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November 2008

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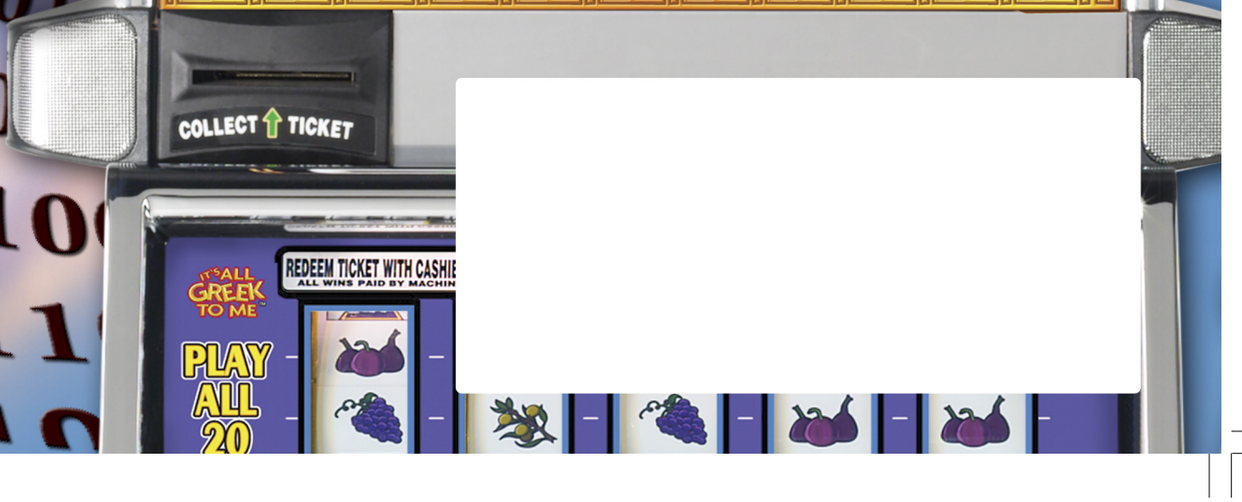

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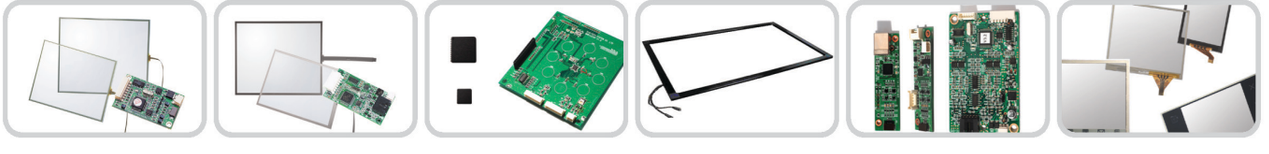

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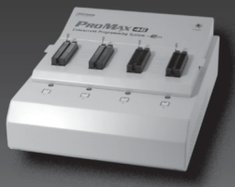

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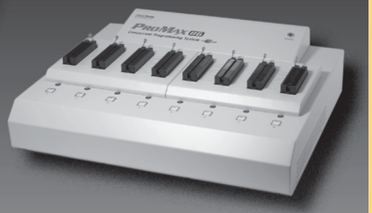

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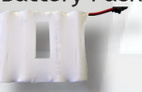

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Inside Slot Tech Magazine

November 2008

Dear Readers,

Hello to the 3000 of you that picked up this magazine at the Global Gaming Expo. That's how many copies of Slot Tech Magazine are slated for distribution at the show, anyway. We didn't do anything special for this "show" issue. It's really pretty typical of what Slot Tech Magazines brings to our readers each month. It's sort of a mix of new products, slot-related products and slot repair, the raison d'être of Slot Tech Magazine. We are dedicated to technical education and training for slot machine technicians, from the novice floor tech to the experienced bench tech who is looking to pick up on a few new techniques.

Some of those experienced and talented slot techs are our contributing writers. Our technical articles are penned by working technicians and engineers in the gaming industry. Some work in casinos from across the globe. Others work for slot machine manufacturers or the makers of peripheral devices such as bill validators, ticket printers, coin validators and monitors. Readers are guaranteed to stay informed with accurate technical information.

This month, Slot Tech Magazine takes a look at a remarkable new piece of hardware, a Quantum Random Number Generator that uses individual photons in a sort of random coin toss to determine the output. Along the way, you'll learn a bit about random numbers, a subject we've covered many times before.

There is more, of course, including perennial favorite Pat Porath with his "Quick & Simple Repairs."

Enjoy the Expo. See you at the casino.

Randy Fromm

Randy Fromm - Publisher

On the cover: IGT's "It's All Greek To Me" seems a suitable tribute to the complex world of random numbers in this month's look at quantum random number generation hardware. Please note that this does not mean to imply the the unit is or is not in use by IGT in any way. It's just a nice picture of a really nice looking IGT slot machine, gracing the cover of a magazine for the gaming industry's technical community.

Randy Fromm

Randy Fromm's
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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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Quantum Random Number Generation

I get a laugh at self-proclaimed "experts" that claim to know all about slot machines and how they operate. If they are intelligent enough to get beyond the part where they talk about the "dial" inside the machine that the technician turns when the casino needs to make more money (http://tinyurl.com/3jcnkc) they will invariably begin the discussion by saying something like "there is a random number generator inside there." They generally aren't very specific about what it looks like exactly or where this RNG lives exactly or how it works exactly or how the random numbers are applied exactly but they are certain of its existence. Of course, you could look all over the parts list and examine every integrated circuit on the CPU of a modern slot machine but there just isn't a single part called the RNG.

Or is there? There might be. The complex algorithms of pseudo-random number generation that are the basis of modern slot math may be a thing of the past, replaced by a piece of hardware that generates a truly random output, the Quantum Random Number Generator. Disc Jockey Alan Freed coined the phrase "Rock and Roll" and it stuck so I'm going to go out on a limb and call this the "Quarange." Remember folks, you heard it here first. If it catches on, the English language will finally have a word that rhymes with "orange."

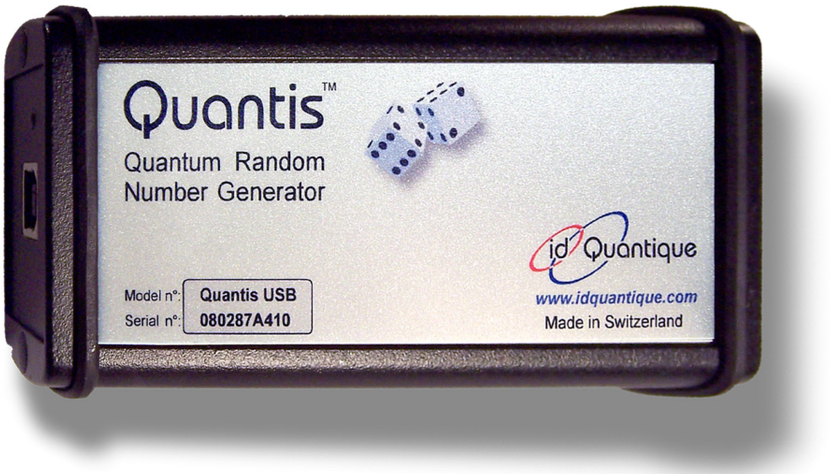
All kidding aside, the generation of truly random numbers plays a critical role in the gaming industry, where high-quality random numbers are absolutely vital. As we move into the server-based gaming environment, the need for randomness expands out of the secure, "locked in a cage" world of the slot machine into cryptographic requirements as well.

Applications of Random Numbers

Random numbers are useful in countless applications, which have evolved over time. With the expansion of computers fields of use and the rapid development of electronic communication networks in the past fifty years, the number of such applications is growing quickly. The following subsections non-exhaustively list examples of such applications.

Cryptography

Cryptography can be defined as "the art and science of keeping messages secure." It consists of algorithms and protocols that



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can be used to ensure the confidentiality, the authenticity and the integrity of communications. Cryptographic algorithms come in a variety of flavors. Some are difficult to crack but make substantial demands to processing power and key management. Others are easier to crack but less demanding and therefore better suited for some applications. All strong cryptography requires true random numbers to generate keys but how many depends on the encryption scheme. The strongest possible method, One Time Pad (OTP for short) encryption, is the most demanding of all; it requires as many random bits as there are bits of information to be encrypted. Many security applications have failed or been severely compromised because their random number generators failed to be sufficiently random.

Confidentiality

In order to guarantee the confidentiality of a message, the sender combines the plain text with a key using an encryption algorithm to obtain the cipher text. This cipher text is then sent over an insecure communication channel to the recipient, who uses a decryption algorithm and a key to unscramble it and recover the plain text. In an ideal cipher system, it is impossible for an eavesdropper to decrypt the cipher text without the key.

The strength of a cipher system ultimately depends on the strength of the key used or equivalently on the difficulty for an eavesdropper to guess it. This difficulty clearly increases with the key length – typical key sizes currently in use are 56 bits (DES), 168 bits (3-DES) and 256 bits (IDEA or AES) – and its unpredictability, which is a function of the randomness of the number used to generate the key. Consequently, it is essential to use sufficiently long and truly random numbers for key generation.

Authentication

Authentication is essential, when a client logs on to a server, to ensure that he is actually authorized to access the data. In order to illustrate the use of random numbers in authentication, one example of a protocol is schematically described.

The simplest possibility for a client to authenticate itself would be to send his password to the server. Doing this is however dangerous, because the password travels over the network and can be intercepted. In order to avoid this, the server, which keeps a copy of all the passwords, sends a message containing a random number to the client. The client calculates a function of this message and his password, and sends the result back to the server. The server compares this result with the value it computed itself using a copy of the password.

The fact that the message sent by the server to the client contains a random number that is never reused, prevents a so-called replay attack, where an adversary would record the authentication messages and resend them to the server, every time it wants to log on. Note that in this scheme, the password is never sent across the network.

Although authentication schemes are in practice more complex, they often use random numbers.

Scientific Calculations

Scientists have devised techniques relying on random numbers to model and simulate complex systems. These techniques are fast and yield high accuracy results. They are essential for modern numerical simulations and especially important in games of chance where it must not be possible for a player to increase his probability to win by discovering a bias towards certain outcomes in the game procedure. Modern slot machines are based on the use of random numbers to guarantee a uniform winning probability. However, as we have seen in past discussions here in

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Slot Tech Magazine (March 05) computers can't actually produce random numbers. They produce, instead, pseudo-random numbers that are all-but-completely random and, at the same time, totally unpredictable. In the gaming industry, we have to be satisfied with unpredictability but guaranteed randomness would be better.

What is a Random Number?

Although it may look simple at first sight to give a definition of what a random number is, it proves to be quite difficult in practice. A random number is a number generated by a process, whose outcome is unpredictable and which cannot be sub sequentially reliably reproduced. This definition works fine provided that one has some kind of a black box – such a black box is usually called a random number generator – that fulfills this task. However, if one were to be given a number, it is simply impossible to verify whether it was produced by a random number generator or not. In order to study the randomness of the output of such a generator it is absolutely essential to consider sequences of numbers.

It is quite straightforward to define whether a sequence of infinite length is random or not. This sequence is random if the quantity of information it contains – in the sense of Shannon's information theory – is also infinite. In other words, it must not be possible for a computer program, whose length is finite, to produce this sequence. Interestingly, an infinite random sequence contains all possible finite sequences. Such an infinite sequence does for example contain the Microsoft Windows source code or the text of the Geneva conventions. Unfortunately, this definition is not very useful, as it is not possible in practice to produce and process infinite sequences. In the case of a finite sequence of numbers, it is formally impossible to verify whether it is random or not. It is only possible to check that it shares the statistical properties of a random sequence – like the equiprobability of all numbers – but this a difficult and tricky task. To illustrate this, let us for example consider a binary random number generator producing sequences of ten bits. Although it is exactly as likely as any other ten bits sequences, 1 1 1 1 1 1 1 1 1 1 does look less random than 0 1 1 0 1 0 1 0 0 0. In order to cope with this difficulty, definitions have been proposed to characterize "practical" random number sequences. One is that "a sequence of random numbers is a sequence of independent numbers with a specified distribution and a specified probability of falling in any given range of values." Another is that "it is a sequence that has the same statistical properties as random bits, is unpredictable and cannot be reliably reproduced." A concept that is present in both of these definitions and that must be emphasized is the fact that numbers in a random sequence must not be correlated. Knowing one of the numbers of a sequence must not help predicting the other ones. Whenever random numbers are mentioned in the rest of this article, it will be assumed that they fulfill these "practical" definitions.

Testing Randomness

Statistical randomness tests aim at determining whether a particular sequence of numbers was produced by a random number generator. The approach is to calculate certain statistical quantities and compare them with average values that would be obtained in the case of a random sequence. These average values are obtained from calculations performed on the model of an ideal random number generator.

Testing randomness is an empirical task. There are numerous tests, each one of them revealing a particular type of imperfection in a sequence. One example is the frequency test. In the case of binary sequences, it focuses on the relative frequency of 1s with respect to 0s. The autocorrelation test, which investigates

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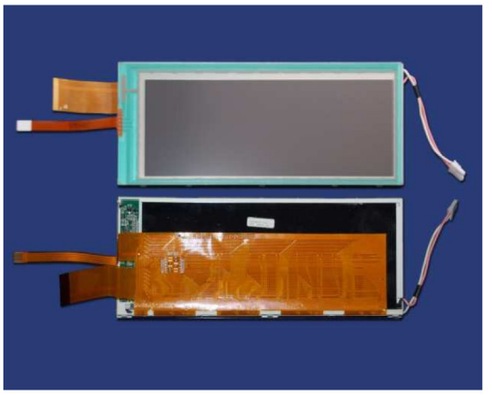

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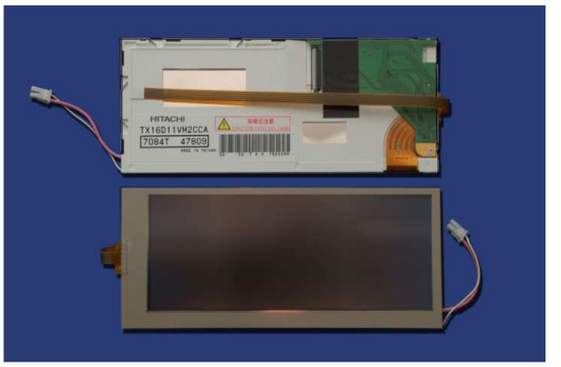

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correlations between adjacent bits, is another example. We are all familiar with data compression. If a given sequence can be compressed, then it is not random.

Because of the difficulty of defining what a random number is, it is essential to choose an adequate generator to produce these numbers. Moreover, it is safer to have a good understanding of the underlying randomness generating process.

Generating random Numbers

A random number generator is a device that produces sequences of numbers complying with the definitions mentioned previously. There exist two main classes of generators: software and physical generators. From a general point of view, software generators produce so-called pseudo random numbers. These two classes, as well as their respective advantages, are discussed below.

Software Solutions

Computers are deterministic systems. Given a certain input, a program will always produce the same output. Because of this very fundamental property, it is impossible for a program to produce a sequence of random numbers. The sequence may have some of the properties of a random sequence (and thus pass some statistical randomness tests) but it is always possible to reproduce it. As the sequences they produce look like random sequences, these generators are called pseudorandom number generators. It is however clear that they do not fulfill the definitions given at the beginning of this article.

Pseudo-random number generators consist of an algorithm into which some initial value – it is called the seed – is fed and which produces by iteration a sequence of pseudo-random numbers. Again, we have covered this previously in Slot Tech Magazine. Although their period can be made very long, the sequence produced by such a generator is always periodic. When working with large sets of random numbers or long sequences, it is important to verify that the period is large enough. One of the properties of the sequences produced in this way is that, as soon as one element of the sequence is known, all the other elements of the sequence, both preceding and following, can be determined. It is immediately obvious that this property is especially critical when such numbers are used in cryptography for key generation. The sequences produced by a good pseudo-random generator initialized with an appropriate seed, pass most statistical tests. However, it is also important to realize that if the sequence considered is long enough, it will always fail at least some tests, because of periodicity.

One important issue when using pseudo-random number generators is the choice of the seed value. If one does not want to continuously cycle through the same sequence, it is essential to change periodically the seed value. How should this seed value be chosen? Ideally, it should be random. As a pseudo-random generator is used, it is likely that no random number generator is available. It is a Catch-22 situation. A solution, which is not always satisfactory, is to use entropy gathering. System information – the clock, the time interval between button presses, etc - is combined to produce a seed. This technique however requires extreme caution.

A security problem encountered by Netscape with its browser in 1995 illustrates the risks associated with the use of pseudo-random numbers in cryptography. At the time, the web was full of promises for online commerce and Netscape had developed a protocol, called SSL and still in use today, to secure communications over the web. Like in the case of other cryptographic protocols, the security of SSL crucially depends on the unpredictability of the key. The company implemented this protocol in its browser, but relied on a pseudo-random number generator

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for key generation. Two Berkeley graduate students reverse-engineered the code of the browser and revealed a serious security flaw. They noticed that the seed used by the pseudo-random number generator depended on the time of the day and some system information (the process ID and the parent process ID). They showed that it was relatively easy to guess these quantities, and thus to reduce the number of possible keys that one should try to crack the protocol. This attack reduced the time for a brute force attack of the protocol from more than thirty hours to a few minutes, and as little as a few seconds in some special cases. This security flaw illustrates why pseudorandom number generators are usually considered inappropriate for high-security cryptographic applications.

In spite of the fact that they do not produce random numbers, these generators do have an advantage in that their cost is virtually zero, as they can be implemented in software and numerous libraries are freely available. This reason, in addition to the lack of good physical random numbers generators, is why these generators are widely used in slot machines.

Physical Sources of Randomness

In applications where pseudo-random numbers are not appropriate, one must resort to using a physical random number generator. When using such a generator, it is essential to consider the physical process used as the randomness source. This source can be either based on a process described by classical physics or by quantum physics. Classical physics is the set of theories developed by physicists before the beginning of the twentieth century and which describes macroscopic systems like falling coins. Quantum physics is a set of theories elaborated by physicists during the first half of the twentieth century and which describes microscopic systems like atoms or elementary particles. Some examples of generators based on each of these theories, along with their advantages, are presented below, after a brief discussion of biased random number sequences.

Biased and unbiased sequences

A problem encountered with physical random number generators is their bias. A binary generator is said to be biased when the probability of one outcome is not equal to the probability of the other outcome. Bias arises because of the difficulty to devise precisely balanced physical processes. It is however less of a problem than one might expect at first sight. There exist some post-processing algorithms that can be used to remove bias from a sequence of random numbers. The simplest of these unbiasing procedures was first proposed by John Von Neumann. The random bits of a sequence are grouped in subsequences of two bits. Whenever the two bits of a subsequence are equal, it is discarded. When the two bits are different and the subsequence starts with a 1, the subsequence is replaced by a 1. When it starts with a 0, it is replaced by a 0. After this procedure, the bias is removed from the sequence.

The cost of applying an unbiasing procedure to a sequence is that it is shortened. In the case of the Von Neumann procedure, the length of the unbiased sequence will be at most 25% of the length of the raw sequence. It was mentioned above that randomness tests basically all amount to verifying whether the sequence can be compressed. An unbiasing procedure can be seen as a compression procedure. After its application, the bias is removed and no further compression is possible, guaranteeing that the sequence will pass the tests. Other unbiasing procedures exist as well.


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Processes Described by Classical Physics – Determinism Hidden Behind Complexity

Macroscopic processes described by classical physics can be used to generate random numbers. The most famous random number generator, coin tossing, belongs to this class. However, it is very important to realize that classical physics is fundamentally deterministic. The evolution of a system described by classical physics can be predicted, assuming that the initial conditions are known. In the case of a coin, a physicist knowing precisely its weight, its initial position, the force applied to it by the hand, the speed of the wind, as well as all the other relevant parameters, should in principle be able to predict the outcome of the throw. Why is that, that in practice this prediction is not possible? Coin tossing is a chaotic process. Chaos is a type of behavior observed in systems whose evolution exhibits extreme sensitivity to initial conditions. Coin tossing is not the only physical system with chaotic evolution. Turbulences in a flow (turbulences in a lava lamp have been used to generate random numbers) or meteorological phenomena are good examples of chaotic systems. The evolution of these systems is so sensitive to initial conditions that it is simply not possible to determine them precisely enough to allow reliable prediction of future transformations. In spite of its popularity, coin tossing is clearly not very practical when many random events are required. Other examples of physical random number generators based on chaotic processes include the monitoring of an electric noise current in a resistor or in a Zener diode. Formally the evolution of these generators is not random, but just very complex. One could say that determinism is hidden behind complexity.

Although their random numbers are likely to pass randomness tests, these generators are difficult to model. This means that it is impossible to verify, while acquiring numbers, that they are operating properly. In addition, it is difficult to ensure that the system is not interacting (even in a subtle way) with its environment, which could alter the quality of its output.

Processes Described by Quantum Physics – Randomness Revealed by Simplicity

Contrary to classical physics, quantum physics is fundamentally random. It is the only theory within the fabric of modern physics that integrates randomness. This fact was very disturbing to physicists like Einstein who invented quantum physics. However, its intrinsic randomness has been confirmed over and over again by theoretical and experimental research conducted since the first decades of the twentieth century. When designing a random number generator, it is thus a natural choice to take advantage of this intrinsic randomness and to resort to the use of a quantum process as source of randomness. Formally,

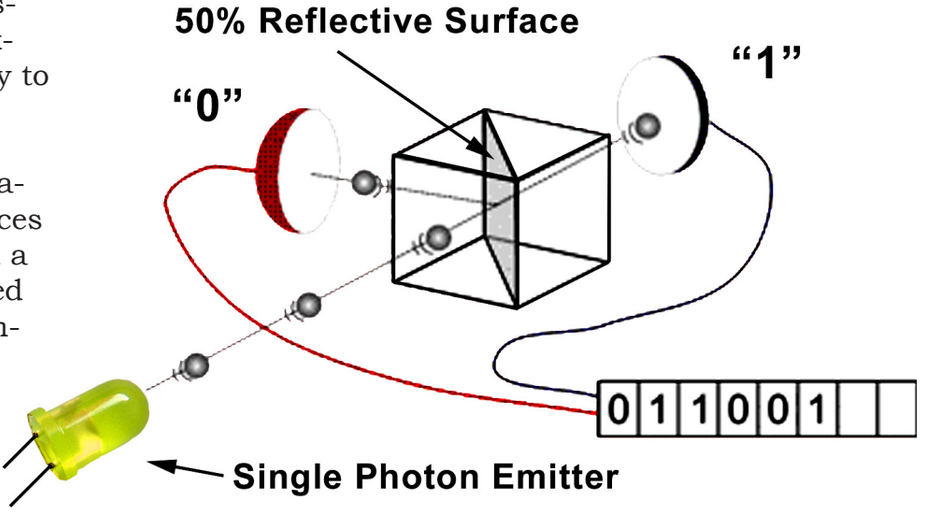


FIGURE 1 - How it works: A single photon is emitted. It will either pass through or reflect off a 50% reflective surface and enter one of two single photon detectors, creating a random 1 or 0.

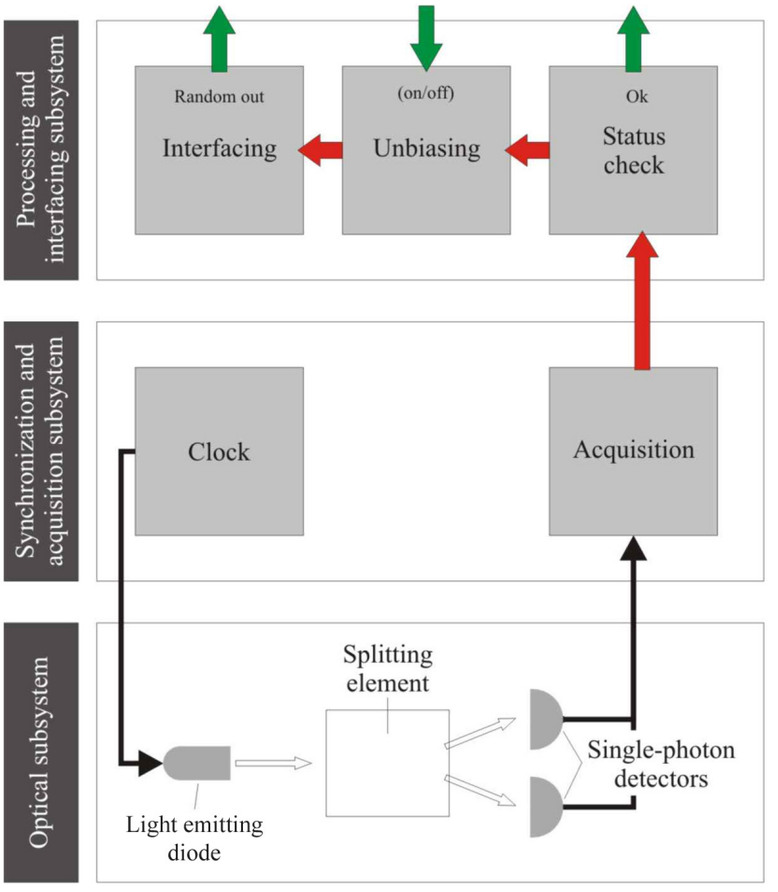
quantum random number generators are the only true random number generators. Although this observation may be important in certain cases, quantum random number generators have other advantages. This intrinsic randomness of quantum physics allows selecting a very simple process as source of randomness. This implies that such a generator is easy to model and its functioning can be monitored in order to confirm that it operating properly and is actually producing random numbers. Contrary to the case where classical physics is used as the source of randomness and where determinism is hidden behind complexity, one can say that with quantum physics randomness is revealed by simplicity.

Until recently the only quantum random number generators that existed were based on the observation of the radioactive decay of some element. Although they produce numbers of excellent quality, these generators are quite bulky and the use of radioactive materials may cause health concerns. The fact that simple and low cost quantum random number generators did not exist prevented quantum physics from becoming the dominant source of randomness.

The Quantis Quantum Random Number Generator

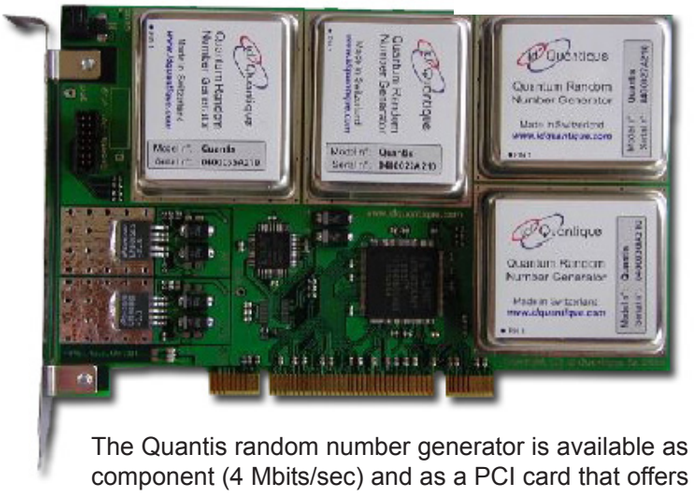
Quantis is quantum random number generator exploiting an optical quantum process as its source of randomness. It uses quantum physics to produce a high bit rate of 4 to 16 Mbits/sec of truly random bits. Optics is, of course, the science of light. The use of optical components is nothing new to the gaming industry where they are used as sensors and isolators. From a quantum physics point of view, light consists of elementary "particles" called photons. Photons exhibit in certain situations a random behavior. One such situation, which is very well suited to the generation of binary random numbers, is the transmission upon a semi-transparent

mirror. The fact that a photon incident on such a component be reflected or transmitted is intrinsically random and cannot be influenced by any external parameters. Figure 1 schematically shows this optical system. Figure 2 shows the block diagram of the Quantis random number generator. It consists of three subsystems. The first one is the core of the generator and contains the optical elements that are used to implement the random process and produce the random outcomes. It comprises a light emitting diode producing the photons, a transmission element, where the random process takes place, and two single-photon detectors (detectors with single-photon resolution) to record the outcomes. The optical subsystem is controlled by a synchronization and acquisition electronic circuit. This subsystem comprises a clock and triggering electronics for the photon source, as well the acquisition electronics for the single-photon detectors. The processing and interfacing subsystem perform statistical and hardware checks, as well as unbiasing of the sequence. This subsystem also shapes the output electronic signals.



Unbiasing of the Random Numbers

As mentioned above, physical processes are difficult to precisely balance. It is thus difficult to guarantee that the probability of recording a 0, respectively a 1, are exactly equal to 50%. With Quantis, the difference between these two probabilities is smaller than 10% or equivalently the



The Quantis random number generator is available as an OEM component (4 Mbits/sec) and as a PCI card that offers high-quality random numbers at a speed of up to 16 Mbits/sec. A USB unit is also available.

probabilities are comprised between 45% and 55%. As this bias may not be acceptable in certain applications, the processing unit of Quantis performs unbiasing of the sequence.

Status Monitoring

As discussed above, one of the main advantages of quantum random number generators is that they are based on a simple and fundamentally random process that is easy to model and monitor. The processing unit of Quantis performs a live verification of its functioning. It continuously checks that the light source and the two detectors are correctly working, and that the raw output stream statistics are within certain bounds. A status bit is output by Quantis. If all the conditions are fulfilled, this bit is equal to 1. If one of the conditions is not fulfilled, the status bit is set to 0 and the bit stream is inhibited. Thanks to this feature, the users of Quantis can have a high level of trust in the random numbers they are using.

Quantis is available as a component, in the form of a compact metal package that can be mounted on plastic circuit boards. It is also available as a PCI card that can be installed in a computer. The PCI card comes with drivers for Windows XP, Linux and Solaris.

Conclusion

Random number generation is a critical security and reliability element in the gaming industry. Because of its intrinsic randomness, quantum physics is an excellent source of randomness. Quantis is a compact, low cost and easy to use random number generator exploiting a quantum optical process as source of randomness. It features a high bit rate output stream – up to 16 Mbits/s – which does not exhibit any correlations and passes all statistical tests.

For more information, contact: id Quantique SA, ch. de la Marbrerie 3, 1227 Carouge, Switzerland, Tel. +41 (0)22 301 83 71, Fax +41 (0)22 301 83 79 sales@idquantique.com, www.idquantique.com

Quick & Simple Repairs #44

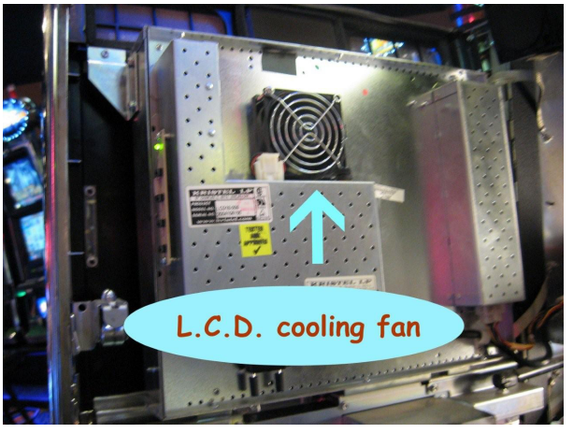
By Pat Porath

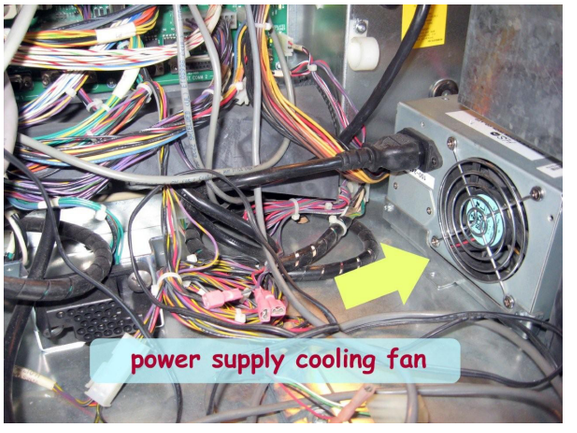
WMS Bluebird With Black LCD

The first thought with a black LCD is that the LCD is bad, such as it would be with a bad inverter board. With the Bluebird, I have seen a few of them that were indeed bad. In this case (as with others) I noticed that the LCD cooling fan ALONG WITH the game power supply cooling fan wasn't turning. This meant that more than likely the LCD wasn't working because of a bad power supply. I also noticed that on the backplane board (the board located on the back of the game) most of the power indicator lights were not lit up. A good indication that there is a power problem is that the cooling fan isn't turning. No power = no power to the fan. Makes sense right? I headed off to the shop and found a spare. Next I installed it in the game (only one small bolt and three connectors). As soon as the main power switch was turned to the ON position, both the power supply cooling fan and the LCD cooling fan started spinning. When I looked at the screen, the game was loading perfectly. The game was back online.

IGT S2000 with a Bill Acceptor Problem

A slot attendant called me to the game and the bill acceptor, which happened to be a UBA 10ss version 1.77-17 and an IDO of 24, wouldn't cycle properly. I looked at the stacker box, which had not accepted a bill or ticket yet for the day so obviously nothing was jammed in it. With the convenient "windows" that are located in the stacker box, I could see that there wasn't anything jammed. Thank you to the guys at JCM for those little windows in the UBA stacker boxes. They have saved me, numerous times, from getting the stacker box contents key. Here, we have to have an additional key so security and I can open the key box just to have access to the stacker box contents key. Security has one and the tech has a different key just to open the key box. Then there has to be two signatures to sign out the contents key, one tech and one security. Then, we can go to





the game and check out the stacker box. The little windows save time by not having to sign out the keys to see if there is a jam, or even to see what the last bill was.

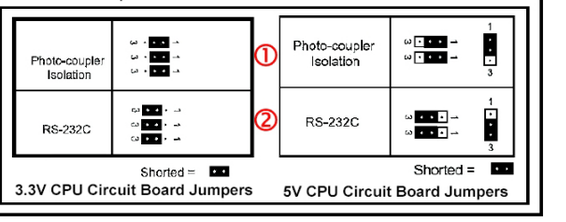
Back to the repair. Nothing was jammed in the stacker box and it looked fine. I put it back in the game and it still wouldn't "cycle" properly. It just kept on wanting to run, almost like the bill acceptor thought it had a jammed bill or ticket. I reseated the bill acceptor a few times after looking at the sensors, optics, and magnetic head, (which all were clean) and it still wouldn't work correctly. It was not time to replace it with a spare. You cannot just install ANY type of bill acceptor in any machine.

This bill acceptor was a UBA 10 with an IDO 24 in it. The IDO (in a nutshell) means the particular type of software that will work in a particular manufacturer's games. For example, IDO 24 is for IGT. IDO 003 is for others such as WMS, Bally, and Aristocrat.

There is another item to check also when replacing a UBA bill acceptor. Located on the bottom, there are "jumpers" that are specifically placed according to the slot manufacturer. It is always a good idea to check and compare the jumpers to make sure that they are in the same places as the original, otherwise it will not work. The jumpers are located on the bottom of the CPU board. They are used to switch the communication from TTL to RS-232. This varies from platform to platform. Most manufacturers use TTL, however there has been a shift on some of the newer games to RS-232. There is a tech bulletin that further describes these at http://tinyurl.com/uba-jumpers.

Perform the following steps to Change communication levels on a UBA from TTL to a RS-232 interface setting by:

1. Moving the jumpers on the CPU to the right (2-1) for TTL operation.
2. Moving the jumpers on the CPU to the left (2-3) for RS-232 operation.



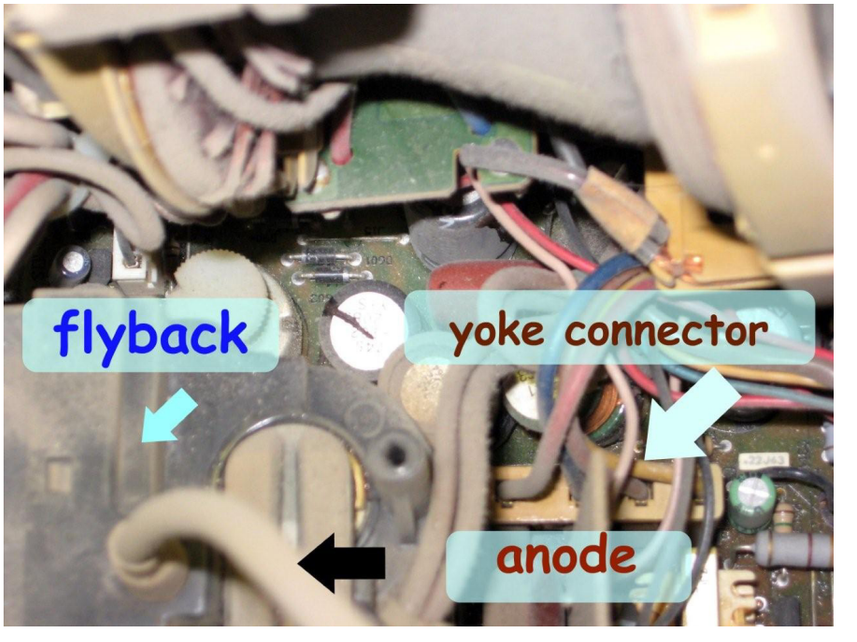
I grabbed a spare, checked the IDO, along with the jumpers and installed it in the game. Once the game was turned back on, it cycled perfectly on the first try. When the main door was closed, the bill acceptor bezel lit up beautifully. As most of us know, when the bill acceptor bezel is lit up, there is a 99% chance that it is working great. With a correct replacement installed, the bill acceptor works great.

Older WMS 550 Video Slot with a Black CRT

What causes a black CRT on a video slot machine? This can be caused by so many things. We have covered them a lot in Slot Tech Magazine, such as when there isn't any high voltage (or power) to the monitor. I headed to the shop and sure enough there was a spare waiting to replace it. I put the monitor in and turned the game back on. What the world? Why is the picture upside-down? Now I had to try to recall what the fix was. I don't work on monitors anymore. I used to a little bit, but not now. What was the "trick" to get the picture so it was right side up? Ah . . . The 4-pin yoke connector has to be broken in half and each piece put back on the monitor chassis board in the opposite position. In other words, I needed to reverse the connections to the vertical deflection coil (the green/yellow pair) and I needed to reverse the connections to the horizontal deflection coil (the red/blue pair) as well. I used wire cutters and cut the 4-pin yoke connector in half. On my first attempt at putting the picture right side up, I put both of the broken sides of the connector to the left side, put the monitor back in and turned on the game. Now the picture was right side up but the image was backwards (a mirror image)! Well, after a second try it was ok. I put the broken ends of it on the outside. Since it was cut in half, normally the crack would be in the middle, now the cracked parts (two halves) were on the outside. The wiring was in the total opposite of its original position. It sounds kind of funny, but it works. This time when I turned on the game the picture was finally normal and the game was back up and running. This is NOT a normal procedure, the reason why I turned around the yoke connector is I only had the one spare monitor. With a bit of "monitor trickery" the game was back online.

IGT AVP 2.5 "Wheel of Fortune Las Vegas" with a CDS Communication Problem

The game was in the out of service mode because, for one reason or another, CDS (AKA OASIS) has lost communication with the game and system. I knew this right away because the CDS display was in lower case letters. When I opened the game and looked at the Sentinel board, the green communication LED was not blinking at all also indicating that COM has been lost. Normally the green LED on the Sentinel will blink rapidly showing everything is working properly.



How has it been lost? Well, I wasn't quite sure yet. Sometimes the "bank in" or "bank out" wires come loose inside of the connector so I checked that and it was fine. I quickly looked at some other connections such as the fiber optic lines and also checked for any chips that had bent legs. Everything appeared to look OK even though something was wrong. Next, I opened the game to the left of it and looked at its "bank out" connections." Could this be the problem? One of the two wires was barely making a connection in its socket. I used my handy small flat tip screwdriver and gently pushed it back in place then applied power back to the Sentinel. It sounded good, but it didn't fix the problem, even though it very well could have been part of the original problem with the game.

Now what? I checked the "global setup" and all of that seemed to be ok, but one thing was kind of weird. The card reader wouldn't read any of my other cards, it would only read my global card (with our system, techs have a global, floor, tech, and meter card.) Next, I replaced the Sentinel and brought along a spare EPROM just in case. The Sentinel and the EPROM didn't do the trick either. The game next door was opened and it was time to compare connections. After looking it over, I noticed that one of the fiber optic cables wasn't hooked up. The game on the left had three plugged into the converter board while the one on the right only had two. Was it because it was the last game on the bank or was it needed? I searched for a bit and found it laying towards the bottom of the game and plugged it in. "Mission control...we have lift off." As soon as the cable was plugged in, LEDs began to flash, the lights on the converter board AND the COM LED on the Sentinel! Communication has been established! Before I even started working on the game I was told that the "E-square" chip had been replaced on the Sentinel and a few other components and boards have been swapped or replaced. I started right from "square one" when working on it, taking the previous repairs into consideration. When the converter board was replaced on the game, one of the fiber optic cables accidently didn't get plugged in. That was the problem. The game to the

left of it did in fact have a poor "bank out" connection at the Sentinel which may have been the original problem to begin with. Now the game could be put back in service. With modern day slot machines, games HAVE TO have strong system and game communication. Without it, the game may not print tickets, the players won't receive points on their player's card, promotional cash won't download, and the "books" on the game will be off because the system isn't counting exactly what is being played. Everything has to be working, and working properly. With this particular game, a repaired "bank out" connection and a fiber optic cable properly plugged into its socket got the game back in service.

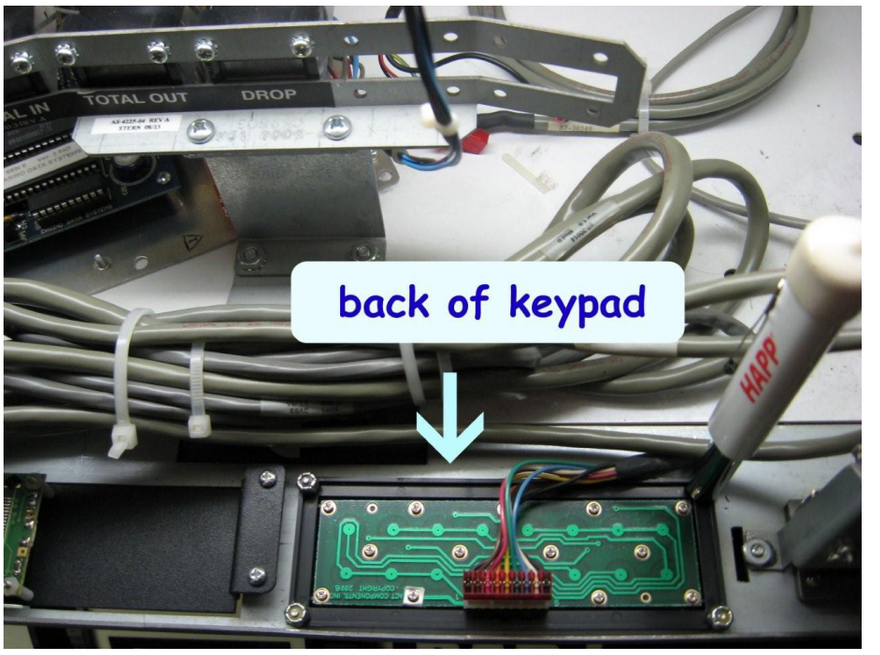
Bally New York Gold Progressive Sign Was Black

I was asked to look at our Bally New York Gold progressive sign because the display was black. Not exactly remembering where the graphics controller was, I looked in the game at the far left. This is where the progressive controller was located, not the one for the graphics. I checked the game to the right of it and there it was. I simply disconnected the power from the unit and let it rest for a minute. Then I plugged the power cable back in. "No signal" appeared on the sign. This meant that the LCD had power but no graphics signal. As I waited patiently (praying to the almighty Slot God that it would work) after a minute or so, a beautiful picture and correct progressive amount appeared. What an awesome sight. A simple reboot of the graphics controller got the sign working again. I recently ran into the same situation with an Aristocrat Loco Loot progressive sign. The LCD was black; the controller was powered down for a minute, power applied once again and PRESTO! The sign was working again.

Worn CDS Keypads

In the morning hours I thought to do a bit of maintenance on some machines. I went back to a Bally progressive bank that I had started on to finish it up. The floor was pretty slow at the time so I could easily access the machines and work on them. Since I was there, I might as well clean and calibrate the bill acceptors, while replacing the worn out keypads. The worn keypad in the picture is one of the worse that I had ever seen. It's hard to say how long that it was in the game, but no doubt it was worn out. On the older Bally 6000 nickel bank, it is very easy to replace the CDS keypad. There are only two screws that hold in the "faceplate bracket" (the item that holds the display, keypad, and card reader) and there are only three connectors to remove it from the game. All that holds the keypad in place are four small 1\4 inch

Worn Keypad



nuts. It is simple to replace them when they are worn. Even on games that take a bit more time to do, the only extra steps are removing a reel or two, or a monitor. Yes the top glass has to be removed too if applicable. Once they are replaced, the game sure looks a lot better. Why not clean and calibrate the bill acceptor since you are there anyway? Be observant of other things that may be out of place too. On the bank that I worked on, one game had a small bolt missing on the stacker access door. Luckily it had just fallen out and was laying right there. I didn't have to go searching for a replacement. With another game, the bill acceptor motor was running very slowly. It didn't even want to accept the black and white calibration paper (the bill acceptors that are in the Bally 6000s are WBA 11s).) I removed the stacker box and looked at the tabs that are located near the stacker box gears. One of the tabs was bent inward, putting pressure on the gear therefore slowing down the motor. I simply bent out the tab on the box and put it back in the game and turned on DIP switches 5, 6, 7, and 8 for calibration (I didn't clean it because it must have recently been done). This time, when the bill acceptor was put in the game, the motor was operating at the correct speed and it calibrated perfectly. Once complete, I turned off all of the DIP switches and put the bill acceptor back in. So, on this specific game, I could have only replaced the ugly worn out keypad but since I was already there and went to calibrate the bill acceptor, the stacker box got repaired too. This also prevented a tech call because it wouldn't have accepted bills. Maybe that is why it is called "preventative maintenance?" To prevent tech calls, and prevent machines from looking and running poorly? :-)

Here at the Island Resort and Casino we are currently running 1405 games. With customers downloading promotional cash, slot attendants entering codes and techs entering codes, the keypads get quite a bit of use here. They are quite durable but they can only take so much abuse and need replaced when it is slow on the floor. As stated above, other problems can be found along the way too. I like the new LCD Touchscreen type with the keypad and display built into one. As pictured, the LCD has a touchscreen and the keypad is right there. We only have two games that have the "Sentinel 3 Touchscreen displays." When I was shown how to install one on a game, the OASIS tech told me that they are quite durable. So far we haven't had any problems with the two, and they have been in for six months or so. It will be pretty neat when we eventually install them in the rest of the games.

- Pat Porath
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TICKETS!

By Tom Mitchell

Are all Ticket-In Ticket-Out tickets equal in performance and value? Most casinos are on tight budgets these days and are looking for ways to save on operational costs. The ubiquitous common paper tickets, a.k.a. slot tickets, produced in huge quantities by Slot-Tickets™ a division of WS Packaging Group, Inc., are a common target for cost cutting savings.

Paper is paper. Right? No! Slot tickets are obtained from the converter, that is the company with the printing presses, who is specially equipped to produce the tickets using very technical grade thermal papers formulated to meet the highest standards in order to provide the casino and players a flawless, enjoyable event.

The use of slot tickets has saved operators a bundle, saved players many hassles, greatly improved security, all but eliminated theft, and become as common as chips. One of the key factors impacting the acceptance of tickets is the ticket itself. If tickets jammed as often as coins, or did not image fast and clean, who would have ever accepted the conversion from coins? The real secret of manufacture is in the nature of the paper and the ability of the converter to artfully produce a zero defect product by the billions that reliably dispenses every time and never jams the slot machine printer or rejected by the bill validator.

Bill validators are calibrated to accept tickets that are produced to exacting specifications; soft count equipment is expecting the tickets to be in spec and anything that reads the bar code demands the paper meet ANSI standards. A properly produced ticket fulfills all of these requirements at an exceptionally low cost.

What is so special about the paper? It is certainly NOT the same stuff used to print your grocery receipt but there are some similarities. Just like the old fax paper it does require heat to form an image. If the printing on the slot tickets were to disappear in a few days, just like it does on those gas or grocery receipts, the regulators would have never have approved the use of these thermal slot tickets. They are very special. Now it has almost been ten years since our first efforts to find and produce a paper ticket for slot machine and other uses that would not only hold its value message for ten years but would also have the feel of new currency, called “hand.” And the tickets must dispense flawlessly over and over every day by the billions in many counties around the world without regard to the EGM or any downstream equipment. That quickly becomes an impossibly tall order to fill when using a cheaper unapproved paper, or obtaining the slot tickets from an unapproved converter.

Approved papers? Approved converters? Who cares? You do. In the beginning with the current ticketing process, IGT demanded that there be an approval process that would guarantee a low-cost, flawless ticket. The same high standards were demanded of the original thermal printer OEM manufacturer, Seiko/FutureLogic, and of Slot-Tickets and Kanzaki Specialty papers who worked hand-in-hand to produce the first paper and converting specifications.

It is just natural in a competitive market for Johnny-Come-Lately to show up at your slot department or your purchasing manager’s door with a cheaper product than is not produced by the approved vendors. However, will it really be truly cheaper in the long run? That is unlikely, especially if the converter is not approved or if the paper is not one of the approved thermal papers.

If your floor is willing to accept more down time, employ more labor and more unhappy customers, and perhaps even a warranty violation by using unapproved product, then at least be very sure you save a bunch in up-front costs because in the end it will cost more. Many slot managers and buyers have been tempted by the allure of false savings and most of them will never do it again.

How do you find who is an approved slot tickets manufacturer? Check with your EGM. IGT maintains the industry de-facto standards and those are available to anyone needing them. Ask your service technician for the link.

The true mark of a product’s success is that it works so perfectly that the user remains completely unaware of the high degree of technical expertise that is required in its manufacture. Yes, it is just a little bit of paper but the fluidity of the floor operation and monetary security of the gaming venue rides on the absolute perfection and adherence to stringent specifications of the slot ticket. Be sure your property is getting what it pays for and do not short change the ticket.

It has been said about the slot tickets that, “anyone can make a few thousand but can they make billions with zero defects”.

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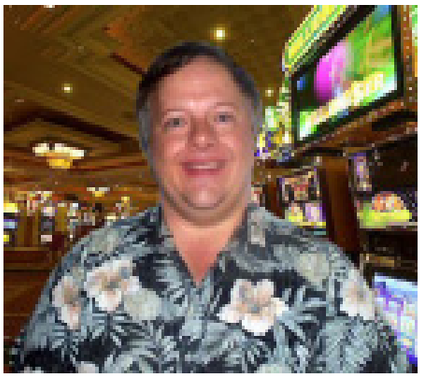

Repairing Slot Machine LED Assemblies

By Vic Fortenbach

Over the past years, there has been a revolution happening on the casino floor, unannounced to most slot machine players and some technicians. During this revolution, the casino floor seems to look brighter, almost a cleaner, whiter color. No, it's not because of any new windows installed in the casino, it all a result of the new use of LED lighting to replace the old bulbs and florescent fixtures of the past. Most of the new LED replacement lamps emit a clean, bright white color. LED lamps and technology has come a long way in the past five years. LED lamps are brighter and more efficient than ever before. LED lighting is now used to replace or update almost all the lighting used on the casino floor. LED lamps that are available for slot machine illumination have the same specifications (sometimes better) as their glass counterparts. Plus LED lamps have many advantages, including low heat output, lower operating current requirements, and more lamp brightness. One really cool advantage is the fact that a single LED lamp can be manufactured with three different color elements together in one small LED package (red, green and blue). This single LED can be made to produce over 16 million colors. These LEDs devices are typically called RGB LEDs and the color effects produced are stunning. Because LED lamps are small, many LED lamps can be combined together on a single circuit board to form a lighting panel or LED assembly. The LED assembly is basically a circuit board that can be any shape or size. This circuit board is then populated with several LED "bulbs" spaced close together and soldered to the circuit board. When powered up, all the LEDs light up together. This light assembly has the same brightness as a standard florescent or regular bulb. Happ controls sell an LED assembly that is really a circuit board strip enclosed in a plastic tube and shaped like a F15T8 florescent lamp. It can replace a reel or belly light in a slot machine that uses a standard florescent lamp. For IGT slot machines, the LED assembly connector is the same as the IGT ballast power connector, which makes installation easy. Several other sizes and versions of this

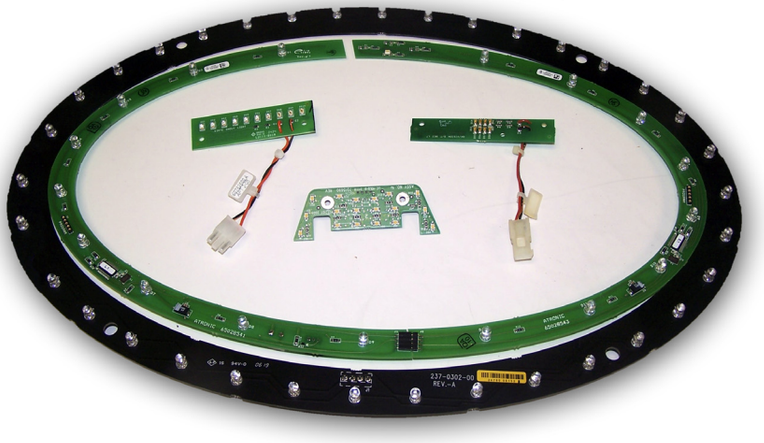

Figure 1 - Various LED light assemblies: Two topper LED rings from Aristocrat and Atronic toppers, IGT printer and bill acceptor bezel LED assemblies and an IGT trimline bill acceptor assembly (the odd shaped one).

type of LED panel are available for other games including Aristocrat games. Happ controls has a complete listing of all the details as well as pictures of this LED light assembly on their website (www.happ.com).

All of the major slot machine manufacturers now use LEDs in some form or another on their slot machines. The LEDs are used to illuminate many of the areas that a standard bulb used to. Some of the areas using LED assemblies include the slot machines top attraction panel, in front of the reels, behind the reels, and for the printer and bill acceptor bezels. Don't forget the game's attraction topper, with the glittering ring of bright white LEDs. Bally Cinereels games use the RGB LED light assemblies exclusively, which makes for a dazzling light show on the reels when ever a bonus is hit. WMS also uses RGB light assemblies on their Bluebird slot games but they use individual red, green, and blue LEDs instead of the combined together RGB LED package. Both LED assemblies produce eye catching colors; one is easier to repair than the other. Every slot manufacturer designs and uses there own specially designed LED assemblies. IGT has different ones for the bill acceptor bezel and printer bezel, Bally has their own for their bill acceptor and printer bezels. Because of the manufacturing differences, you cannot mix LED assemblies between different slot manufacturers' games.

Since the single color LED light assemblies are really multiple LEDs combined together on a circuit board, locating and replacing a bad LED on a panel that has no light output is more of a challenge. No longer can you just grab a bulb from the repair shop and replace it, and throw the bad one away. Now, when an LED assembly stops working, the technician has to apply basic troubleshooting skills to determine why the LED assembly will not light. Since most of the LED assemblies are mounted to a door, whether the bill acceptor, printer or main door, the wiring harness nearest the doors hinge is a good starting place. Pinched wires and wires that have the insulation skinned away, have to be checked first. Once the wiring has been checked, it's on to the LED assembly itself. Just don't start to remove the LED assembly; there is one more item that has to be checked. You have to ask yourself this question: Does the LED assembly illuminate at specific time? Does the LED assembly turn on only when the bill acceptor or printer is ready and enabled? If a certain LED color does not light, run the games self test for the LED assembly to determine if that color is really out. If the LED panel is used on a bill acceptor or printer, the reason why the LED assembly never lights may be linked to a bad I/O board or even the driver circuit on the main logic board. So

far, the problems I have encountered with LED panels (luckily) have been associated with the LED panel itself, which are pretty easy to repair.

But like other light-emitting devices, LEDs can and do "burn out." While the life span of a typical LED lamp is over 10,000 hours, manufacturing defects and voltage spikes and surges can reduce that time frame. A technician with soldiering skills has to replace the defective LED on the lighting panel. Sometimes it can be as easy as just removing the bad LED lamp and replacing it with a new one. Most all LED assemblies with multiple LEDs are connected in a series configuration. The LEDs on the assembly are connected together just like Christmas lights where when one light burns out, the whole light string fails to work. What that means is that when one LED is not working, it may not let the current flow through so all of the lights on that string will not light. The same concept applies to a bad LED assembly. The LED assembly may have 20 or more LEDs on it and when one goes out, the rest are out. How do you figure out which one LED is causing the whole LED assembly not to light? Most of the time, LEDs do not look bad when really are, unless you had a flame out or the LEDs are getting really old. So visually looking over the assembly to see if you can spot a bad LED usually is not an option. Yes, you can give the assembly the "once over" to look for bad or cold solder joints, which I recommend. But looking for a bad LED is pointless. The coolest way I have found to figure out which LED is bad in an assembly of five, ten or more LEDs is to use a digital multimeter. Since an LED is a diode, you don't need to check the resistance of each of the LEDs with the multi-meter, although you can to find the bad one. A bad LED will have high or infinity resistance on both LED leads. Instead of checking each LED and looking at the meter, all you need to do is to set the multi-meter to the diode test setting and touch each LEDs legs with the meter leads. As you touch each LED with the meter leads the LED should light, if it's good. If the LED does not light then reverse the way you're holding the meter leads. It's extremely difficult to see the anode and cathode markings on an LED when it's connected and used on a LED assembly. This technique typically only works with the smaller, surface mount LEDs. Different colors of LEDs have different testing and current requirements and different meters will have different current and voltage outputs in the diode test so your results will vary from unit to unit. Experiment with some good stuff and see what works and what doesn't.

When you use the meter test to test an LED, you will have to have the right meter lead polarity, if you do, then the LED will light if it's good. Don't use an analog meter (one with a needle) for this test. The analog meter will produce too much current at its probes and can damage the LEDs. That would be the worst!

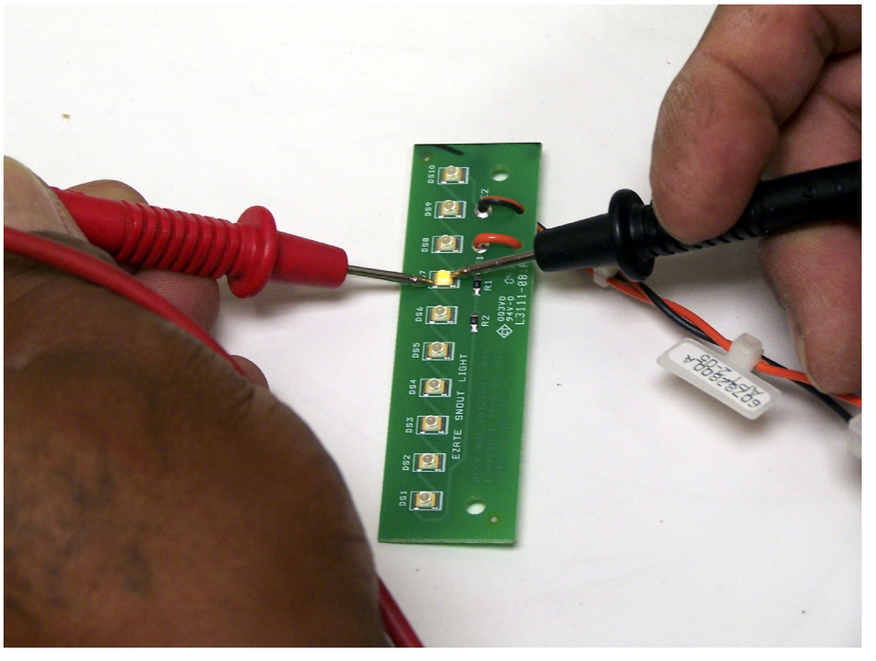

Figure 2 - An IGT LED assembly being tested using the diode test function of the meter to light the LED.

Just think, if you use an analog meter and damage each LED as you check it only to find out in the end that most of the LEDs are now bad because of the use of an analog meter. As you are checking each LED on the assembly, the bad one will be mixed in with the good ones. To mark which LEDs are bad on the assembly, I use a sharpie marker and mark right on the top of the bad LED and then continue testing. It's then easer to go back and replace it, once you have figured out and identified what LED is bad

Ok, so now you have identified what LED is bad on the LED assembly. But you do not have an exact match to replace it with. You can designate a "parts" LED assembly from a good one off the shelf. Not the best idea. Or like most slot shops, you have a LED assembly that is bad, that you can use parts off of. The bad assembly does not have to have the exact same LED on it. You can most likely use any LED just as long as you observe the basics of the LED. These include the brightness, color and physical size. I have used an LED from topper LED ring to repair a bill acceptor LED assembly. The replaced LED was larger then the rest of the LEDs on the assembly. Only I could tell the difference when the panel was reinstalled back in the game.

- Vic Fortenbach
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KICTeam and TransAct Technologies Announce a Joint Development Project to Create a Cleaning Card System for the Epic 950® Ticket Printer

Product to Maintain the Clarity of Cashless Tickets in the Gaming Industry

KICTeam and TransAct Technologies have announced a joint development project to incorporate the use of Waffletechnology™ in a Cleaning Card System to maintain the Epic 950® Ticket Printer. In an effort to increase efficiency and lower maintenance costs, the new Cleaning Card System with Waffletechnology will enable gaming properties to clean the Epic 950® Ticket Printers easily and quickly without opening the printer.

"TransAct Technologies will be introducing this new Cleaning Card System as part of an overall preventative maintenance program," said Jim Stetson, TransAct Senior Vice President. "This product will offer TransAct Technologies Epic 950® Ticket Printer customers an excellent way to clean the device, helping to increase the products' longevity and maintain the quality of the printed ticket. Further, we are pleased to provide our customers quick and convenient availability on our web store, www.transactsupplies.com."

"The development of Waffletechnology products has helped our OEM partners maintain and clean their technically-advanced equipment easily and quickly," explained Debra Ross, Product Manager / OEM Business Development Worldwide, KICTeam. "Our JCM Cleaning System product and the relationship of TransAct Technologies with JCM, helped facilitate this new project. The initial Cleaning Card System prototypes for the TransAct Technologies Epic 950® Ticket Printers, leads us to believe that a product will be deliverable to the marketplace sometime in December. Our goal is to ensure optimization of the ticket printers' performance for the Gaming and Lottery Industry."

TransAct Technologies and KICTeam will be introducing this new Cleaning Card System during G2E in November at the Las Vegas Convention Center. TransAct Technologies will be presenting this product along with their Epic 950® Ticket Printers in a joint area with JCM-Global Booth # 1656.

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One Week Intermediate Level Class	Power Supplies	CRT Monitors	LCD Monitors Hands-On Repair Lab CRT Monitors, LCD Monitors, Power Supplies, etc.		JCM or FutureLogic or Ithaca or MEI	
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Transact Printer		■			
JCM UBA		■			
OASIS Hardware			■		
Digital Electronics			■		
Basic Electronics				■	
Hands-on Repair Lab	■	■	■	■	■

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Randy Fromm's Slot Tech Magazine is published monthly by:
Slot Tech Magazine
1944 Falmouth Dr.
El Cajon, CA 92020-2827
tel.619.593.6131
fax.619.593.6132
e-mail editor@slot-techs.com

Subscription rates:

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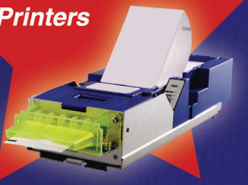

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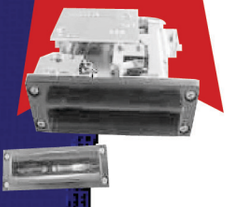

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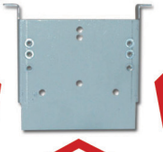

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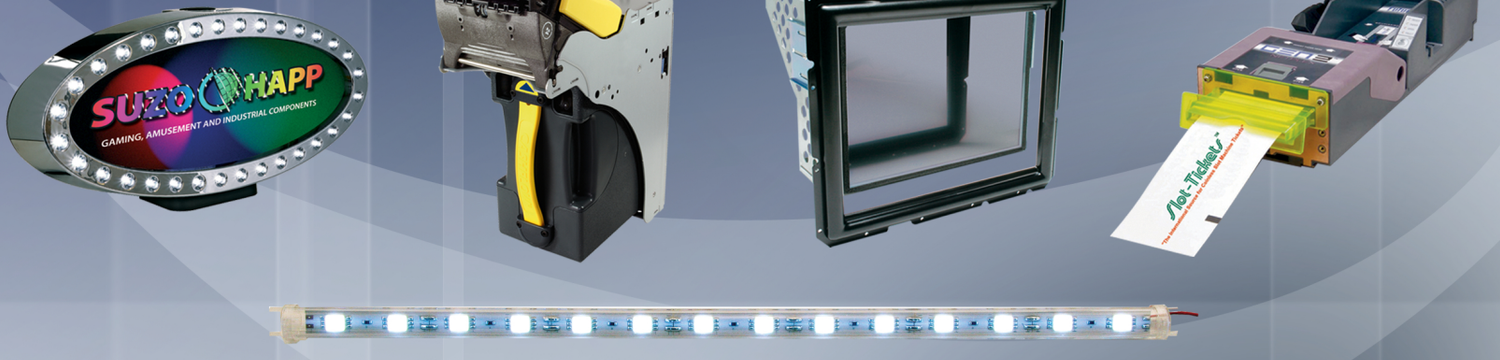

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