upon its electronic configuration.

So getting back to Lithium, we now have an electron that’s by itself in an outer orbit (the L shell). This “loner” electron is further away and less strongly bound to the nucleus and

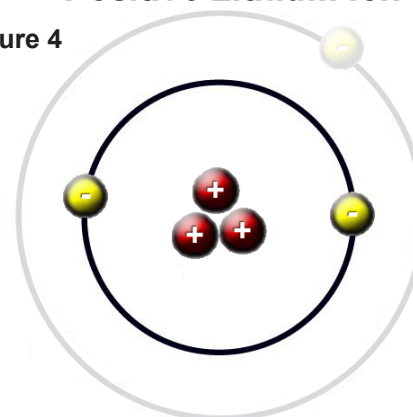
Figure 3

Lithium



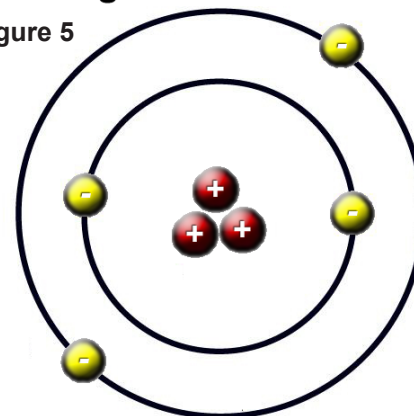
Positive Lithium Ion

Figure 4



Negative Lithium Ion

Figure 5





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is easily pushed out of orbit. As far as we are concerned as electronic technicians, there are three things that can accomplish this: Heat (just heating up an atom can cause its electrons to fly out of orbit), light (we use light-operated electronics, AKA “opto-electronics” a lot in the casino business) or an applied field (such as a magnetic field or an electrostatic field).

When this happens (when it loses an electron) the atom is no longer balanced. It has a net positive charge because there are now more protons than electrons (fig.4.) We give this unbalanced atom a new name. We now call it an ion. Further, we now call this a “positive ion” because there are three protons in the nucleus (remember, the number of protons in the nucleus determines the type of element) for a +3 charge but only two electrons for a -2 charge. The net charge is $+3-2=+1$. Another (more proper) term for a positive ion is “cation” (pronounced “kat ion” not “kay shun” as you might think if you were following normal rules of English pronunciation). It was discovered and named by famous English physicist Michael Faraday.

From the Wikipedia: A cation (+) (/Èkæt.aj.Yn/KAT-EYE-YN), FROM THE GREEK WORD (katá), meaning “down,” is an ion with fewer

electrons than protons, giving it a positive charge.

Sometimes the electron in the outer shell can ask a fellow electron to join him in the outer orbit. When this happens, the atom has a net negative charge and we now call it a “negative ion” or “anion” (again, named by Faraday). There are three protons for a +3 charge, and four electrons for a -4 charge. $+3-4=-1$.

From the Wikipedia: An anion (“) (/Èæn.aj.Yn/an-eye-Yn), from the Greek word (ánM), meaning “up,” is an ion with more electrons than protons, giving it a net negative charge (since electrons are negatively charged and protons are positively charged).

So, by definition, we can have “balanced atoms” with the same number of protons as electrons (giving the atom a neutral charge), we can have “cations” that have lost an electron (giving them a positive charge) and we can have negatively charged “anions” that have gained an extra electron.

Author’s Note: For the purist who is familiar with electronics, the following description is based upon the “conventional current” description of electric current flow. Yes, I understand “electron flow” but for this discussion, “conventional current” is all we need and is, IMHO, the

easiest way to understand this. If none of this paragraph makes sense to you, please don’t worry about it. Thanks.

I think you can see where this is going. The “cathode” is the thingy where the cations live. It is the thingy that that emits electrons. By emitting electrons, what’s left behind is the cation. An “anode” is a thingy that attracts electrons. Adding electrons to the mix creates anions. So, in a nutshell, cathodes emit electrons and anodes attract electrons. Another way to look at this (a more proper definition, I suppose) is that current flows OUT of the cathode and INTO the anode. This definition also satisfies the description of the PN junction of a semiconductor diode where current flows INTO the type P silicon of the anode, despite the seeming contradiction that the anode is actually made from positively-charged material, making it full of cations.

Sometimes electronics is pretty weird. This two-sided look at the actual “charge carriers” of electric current flow is certainly one of the most odd things about understanding theoretical electronics. Fortunately, as technicians we really don’t shiv a git about most of it. Regardless, it’s always nice to know what the terms mean as long as we’re going to throw them around.**STM**



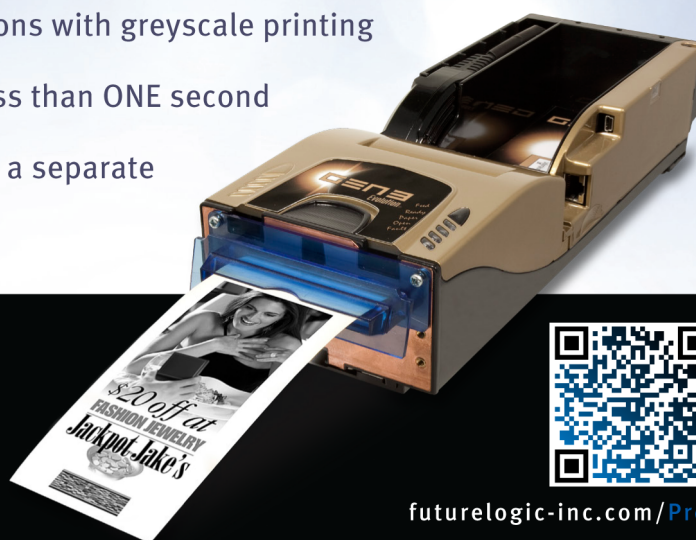
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CERTIFICATION OF VITAL RECORD

CERTIFICATE OF DEATH

Name of Deceased: **Cathode Ray Tube**

Of the many articles I've had the pleasure of writing, articles that span far and wide, which cover almost everything under the sun (and beyond) never have I had to put pen to paper to compose an obituary. It is long overdue, a sad, melancholic and even heartbreaking moment. Out of the great respect accumulated along the passage of time, I have found it more than necessary to write a few words of remembrance for the lost, but never forgotten, Cathode Ray Tube.

The majority will remember it well, while some will smile at the memory of once being the proud owners of a highly polished wooden box that housed a mysterious glass tube. This marvel of technology had the capacity, almost magical, to show a moving picture to its captive audience. The CRT gave people eyes by which to see out of their normal range of vision, even from thousands of miles away. The whole world watched and held its breath in triumph and amazement as Neil Armstrong set his first footsteps on the moon. This incredible feat, this historic conquest, this one small step for man and a giant leap for mankind, was only possible to share with everybody by means of the treasured CRT. To watch history being made right in front of everybody, in glorius black and white, was a tremendous achievement. I guess, in a way, this was also a giant leap for mankind.

The CRT was conceived as a product of technology and its wonders were enjoyed for six decades. Along the years, it became better, colorful, larger and more versatile. Ironically, it was the same sort of advancements in technology that first brought it to life, which sadly signaled its doom. Now, its thriving career has died.

We are assembled here today, technicians and not, to pay our final respects to our honored dead. The CRT has made way for a new dawn, a new beginning, a new form of superior technology that doesn't understand about flyback transformers. It doesn't understand about degaussing and it doesn't understand about scanning coils. To the layman, this was a foreign language but to those who know, a kind of warmth glowed within at being one of the select few.

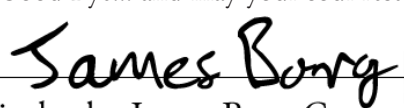
In the midst of our sorrow, wonderful memories of the CRT, will always prevail.


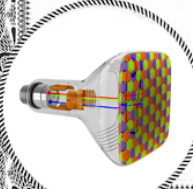
To the dedicated technicians who kept CRT video systems working, I raise my hat. Without them, any form of success these systems were destined to reach, would have quickly crumbled into a disappointing failure.

Mourned by all who cared and their faithful followers, the legacy they left behind will never wither away, and die. We will never forget the good times they gave us, and we will never forget the challenges they had thrown at us, which only sealed the tremendous bond formed between techs and CRT units. Today was never possible without yesterday, and yesterday was when the CRT ruled the Earth, just like the dinosaurs did, such a very long time ago.

They served us well, and they deserved an obituary, for which I'm grateful to Randy for giving me this opportunity.

To my almost human friend, I say, 'Good Bye... and may your soul rest in peace...'


Witnessed this day by James Borg-Coroner 638808

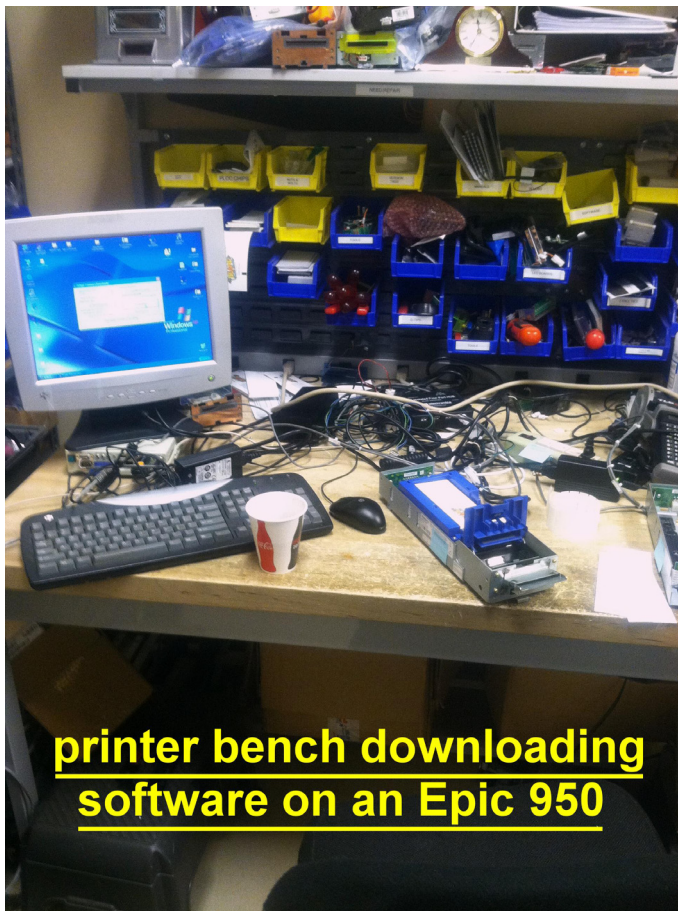


ANY ALTERATION OR ERASURE VOIDS THIS CERTIFICATE



Ithaca Epic 950 Printer "HEAD OPEN" Switch Not Working?

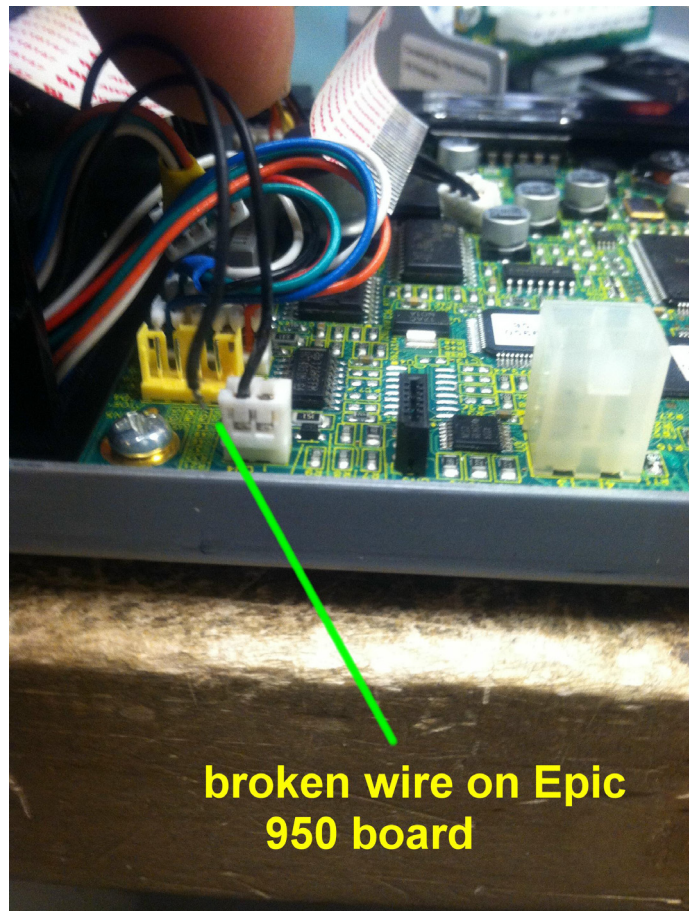
We are in the process of upgrading the firmware on our ticket printers and on one device, it wouldn't indicate a "HEAD OPEN" status (printer head open). To put the printer into "download mode," part of the setup is to open the head. For some reason, it would not show an "open" on the LED indicator. I set the printer off to the side to look at it later because I had spares to finish the task at hand. When I got back to the printer and took it apart, it was obvious what the fail-



printer bench downloading software on an Epic 950

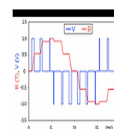
Quick & Simple Repairs #102

By Pat Porath



broken wire on Epic 950 board

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ure was. I gently pulled on a two pin connector which was for the “head open switch” and one of the wires broke right off. After the wire was repaired and the printer put back together, I did have my “print head open” indication and it worked perfectly.

Bally “Progressive Broadcast Error”

On one of our Bally progressive “Quick Hits” progressive games, a “progressive broadcast error” wouldn’t clear. A customer was paid for his credits he had remaining because none of my quick fixes worked: Rebooting the progressive SIB board, rebooting the game, reseating CAT-5 connections on the SIB, reseating the brain box and checking connections on the SIB. All kinds of red and green lights were flashing on the SIB telling me that it seemed like it was communicating. I also checked connections on the backplane board of the game. What the? I didn’t see a tech standing behind me LOL, I was told to clear RAM on the SIB. How do you do that? I couldn’t remember how at the time. Power down the board, turn DIP switch 8 ON, power up for a few seconds, then power down, turn DIP switch 8 OFF, re-apply power to the board. Next close up the game...and...bingo! Progressive error gone, game back online.



IGT AVP “Configuration Verification Required”

When the game was turned off and a ticket printer was swapped out, an error message appeared on the game

screen. It read: “configuration verification required” which is not a very good sign. All I did was turn off the game and swap the printer, what happened?

After a turn of the jackpot reset key the touch screen

calibration menu appeared. Next, a time setting appeared. It appeared the game somehow lost its configuration a.k.a. machine options. I had thought the game was an SBX one in which cabinet memory would need to be cleared, along with game software re-downloaded because it appeared it had lost the info. I called another tech to check it out because do not even have a user name or password for the SBX login screen.

Later on, I had inquired about the game because it was back up and running pretty fast. Only "USB Key 7" was needed to ENABLE the game. I guess it was "there" just not "turned on." Some of the game setup and options were lost, not all.

After the game software was set to ENABLE (and probably a few other options such as SAS, address 1, secured enhanced, ticket printer enable, and such) the game was fine.

Oasis 360 Floor Logix Showing Three Games With Problems

On the Oasis Floor Logix monitor, there are many, many things that can be seen and used for diagnostics. One of them is "serial com down." This shows if there are games that have serial communications down such as when the game is not talking TO the

Sentinel. The failure may be a loose interface cable coming from the game to the Sentinel or a loose COM board in a game or maybe a game com option that has gotten lost.

I had three games basically in the same area, two in the same bank and one on the next that were showing serial com down on Floor Logix. When taking a look at the games (IGT AVP G20s) everything looked fine. From SAS settings, nice flashing red and green LEDs on the COM board located on the backplane of the game (flashing red and green indicates transmitting and receiving data).

The Sentinel N-Compass diagnostics looked really good too. There wasn't a red or yellow border around the LCD display, which means that there has been a game COM or Sentinel COM

failure. Under the "diagnostics tab" using the mechanic card everything showed "connected" and OK, no communication errors at all. When opening and closing the main slot door it did display accordingly on the Sentinel LCD meaning I did in fact have game TO Sentinel COM. Otherwise the display would not show an OPEN and CLOSED status.

For the heck of it, I turned off game power and disconnected main 120 VAC incoming power. That totally killed the game as well as killing power to the Sentinel. I waited about 15 seconds then plugged it back in. This brought power back to the Sentinel, then game power was turned ON. Boot up appeared to be normal. Once complete, the bill acceptor lit up and all looked fine. Floor Logix was checked to see if the power

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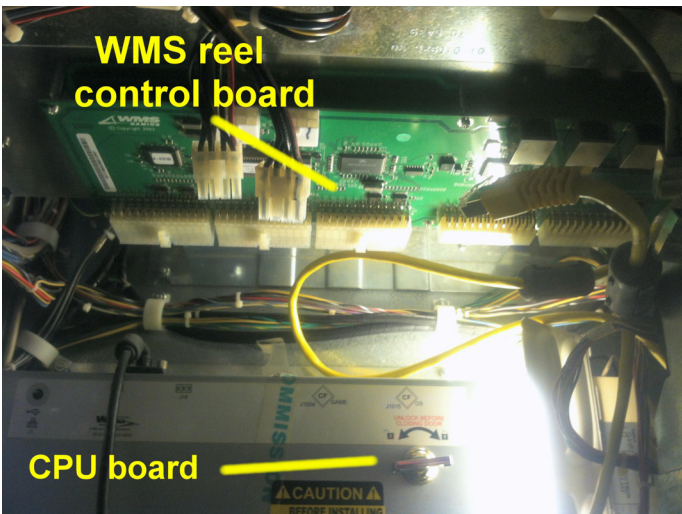
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cycle cleared the game off the screen. IT SURE DID! Doing the same procedure on the other two games worked too. Disconnecting and reconnecting the main power cord on the games did the trick.

There was one more game that appeared on Floor Logix with a communication problem but the cause was obvious. Once in a great while, an Oasis Sentinel III display will be “froze up” (stuck in one screen) or the screen will be all one color such as gray or green. A simple power cycle of the Sentinel fixes the problem the vast majority of the time, at least the ones I have run across. It worked once again with this one too.

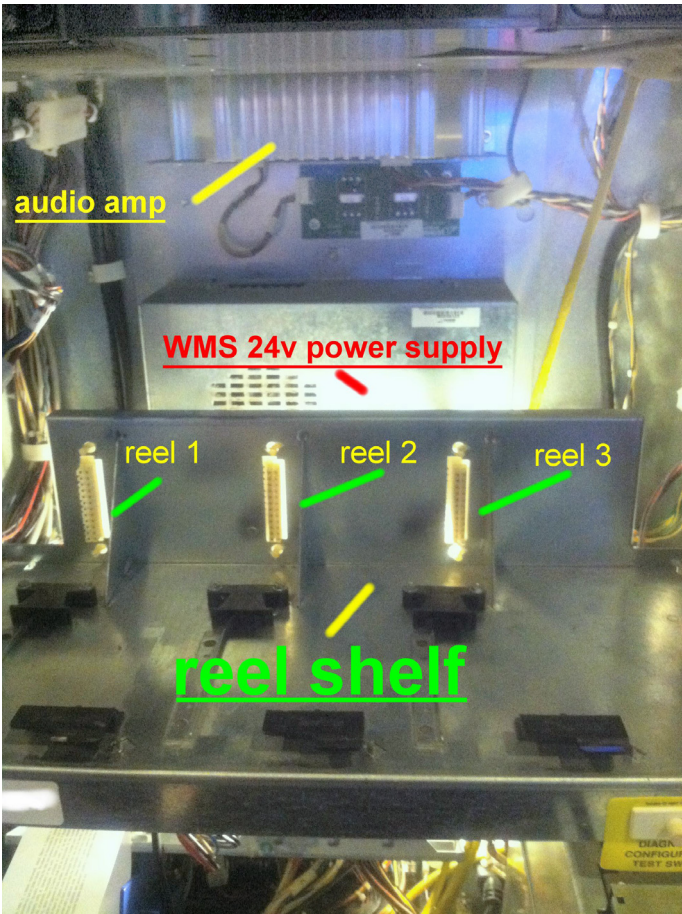
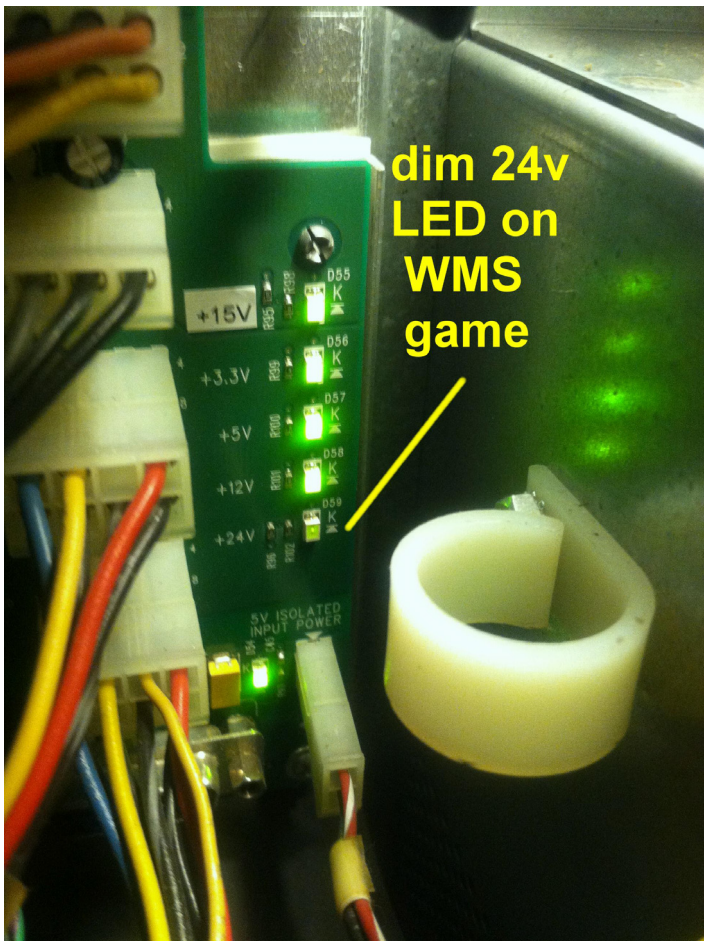
WMS BB1 24v Problem

A slot attendant was cleaning the reels on a WMS BB1 upright game when I was called over to check out the problem. I was told the reels were cleaned and the game was rebooted but the game wouldn’t come back to life. The 24v LED indicator light on



the backplane board was flickering very dimly and the ticket printer diagnostic lights were flashing weird as well (as a note, the Ithaca Epic 950 printer runs off of 24v).

On the small LCD display, a printer error appeared along with a reel tilt error. I rebooted the game only to have the same results occur. Since it appeared to be a power problem, the power supply located



on the bottom right hand side of the game was replaced. The 24v indicator light was still dim.

Next I reseated the CPU board, no fix there either. This time the ticket printer, bill acceptor, and CPU were disconnected. With all of these devices disconnected and power turned on and if I had my 24v, one of the units would be causing a power problem. In other words, if the items are out of the circuitry and the problem goes away with applied power, one of the units is causing the failure.

Even with the units disconnected, I STILL had a power issue. What the . . .?

Next, the reels were taken out and the power cable to the reel control board (located under reels) was disconnected. No luck there either.

I didn't really know which direction to head in next for troubleshooting so I had to make a phone call. I was told there was a very good chance the 24v power supply located behind the reels had failed. Unit behind the reels? I thought perhaps that the unit had something to do with the game sounds. Both a co-worker and I had never heard of that power supply failing before.

So, the power supply was rebuilt then reinstalled into the game. As soon as game

power was turned on, the 24v indicator lighted up perfectly. It wasn't dim at all. Something to keep in mind, if a BB1 is acting unusual AND has a dim voltage indicator LED on the backplane board, it may be a weak power supply behind the reels.

- Pat Porath
pporath@slot-techs.com

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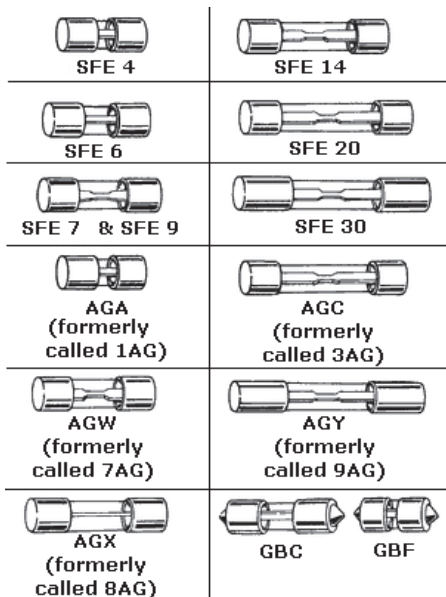
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This article is about Fuses. Those sweet little creatures that give their all to protect other circuits in the event of an over current condition. We will spend most of our time on two major types, based on popularity. There are 1/4" x 1 1/4" size, and the smaller 5mm x 20 mm size. Both come in a variety of fashions, either Fast Blow, or Slow-Blow, glass case or ceramic case. Toward the end, we will consider other current limiting safety devices.



Fuses

By Herschel Peeler



Fast Blow fuses are used to protect semiconductor circuits where excessive current is a major indication of a serious problem. Excessive current for even a short time can do major damage to semiconductor circuits, so we want the fuse to react quickly. Slow Blow fuses are used in circuits that we expect a surge of high current for a short period. With inductive devices (such as solenoids and motors) and fluorescent lamps, we expect to draw a high current for a short period of time before settling down.

Either type of fuse will sustain a slight over-current for a certain length of time. For fast blow fuses, this is more in the range of 25% over the rated value for tenths of a second. For slow blow fuses, this may be 100% over the rated value for a few seconds. In either design, the fuse is a metallic element that gets hot as current passes through it, and it melts. The element is usually some metal with a low melting point. It is normally a good practice to replace a fuse with the proper type and current

5 x 20 mm Time Lag Fuse (Slo-Blo® Type Fuse)

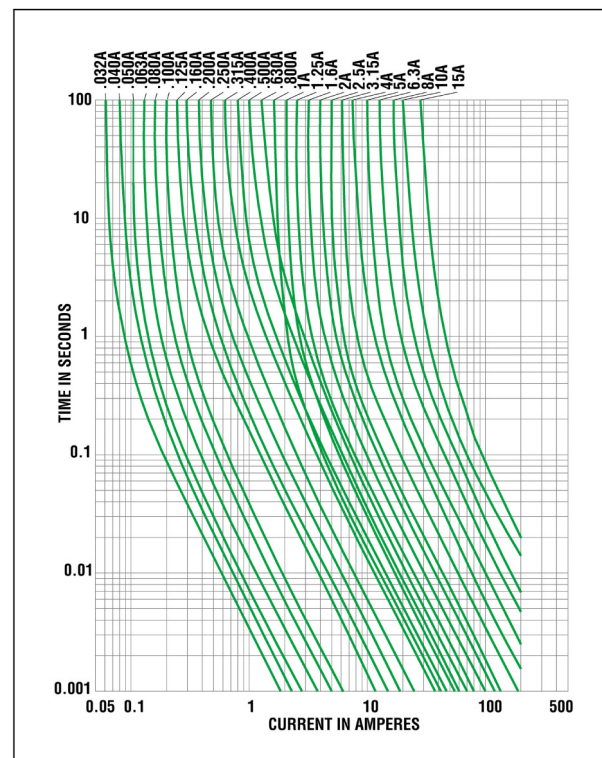
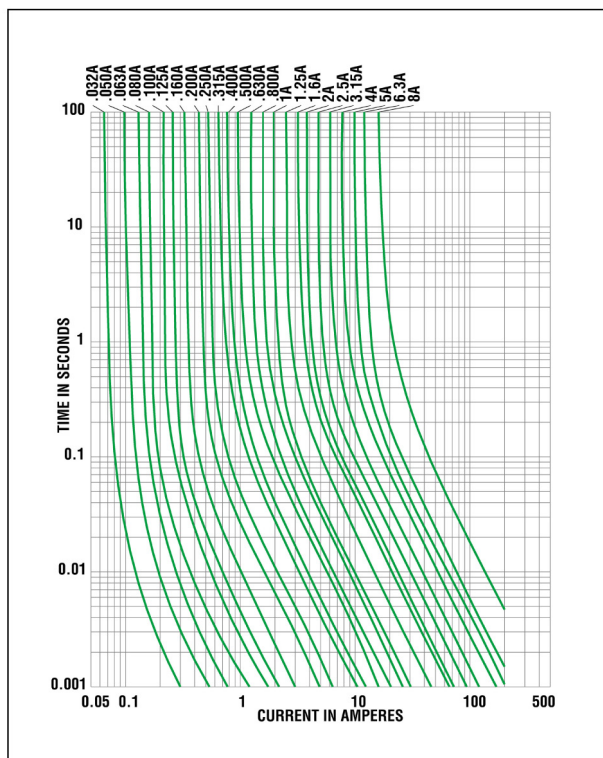
ELECTRICAL CHARACTERISTICS:

% of Ampere Rating	Ampere Rating	Opening Time
150%	.032-.100	60 minutes, Minimum
	.125-6.3	60 minutes, Minimum
210%	.032-.100	2 minutes, Maximum
	.125-6.3	2 minutes, Maximum
275%	.032-.100	0.2 sec., Min. ; 10 sec. Max.
	.125-6.3	0.6 sec., Min. ; 10 sec. Max.
400%	.032-.100	.04 sec., Min. ; 3 sec. Max.
	.125-6.3	.15 sec., Min. ; 3 sec. Max.
1000%	.032-.100	.01 sec., Min. ; 0.3 sec. Max.
	.125-6.3	0.02 sec., Min. ; 0.3 sec. Max.

Slo-Blo fuses allow a load to draw high current for short periods of time but will open circuit when time and current ratings are exceeded. Notice from this chart how a circuit might draw more than double the fuse's current rating for as long as two minutes before blowing and up to an hour at 150%!

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5 x 20 mm Time Lag Fuse



Here is another way to look at fast-acting Vs. Slo-Blo fuses. On the left is a graph of time/current for fast-acting fuses. Compare that to the graph on the right for Slo-Blo fuses. The graphs might seem a bit confusing when you first look at them but they actually make a lot of sense. Each of the curves is for a fuse of a different current rating. Just pick one of them (say, 1 amp) and ignore the rest and you'll see how the graph shows the time it takes for the fuse to blow in the vertical direction (y axis) in comparison to the amount of current drawn across the fuse by the load in the horizontal direction (x axis).

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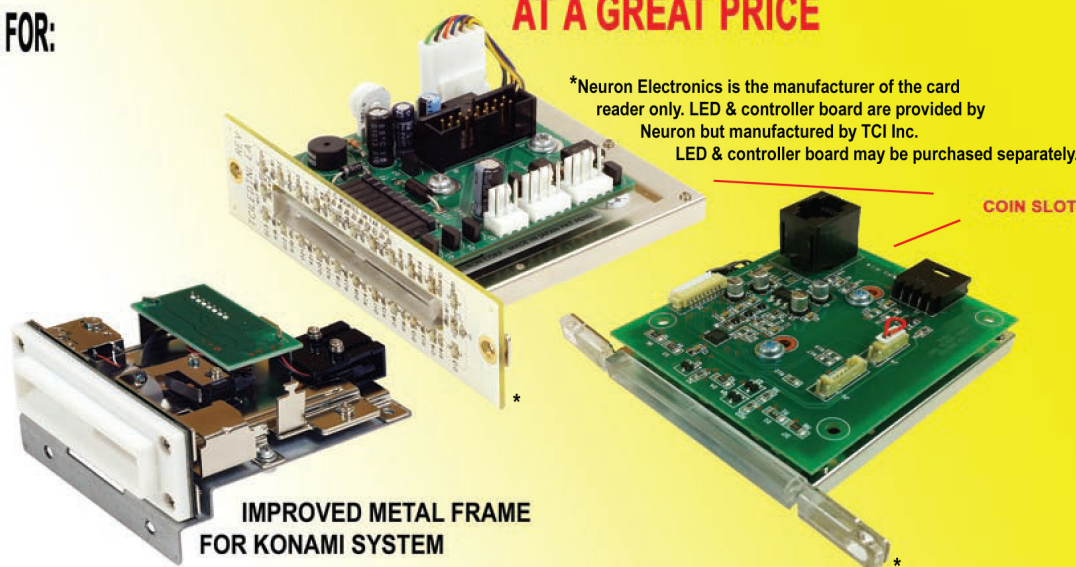
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rating. When we get around to bench troubleshooting, we may make exceptions to that policy, but not on the casino floor. In a game, always replace the fuse with the proper type.

Editor's Note: Notice Herschel said "replace the fuse with the proper type" and not "replace the fuse with the same type that came out." You are not the only technician to work on a machine. If the technician before you has used too light of a fuse (one with a lower current rating) you may find yourself chasing a problem that doesn't exist. Of course, too heavy a fuse can cause damage to a host of other components or circuitry. Always consult the fuse labels or placard if you are uncertain of the fuse rating.

There is no standard part numbering system used between the various manufacturers. Major manufacturers each have their own part numbering system, even though the fuse itself may be identical. The "Standardized Parts List" available from the Bench

Tech forum (Delphi forums) contains a cross reference to find equivalent part numbers and a description of the part. The older "American" standard part is cylindrical, and 1/4" in diameter, 1 1/4" long, with metal caps on each end. The body may be glass, or ceramic. Glass is cheaper and allows you to visually inspect the fuse. Ceramic bodies are used for higher temperature environments, usually. The more modern body style is also cylindrical shape also, but is physically smaller, 5mm x 20 mm, and also comes in glass or ceramic body styles. This style has the advantage of taking up less board space, and more popular acceptance worldwide. There is no other engineering advantage of one over the other.

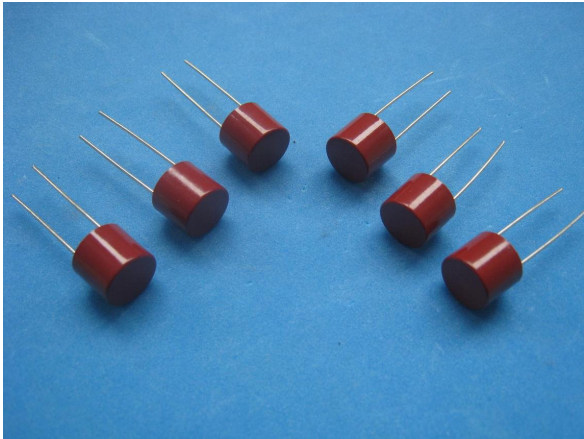
Fast blow fuses normally have a simpler internal structure than slow blow fuses. Slow-blow fuses are more complicated inside and look like springs. The objective is to have a way of dissipating the heat for a few seconds before blowing.

has literally exploded. Look for something major to be wrong. If the fuse is only open in a small point in the middle of the fuse, and sagged before finally blowing out, the problem may not be so obvious. In these cases, the over-current was marginal for an extended period of time.

Satisfying Substitutes

Fuses are not the only option for over-current problems. Circuit breakers have an advantage in that they can be reset. The disadvantage is that they are more equal in operation to slow blow fuses. It takes a while for the thermal operation of a circuit breaker to react. This is often too long for the protection of semiconductor devices. Games that use circuit breakers will also have a separate fuse in the power supply that feeds power to the logic board.

Poly fuses work much like a



Fuses look like this too!

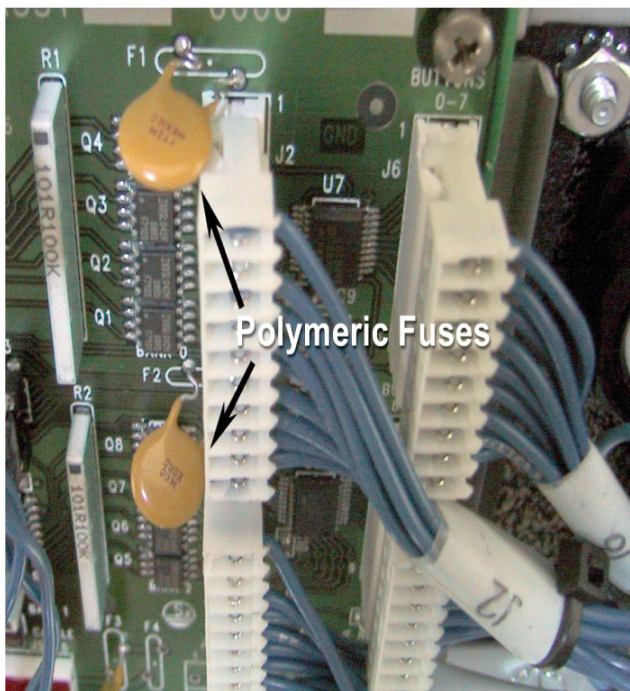
Fuse Forensics

Problems in games that cause excessive current may be extreme or marginal. In extreme cases, like a shorted capacitor or a pinched wire, the over-current is excessive. You can see that the fuse

Catalog Number	Ampere Rating	Marking Code	Voltage Rating
0466.125	.125	B	125
0466.200	.2	C	125
0466.250	.25	D	125
0466.375	.375	E	125
0466.500	.5	F	63
0466.750	.75	G	63
0466 001.	1	H	63
0466 1.25	1.25	J	63
0466 01.5	1.5	K	63
0466 1.75	1.75	L	63
0466 002.	2	N	32
0466 02.5	2.5	O	32
0466 003.	3	P	24
0466 004.	4	S	24
0466 005.	5	T	24
0466 007.	7	U	24

Cracking the Code: Here is Littlefuse's code for their SMD type 466 very-fast-acting fuses. As you can see by the letter N, we are looking at a mess of itty-bitty, 2 amp fuses on the left.

self-resetting circuit breaker. These wonderful little devices look like capacitors and act like a slow blow fuse. Many I/O boards have gone to using these to protect indi-



vidual components. Many have a poly fuse on each output line. IGT, to mention one, has done this. The advantage is that problems in one circuit will spread no further than that circuit. Polymeric fuses come in different packages. The PFSM is popular on IGT's small I/Cards.

Surface Mount Devices

As does just about everything these days, fuses also come in surface mount packages. Like everything surface mount, it's hard to tell one part from another. The cases vary in structure from "big enough to recognize as a fuse" to "just another small flat rectangle." The smaller ones are usually white, which makes them easier to recognize. The lettering may, or may not,



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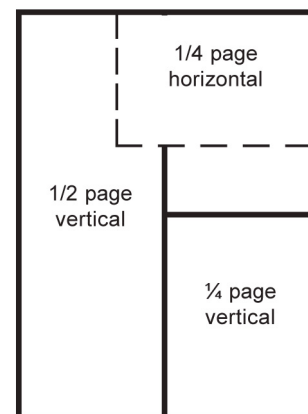
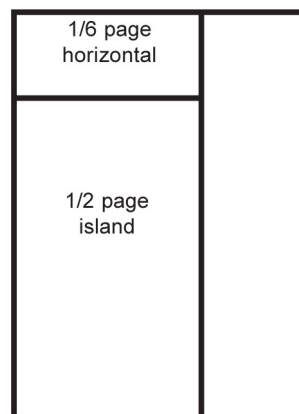
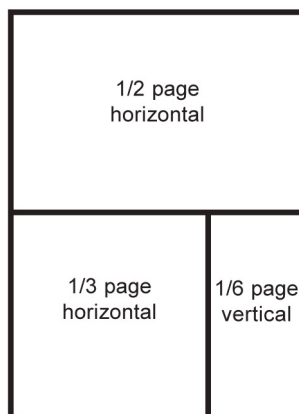
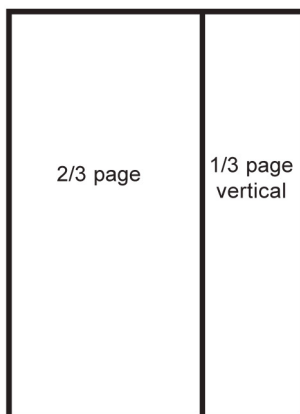
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indicate the current rating. The biggest problem with the small ones is that when they go bad, it destroys the writing on the fuse and you can't tell what amp rating it was. To make this really interesting, some people, like IGT, may use a small value resistor (10 ohms) on the board as a fuse. The wisdom is simple. Resistors cost a penny. Fuses cost a dollar. The function is the same. When enough current passes through the resistor to exceed the wattage rating of the resistor, it burns up.

Troubleshooting Boards With "Bad Fuse" Problems

As mentioned earlier, always replace a fuse with one of the same type, unless... Well, here's the exception. Given the example of a bad Door I/O card on an IGT 960series game. The "fuse" (a 10 ohm surface mount resistor) has gone up in smoke. Suspected problem is a shorted cap or smoked IC. No visual damage other than the "fuse" is obvious. The fuse has done its job and given up its existence to protect the board. The obvious thing is to throw the board away and buy another. BUT NO!!! We have to be technicians and fix this puppy. We replace the "fuse" with a small piece of wire and apply power again, keeping our finger on the power switch. Not having the safety net of the fuse, the shorted capacitor now overheats, turns brown, and gets real hot. We quickly

turn power off and replace the bad capacitor and the fuse. For \$0.10 worth of parts and ten minutes of work, we repaired a \$100 board. I think that is worth it. As with any "break the rules" remedy, we stand the chance of doing damage to the board. Such extreme current required to smoke a bad cap or IC can destroy the circuit board as well. Tiny traces that make up the circuit are easily destroyed. But the board is already considered bad and is written off. We are talking about ten minutes of time and a few pennies worth of parts in an attempt to avoid a \$100 loss. I have about a 90% success rate finding bad caps with this method.



Fuses come in ceramic as well as glass. No, it's not just to make your life more difficult. These are high current, high voltage, "nonexplosive" types.

- Herschel Peeler
hpeeler@slottechs.com



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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.***

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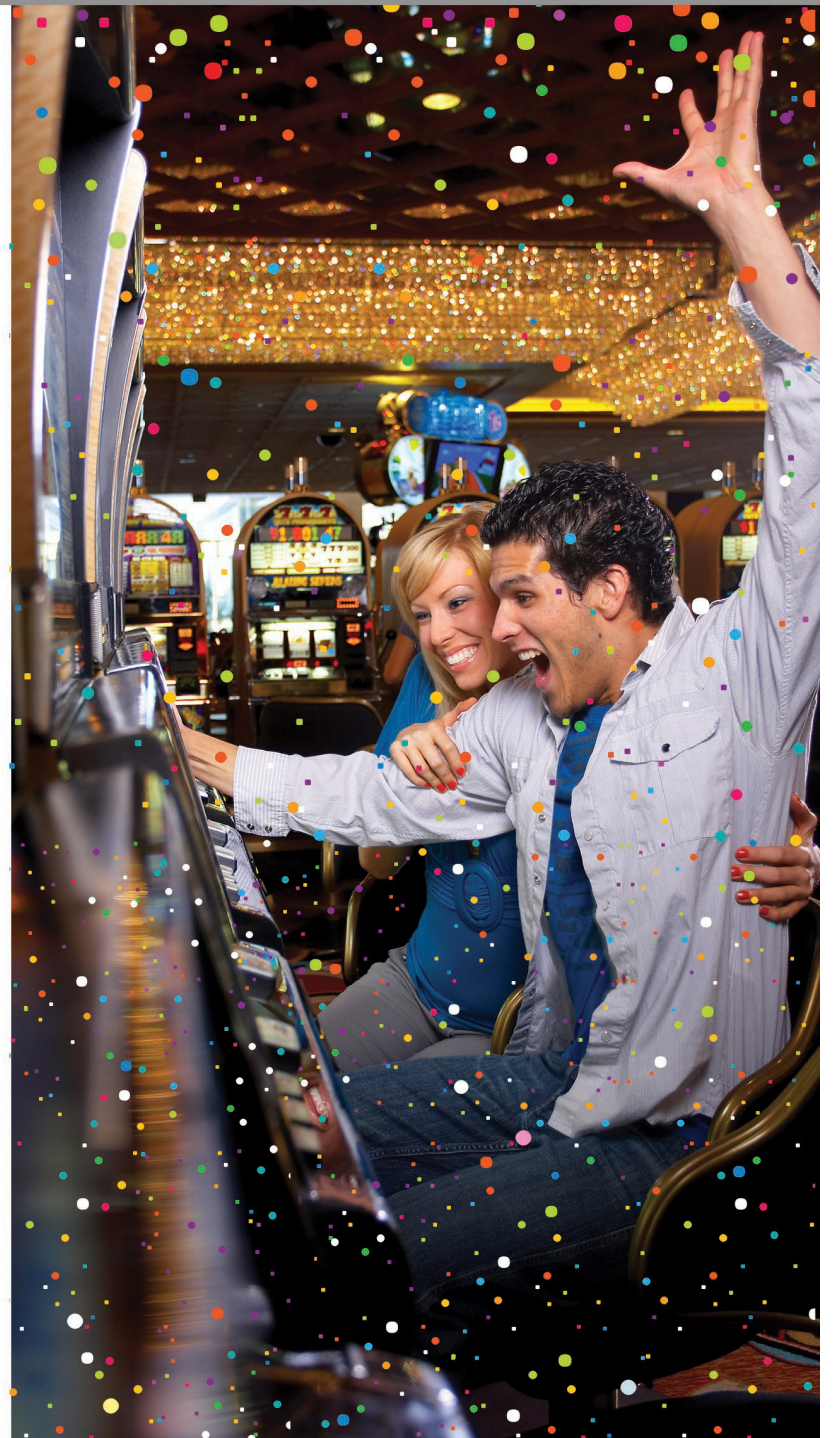


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