


IGT Slot Machine at G2E 2004

# Slot Tech Editorial

The topic of power supply operation and repair has been covered extensively here in Slot Tech Magazine and for good reason. Power supply failure is a big part of being a technician. This holds true for all types of systems, not just slot machines. Of course, fixing power supplies also means testing power supplies. This month, Herschel Peeler shows us how to build a power supply tester that gives a quick "go/no-go" when you're testing power supplies on the bench. He also gives us a peek at using something called a "pseudo-resistor" as a power supply load instead of high-wattage (and high-dollar) power resistors.

Last month, John Wilson introduced us to the real world of random number generation. We learned that "random" is sort of a misnomer as applied to slot machines and that what we're realistically able to achieve is "unpredictability" rather than true randomness. This month, Mr. Wilson shows us how our unpredictability factor can be increased using a variety of techniques. We'll see what works and what doesn't (and why).

Pat Porath is back with another installment of Quick, Simple Repairs. I've been asking around for quite some time now for someone that might pen a column that covers just the most basic and simple repairs. Pat stepped forward to see what he can contribute and what he has given me is exactly what I was looking for. If you're an experienced slot tech, this is likely not your cup of tea. Pat's column is meant to fill a gap that has existed for quite some time in that we cover lots of bench tech (intermediate to advanced) stuff but have had little in the way of the day-to-day things that are repaired on the slot floor.

Our discussion of Digital Monitors continues with part four of the series. This month,


we'll look at the brains of the outfit, the microcontroller. The Samsung microcontroller used in the Tovis Digital Monitor is a wonder of competence and versatility. It controls quite a few of the monitor circuits in some pretty amazing ways and yet the circuitry is straightforward and easy to understand. While we're at it, we'll look at how our digital world interfaces with the analog circuits. We'll also begin looking at some monitor waveforms, thanks to our friends at Sencore who have generously donated an SC3100 Waveform Analyzer to the Slot Tech Laboratory for waveform analysis. We will see much more waveform analysis in the months ahead as we begin our discussion of the deflection circuits in future articles. Hats off to Sencore and thanks.

There is quite a bit of news as well so enjoy reading this month's fourth anniversary edition of Slot Tech Magazine.

See you at the casino.

Randy Fromm

Randy Fromm

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# Testing Power Supplies

By Herschel Peeler

Power supplies are one of the more common items we get coming off of the floor for repair. Testing them after repair is always a good idea. Do you do more than just measure the DC voltage? You should. Here are some ideas on testing power supplies. To use a popular example, we will look at the IGT power supply, part number 40009000 or 40009090.

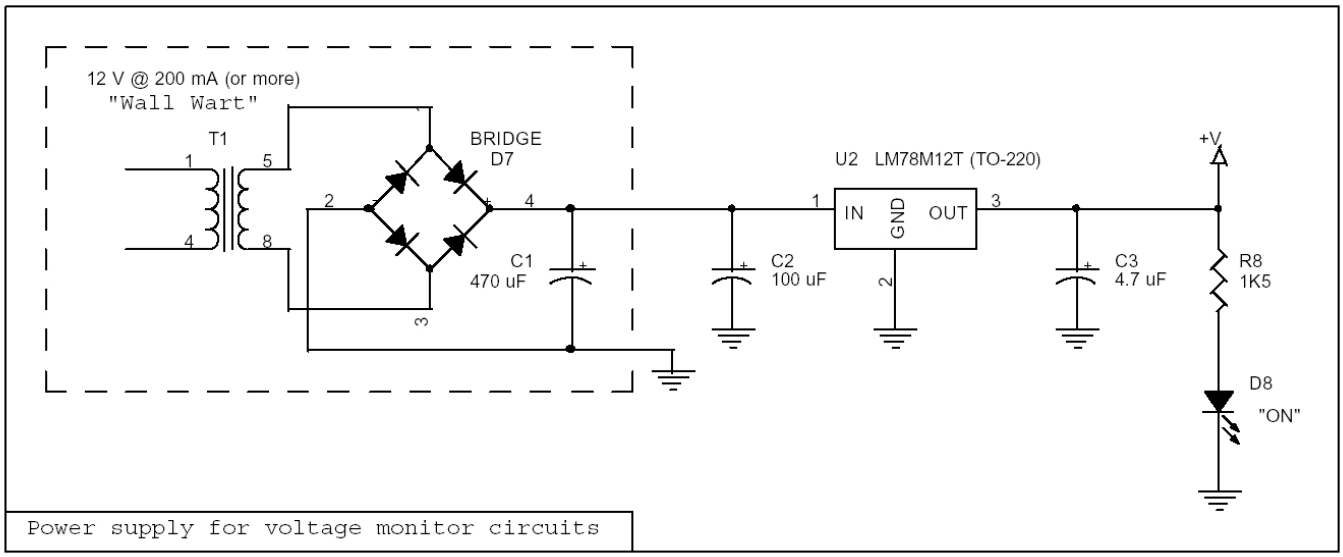
## Test Under Load

Connecting a questionable power supply to a game is not on my list of suggested ways to test a power supply. Let's not endanger a game in order to test a power supply. However, the power supply should be tested under a load of some kind. The IGT power supply is capable of supplying 300 Watts of combined power. Two outputs are supplied. 25 Volts and 13 Volts. We connect an 8-Ohm load on the 25 Volts (about 3 Amps) consisting of three 25 Ohm 50 Watt resistors in parallel, and a 3-Ohm load on the 13 Volts (about 4 Amps) consisting of four 3 Ohm 25 Watt resistors in a series-parallel configuration. This is less than the full rated load for the power supply but the load assembly is used for other power supplies and works such as it is.

I measure the DC Voltage under a load and look at the outputs with a scope as well to check for ripple, noise and oscillations that would not show up using a DC meter reading alone.

## Using LEDs to Monitor the Outputs

Ah, the main purpose of this article. In the past, I have always put an LED on the outputs of the power supply for a quick "go/no-go" check.




Power supply for voltage monitor circuits

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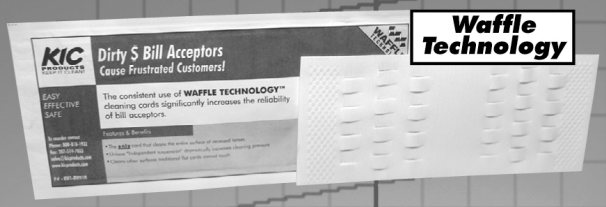


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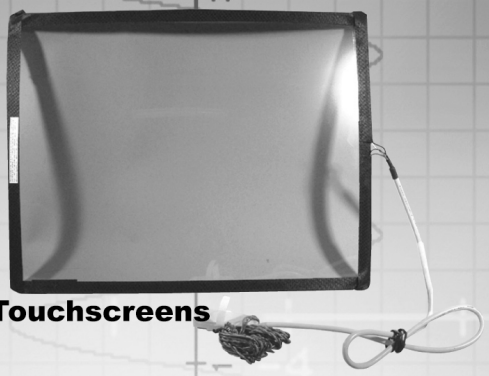

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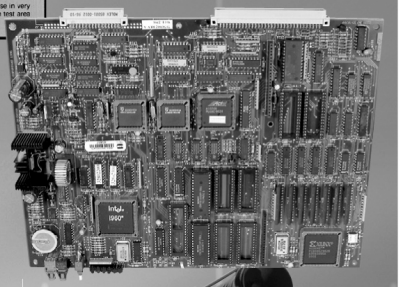

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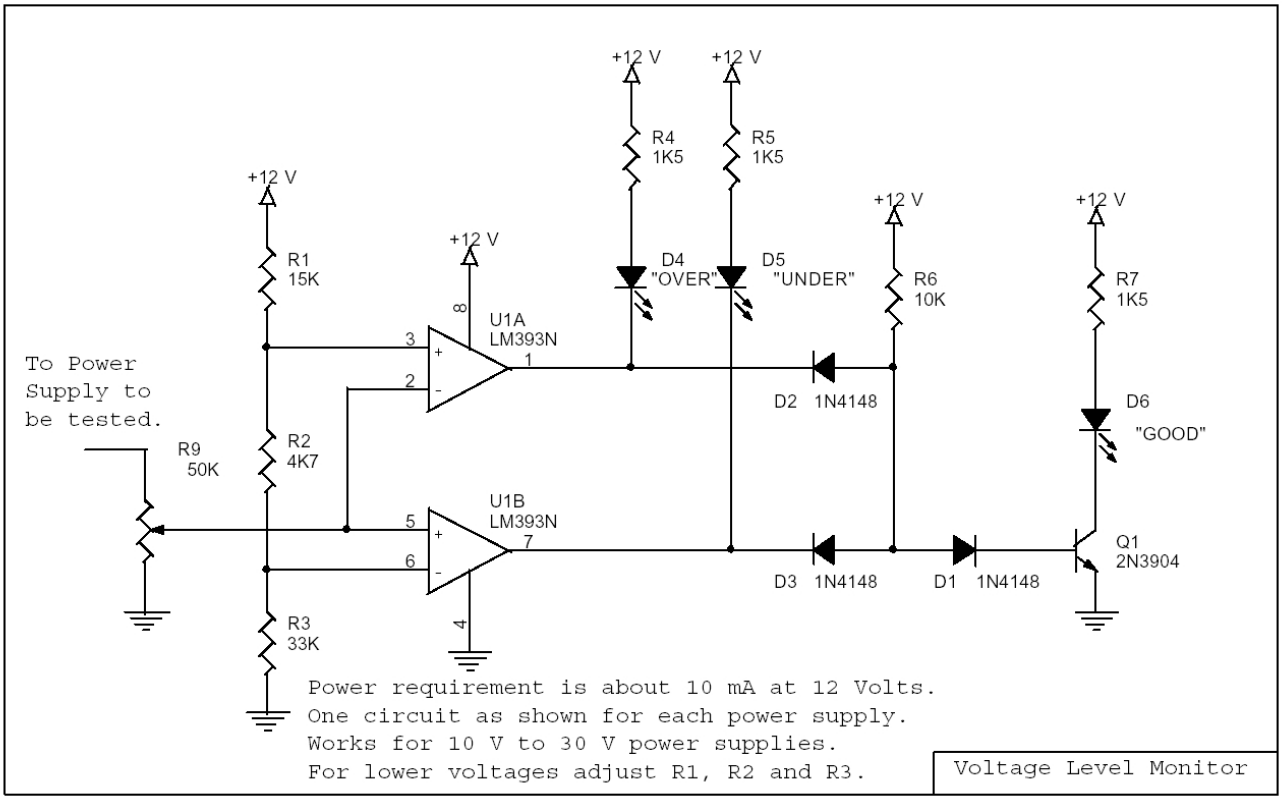
It gave me an immediate indication of a problem. More recently, I have gone to doing away with the LEDs in favor of an actual Voltage Level Monitor circuit that tells me the voltage is not only there but also that it is within a reasonable margin of where it should be. The LED alone tells me a voltage of some kind is there but history has encouraged me to get more specific information.

The Voltage Level Monitor drawing shows an example of what the circuit looks like. Like most of the test fixtures I design, I build them around parts already in stock. Using the same parts for test fixtures as the games use keeps my inventory of parts on hand down. This same list of parts is used in our training program by the way. The circuit is a basic Window Comparator. Two Voltage Comparators compare the incoming voltage (from the power supply output in this case) against two reference levels about 5% above and below the target level. One Voltage Comparator checks for a "Over Voltage" condition. The other checks for an "Under Voltage" condition. In either case, one of the outputs will go low lighting an LED letting me know quickly (while my hand is still on the power switch) if either condition exists. If neither output is low it turns on a third LED letting me know the output is right on where it should be.

The Voltage Divider at the input of the Voltage Comparators is set up for an 8-Volt level, plus or minus about 5%. No, I didn't get precise when I designed the circuit. The incoming voltage is applied to a pot adjusted so that when the power supply is where it should be the voltage applied to the Voltage Comparators is right at 8-Volts. This circuit is suitable to test any power supply in the 10-Volt to 30-Volt range with a simple pot adjustment. For voltages lower than 8 Volts I would have to change the design of the voltage divider.

## How the Voltage Monitor Works

A word about the LM393. This is two Voltage Comparators in one package; Very convenient since we need two for each Voltage Monitor circuit. We have an Inverting input (marked with a "-") and a Non-Inverting input (marked with a "+"). The inputs are an analog voltage. If the Inverting input has a higher voltage on it than the Non-Inverting input the output will go Low. If not, the output will float. It is an open



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collector output. External components determine how high "Not Low" will be.

R1, R2 and R3 make up a Voltage Divider. The point where R1 and R2 come together should be about +8.4 Volts. The point where R2 and R3 come together should be about 7.6 Volts. R9 is adjusted so that the incoming voltage will be at 8 Volts. The 8.4-Volt and 7.6 Volt level represent +5% and -5% margins. No, the voltages didn't come out exactly at that level, but the circuit it adjustable so it doesn't really matter.

If the power supply output voltage is too high, Pin 1 of the LM393 will go Low and the "Over" LED comes on. If the output of the power supply is too low, Pin 7 goes low and the "Under" LED turns on. If either pin 1 or pin 7 is low, diode D2 or D3 conducts turning Q1 off. If the voltage is correct, both pin 1 and pin 7 will be high and Q1 is turned on through D1 and R6.

**Building the Voltage Monitor**

All of the circuitry, including the voltage regulator and two Voltage Monitor circuits, fits on a Radio Shack 276-168 circuit board with ease. Layout is not critical. When I build a circuit I have gotten into the habit of building it in functional sections and testing it as I go along. In this case I built the Voltage Regulator. Tested it. Built the circuits on the output of the Voltage Comparators. Tested that by grounding the pins of the socket (pins 1 and 7). This simulates the output of the Voltage Comparator going low, indicating an error condition. Built the circuit on the input of the Voltage Comparators. Tested that by making voltage measurements of the voltage divider and input circuit. Then installed the Voltage Comparator itself and tested the circuit as a whole. To test the overall workings, I connected the inputs up to a Bench Power Supply with a variable output and adjusted the power supply confirming that the Under Voltage, Good, and Over Voltage all worked where they should. Pot R9 was adjusted for the +25 Volt and + 13 Volt levels the monitors are designed to test. So you see it doesn't matter if my Window is not precisely 7.6 V and 8.4 Volts, as long as I have a suitable size window.

Keep in mind that there are two Voltage Level Monitor circuits in this test fixture. Both can run coolly off of the Voltage Regulator shown. Each circuit probably draws maybe 15 mA since only one LED should be on at a time. The regulator is capable of supplying hundreds of mA so it should run just fine with no heat sink required on the voltage regulator.

**The Power Supply and Voltage Regulator**

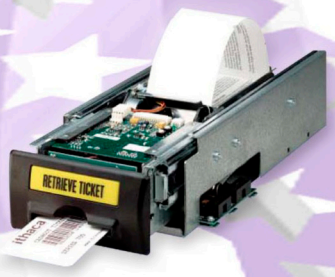
Main power for the assembly is supplied by an unregulated "Wall Wart" power supply I picked up at a second hand store for $1.00. It was rated at 12 Volts at 200 mA. The Voltage Monitor only draws maybe 50 mA so the unregulated output was up around 18 Volts. I ran this into an LM78M12T Voltage regulator to bring it down to a properly regulated 12 Volts used to power the Voltage Monitor. A point of note, yes, the Voltage Monitor circuit must be powered from a different source than the Power Supply being tested.

**Comments on Parts**

The Voltage Regulator was one purchased from Jameco in their bargain bags. You get 100 mixed voltage regulators for about $8.00. For $0.08 each this is a bargain I have purchased a couple of times and never been unhappy with what I got. Not that I expected much at this price. Some were garbage. Most were usable. The same for the LEDs. I buy them by the pound from Jameco. About 1900 LEDs make a pound. This comes to about $0.02 each. At this price we let the students in class find out how much abuse an LED can take before it finally dies.

Except for the board and the box the parts might have cost maybe $2.00 in all if I had to go out and buy them. If you forego the box, the whole project can be built for around $5.00.

**Continued . . .**

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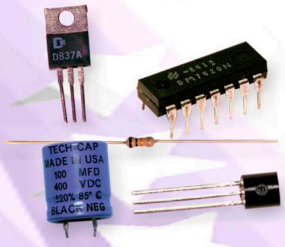


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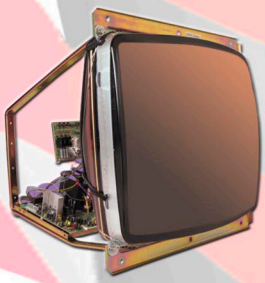

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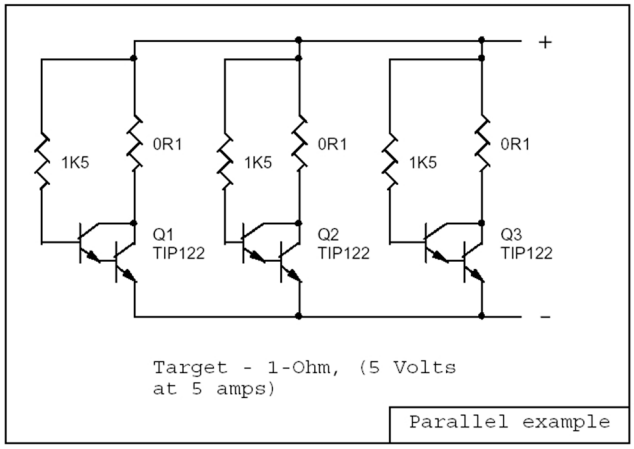


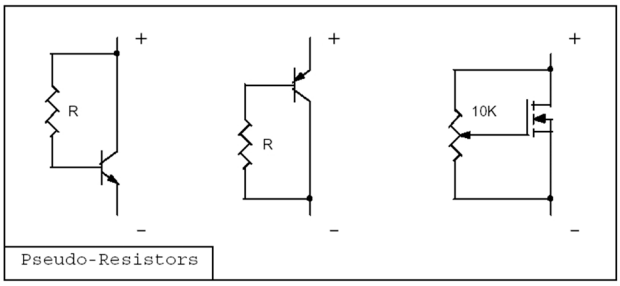


Load resistors for power supplies need not be the expensive 25-Watt, 50-Watt or 100-Watt wire wound mega-resistors. These work but lack flexibility and are not cheap. An alternative is a dynamic load block made of power transistors. Using the Emitter - Collector connection as a power resistor, we can control the base current to set the resistance. We must remember that a transistor is nothing more than a variable resistor. As we pull current through the Base the resistance between the Emitter and Collector gets lower. These pseudo-resistors would be best suited for smaller power supplies, but could be connected in parallel for higher currents.

I don't know about your shop but I have a bunch of power transistors left over from games we no longer have on the floor (or we bought in error). This gives me an opportunity to put this old stock to use.

And don't forget the heat sinks. Gotta have heat sinks. Don't exceed the Amps or Watts rating of the transistors and don't forget to factor in the heat from the room as well. The sole purpose of these pseudo resistors is to burn up power. Any large chunk of Aluminum will work fine for a heat sink. Rule of thumb on heat sinks... one square inch of surface area per Watt of heat dissipated. This counts both sides. Fins take up a lot of surface area fast. Fans are good. I'm sure there is a more "Engineering" solution to heat sink calculation, but I'm no engineer. I'm just a technician.

Select the resistor to bias the transistor in the conduction range, not complete saturation. We want the transistor conducting but not necessarily into complete saturation. If in doubt, build it and adjust the resistor to accomplish the ends you want. The current through the resistor would be the load current divided by the DC Gain of the transistor. Don't use the Data Sheet value for the gain. Actually test the transistors gain under the conditions it will be used. Ideally we would want to choose a transistor with the Emitter - Collector voltage at the designed load current to be equal to the load voltage. Otherwise, select the resistor to have the desired outcome and use multiple transistors if necessary to get the current you want. It may be "Red Neck Engineering" but that's okay with me. I'm a country boy.

The transistor could be any type. NPN, PNP or MOSFET. A TO-220 package can usually dissipate well into the 100-Watt range with a sufficient heat sink. If you are putting multiple transistors in parallel put a small resistor in series with each transistor to equalize the current between the transistors or the transistor with the slightly higher gain will take an unusually large share of the load. Choose a resistor about 10% of the target load resistance.

**- Herschel Peeler**
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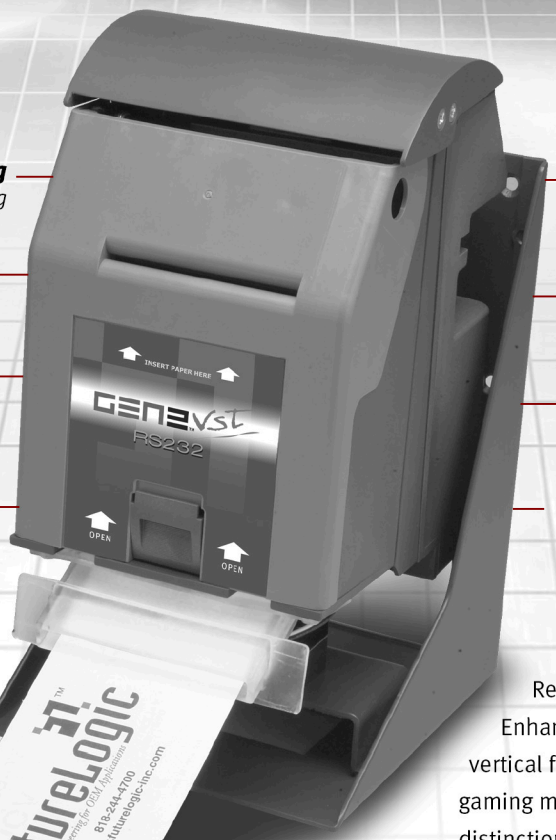


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# Random Ramblings - Part 2

**By John Wilson**


Last month, we took an initial look at the slot machine's random number generator. More specifically, we briefly touched on what 'random' means and how random numbers can be created in a computer. We learned that the random number generators don't generate random numbers at all. They really generate 'unpredictable' numbers, which is not the same as random. Although the numbers are unpredictable (at least they should be) they do follow a specific sequence based upon the logical arithmetic formula used to generate the series of numbers. One of the important points we learned last month was that computer-generated random numbers are a paradox, being reproducible. This is a good time for further study of this point in order to clear up the confusion that we have likely created.

We know that our RNG will produce a finite series of numbers in a set. We can use some different terms interchangeably to describe this. Mathematically, we can call it a set - an abstract collection of numbers or symbols. We can describe it as 'a group of things of the same kind that belong together and are so used'. The term "cycle" describes it in terms we use for the slot machine game outcomes. Whether we call it a set, list, cycle, group or whatever, you just have to remember the basic premise. The pseudo-random number generator produces a whole bunch of numbers, one after the other, that is reproducible. Eventually, the number generator will reach the end of its mathematical list and start over at the beginning. This set, however, could be quite large - perhaps billions of numbers. A small set of numbers is too easy to memorize and makes it easy to defeat the apparent randomness of our machines. However, even a set of a

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 70 | 69 | 31 | 78 | 91 | 89 | 81 | 72 | 93 | 41 |
| 10 | 26 | 2 | 45 | 58 | 18 | 7 | 63 | 49 | 6 | 47 |
| 20 | 76 | 25 | 11 | 75 | 67 | 94 | 14 | 57 | 23 | 92 |
| 30 | 10 | 53 | 88 | 8 | 35 | 0 | 50 | 5 | 85 | 56 |
| 40 | 27 | 30 | 24 | 59 | 17 | 90 | 34 | 42 | 71 | 74 |
| 50 | 62 | 3 | 51 | 32 | 44 | 15 | 22 | 13 | 40 | 19 |
| 60 | 9 | 46 | 1 | 52 | 36 | 77 | 80 | 66 | 84 | 20 |
| 70 | 28 | 12 | 60 | 87 | 97 | 43 | 4 | 21 | 55 | 39 |
| 80 | 46 | 68 | 33 | 95 | 16 | 64 | 37 | 73 | 96 | 83 |
| 90 | 61 | 48 | 79 | 98 | 38 | 82 | 99 | 54 | 65 | 86 |

billion numbers could have a predictable pattern within. Of course, as we saw last month, if the sequence always starts at the same place, we're in for trouble as well.

In order to illustrate the set, I have generated a list containing 100 random numbers. The numbers range from 0 to 99 and each number occurs only once. Add the number on the top of the grid to the number on the left of the grid. For example, if you want the 73rd random number, look at 70 on the left, find 3 on the top, and where the '70' row and '3' column meet, that is your random number. In this case, the 73rd random number is 87. To get 3 random numbers, you continue counting and finding the target number. The 74th random number is 97, followed by the 75th random number, which is 43. If we were to start at the beginning of the list, our random numbers would be 70,69,31,78 ... If you are confused by the grid display, the entire list of random numbers is shown in a linear format over the next two pages.

Suppose this set is our slot machine RNG and these are the values that are selected. Each time we turn on the machine, the first 3 reel positions selected would be '70', '69', '31' as these are the first three numbers in the set. The second spin would always result in positions '78', '91', '89'. This is very predictable and it is this pattern that manufacturers, gaming commissions and casino owners want to avoid!

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| 0 | 70 | 69 | 31 | | 91 |
| 10 | 26 | 2 | 45 | | 18 |
| 20 | 76 | 25 | 11 | | 67 |
| 30 | 10 | 53 | 88 | | 35 |
| 40 | 27 | 30 | 24 | | 17 |
| 50 | 62 | 3 | 51 | | 44 |
| | | 46 | 1 | | 36 |
| 70 | 28 | | | 87 | 97 |
| | | 68 | 33 | | 16 |
| 90 | 61 | 48 | 79 | 98 | 38 |

Our 73rd random number is '87'

**Confused? Look at it from this perspective**

If you are not familiar with the grid pattern of rows and columns that we have established, there is another way to look at our set of random numbers. It is the same set, just presented in a different format.

70 69 31 78 91 89 81 72 93 41 26 2 45 58 18 7 63 49 6 47 76 25 11 75 67 94 14 57 23 92 10 53 88 8 35 0 50 5 85 56 27 30 24 59 17 90 34 42 71 74

Take our list, and write each number on a separate piece of paper. Number the pages 1, 2, 3, etc. The list of random numbers is obtained by simply moving from page 1 to page 2, etc. If our seed value is '26', then we leaf forward to page 26 and read the number shown on that page. In this case, it is the number '14'. To get another random number, turn the page and read the number - it is 57. When you reach page 99, you have to close the book and start over.

Don't confuse the actual random value we obtain with the position within the set. The position within the set is strictly a pointer - showing us the location within the list we are using.

**A problem! And a solution.**

Random number generators, that is to say computer-base pseudo random number generators (we'll use the term random number generator or RNG to mean psuedo-random number) require a seed value. Just like your garden, the seed is the point from which everything starts. In order to ensure that we don't start at the very beginning of the list, we use a seed value to position us somewhere within the list. If we use the seed value '26', then we'll move 26 values into the list and start from that point, which is the number 14. Obviously, we want the seed value to be fairly random. If we always start 26 numbers into our list, we might just as well start at the beginning of our list. Real-time-clocks are often used for this purpose. Take the number of seconds that have passed since midnight and use that as our seed. We can get quite fancy if we want to. The idea is that the more complicated this is, the harder it is for hackers to figure out. Let's take the current time using the seconds, multiply by the minutes, divide by the hours and then add in the day of the month.

The 'seed' values of formulae similar to this one change every second. If we turn on a slot machine one second later than we did yesterday, we start our RNG at a different position of our list, therefore we start generating different random numbers. It does seem somewhat ironic that our computer-based random number generator needs a random number to start it off.

By 'seeding the random number generator', we ensure that we start off with a different random number each time. The first solution is to ensure that we don't start off our list at the same position each time.

**Another problem!**
**But, another solution.**

Now that we have a list and some method of starting at a reasonably random position within the list, we have our random sequence. However, we now have another problem. This is the problem of our list itself. It's a very small list, with only 100 combinations. If we have a 5-reel machine, that means that after 20 games we've completely used our list and must start over. It also means that we'll never use up our cycle because we have only provided 20 different combinations from our RNG. Depending upon where we start in the list, there are at most 100 different outcomes possible. This just won't work. We might have a jackpot every 100 games. Or, we might have none. Our list, therefore, has to be large - very large. This ensures that we have an almost unlimited number of possibilities coming from our random number generator.

Our obvious solution is to create a much larger list; a larger set. Many random number generators are '32 bit' RNGs, meaning that they have a total set containing $2^{32}$ or 4,294,967,296 combinations. IGT uses a 64 bit RNG, giving a set with 18,446,744,073,709,600,000 combinations. As you can imagine, while you could memorize the 100 numbers (or at least recognize patterns that happen) with over 4 billion combinations in the set, it's pretty difficult to locate a pattern. Our second solution, therefore, is to make our list (or set), as large as we can possibly have it.

**Continued . . .**

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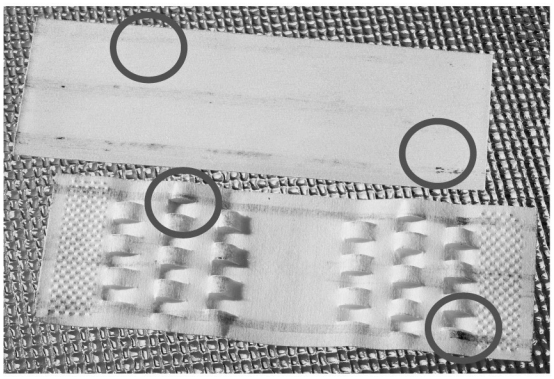

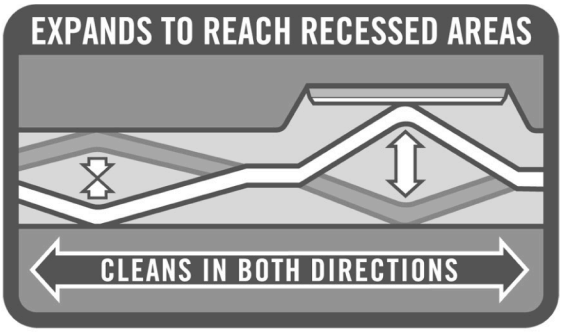


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**Can we make random, more random?**

As we have described our RNG as more 'unpredictable' than 'random', how do we ensure that it is as unpredictable as possible? Mathematicians call this 'entropy', which is often used to represent the degree of disorder or randomness in the system. This problem is easily solved, however, and we can come up with hundreds of methods to ensure our set of numbers is used more randomly.

Some ways to do this include:

- Rather than moving through the list sequentially, select our random numbers 'randomly'
- Have a 2-level random number generator. The first is used to pick a random value from the 2nd
- Use seemingly random or unpredictable events to alter the RNG. Count the number of milliseconds that the player waits between one game and another. Use this value in your RNG.
- Monitor the number of credits in all of your slot machines at any time using this value
- Once you have a random value, apply another formula to it to make it even more random.

There are unlimited means to accomplish this. Some, which use an external event, are going to be even more random. Factors external to the machine and not using a logical, arithmetic formula produce the best results. However, they can be expensive to develop and implement. Perhaps one common server that provides random numbers to each individual gaming machine would result in a very random outcome? This way, you have 2,000 machines constantly drawing numbers from one central RNG.

**Another problem!**
**A consideration!**

There is a problem that is quite serious should it occur. Suppose we modified our "Blazin 7s" game to have a 5-reel format with 128 virtual stops on each reel. We put the jackpot symbol at the very end of each reel, assigning it one virtual stop. In order for the jackpot symbol to land on the payline, the random number generator would have to pick the number "128". For the jackpot to occur, we would need 5 jackpot symbols, meaning the random number generator would have to pick the value "128" five times in succession. What if our set doesn't have this happening? That would mean that we will never have five jackpot symbols line up on the payline and we will never pay out the jackpot. We could either advertise the top jackpot as Fifty Trillion Dollars (knowing it will never be paid), or try to make it an honest game where all possible game outcomes can actually occur. Remember that our set may be quite large and may contain a wide range of numbers. In our example of 100 numbers, we use the number 1 to 100. An actual slot machine RNG won't provide numbers between 1 and the maximum number we need. The numbers selected are going to be quite large, too. Remember the set containing 4,294,967,296 numbers? If every number were picked once, the RNG would give us a value between 1 (or 0) and 4,294,967,296. If we have 64 virtual stops on our reel, we only need 64 combinations. In order to work with the number received, we apply another formula to reduce it to the proper range. If we need 128 combinations for our new Fifty Trillion Dollar game, we can divide this number by 33,554,432 to give us a value from 1 to 128. This further 'mixes up' the numbers, and by applying this method to the value received, we may vary well receive the same number in sequence. In fact, by solving one problem, we have created another one. We will receive the same number, 33,554,432 times in a row! If the RNG gives us the value '1' and we divide by 33.554.432, we receive the final value of 0.00000002980232238769531 25. If we 'chop off' the numbers after the decimal, we have the number '0' (zero). If the RNG gives us the value 33,554,431 and we divide by 33,554,432 we receive the final value 0.99999997019767612304687 5.

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Chopping off the numbers after the decimal again, we have the number '0' (zero). In the end, we will receive the same number over 33 million times in a row. However, since our RNG gives us numbers in a random sequence, the final result should be somewhat random as well.

A better way would be to use division and look at the remainder and use that value. That would result in the numbers being more mixed up. As you can see, for a simple item as a random number generator, there is a lot to consider. Also, once you have the random number, it might not be what you need. You may have to take some further action on it. However, each step you take you must ensure that the number is no more predictable and that every possible outcome is not only represented, but represented evenly.

This is where organizations like GLI (Gaming Labs International) come into play. GLI tests every machine that has a random number generator in it. They conduct a number of tests to ensure the accuracy, integrity and randomness of the RNG. They put it through a battery of tests to ensure that it works, and works well. This is a very long, complicated process and requires tedious effort on the part of the tester. The process will, however, identify any problems with the random number generator that the machine manufacturer had not even been aware of.

We have had a lot of theory on RNG's this past two months, and next month we'll get into some practical exercises and some fun. We'll provide our readers with a program that will allow you to take a look at how the numbers are selected and how the set of random numbers appears.

**- John Wilson**
**jwilson@slot-techs.com**

http://www.eds-inc.com/88users.html page 2

"I used my ecg cap tester today and it called a cap out of circuit good and gave the correct value. The CAPANALYZER 88A called it bad; I replaced the cap and repaired the tv set. What a tool! Thanks"
-Stout's tv-vcr, Louisville, KY.

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"Thank you for a really fine product. We received our EDS88A capacitor checker today. I had a circuit board from an obsolete converter and tested almost all the electrolytics and was very impressed with the quality and functionality of the unit. I am sure this unit will definately help us in our repairs of cable converters." -Time Warner Cable, Bakersfield, CA.

"The EDS-88A works great, I have used the sencores in the past when I was a project-R/D engineer in Ronkonkoma but for trouble shooting and things the LCR does not tell you, this is far better.
-Audio Radio, Boca Raton, FL

"Can't praise the CapAnalyzer enough. It has been well worth its price; I use it everyday and take it on all home calls." -Walton Service Center, Luling, LA

"I did not believe it, even when I read the reviews by the other shops, but I ordered it and it is the best thing since Pepsi Cola. I fixed two dogs the first day" -Video TV And Appliance, Tarboro, NC

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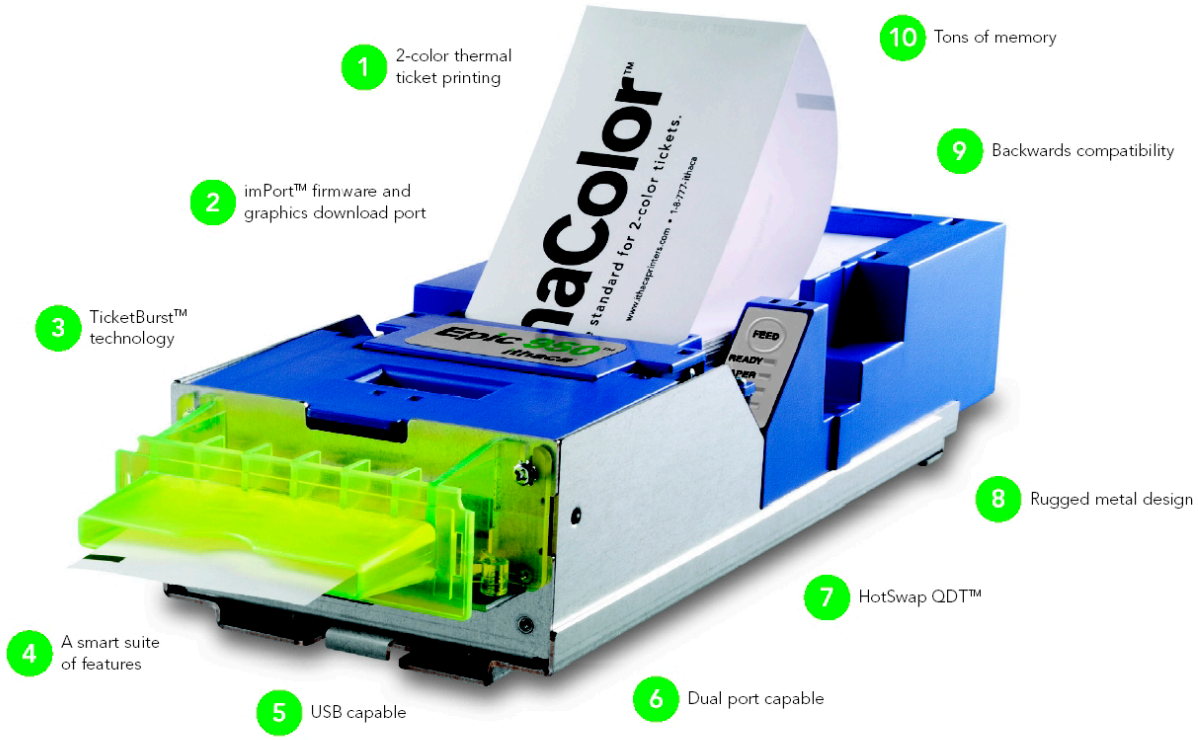
to be continued...

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# Unicum Goes Far East

The leading Russian gaming supplier, Unicum Group, opened a business unit in Khabarovsk, the city in the Far Eastern part of the country. Unicum's fifth Russian representative office will provide slot machines and technical services to Far Eastern operators.

Alexander Goncharov, Commercial Director of Unicum Group of Companies, made his comment on the event:

˜Unicum sees great significance in establishing a solid network of company's regional offices. Our experience and research show that Russian regions develop gaming business much faster then Moscow and Saint-Petersburg did a few years ago. Specifically Far East, the region with a great need in quality gaming equipment, sites and casinos. We simply react to a very high interest in modern and quality gaming machines, expressed by local operators. Unicum looks forward to future cooperation with its clients and is ready to accomplish set objectives."

During the past year, Unicum Group has opened three regional offices in Russia: in Yekaterinburg, Saratov and now in the Far East. The new Unicum unit meets all requirements of its regional office and includes two departments: a sales department and technical support service which will provide sales and necessary support of all gaming products, distributed by Unicum in Far East. The office staff has passed the training program in Unicum's training center and has already taken their duties.

"While looking for the right location for the new office, we studied many options," explained Sergey Kuzmenko, the head of the new Unicum unit. "Finally, we selected Khabarovsk due to three major factors: The city is a large administrative and financial centre, a connection point between Asian countries and Russia. It is located between important business and commercial centers: Vladivostok, Blagoveshensk, and Komsomolsk-na-Amure."

Unicum's specialists expect sales to rise sufficiently with the seasonal business leap in March and April. The first batch of slot machines was shipped to Khabarovsk in the end of February. At the same time, Unicum Moscow managers have been already working on building a new international office.

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**Sergey Kuzmenko, the head of the new Unicum unit**

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- RGB Interface
- DVI Theory – DVI Interface
- Performance Testing
- LCD User Adjustments
- Color Theory
- Precision Color Balance Adjustment
- System Block Diagram Overview
- Power Supply
- Backlight CCFL
- DC to AC Converter
- Digital Signal Processing
- LCD Display Module

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- Government Technicians
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## What Do You Get?

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dates & locations

### 2005 DATES & LOCATIONS

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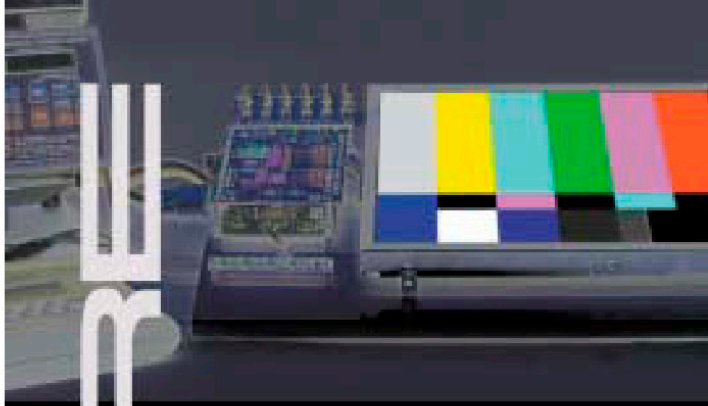

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***LCD Troubleshooting***

***and Calibration***

***Tech School***

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## What Will You Learn in this 3 Day Tech School?

- *Understand and apply safe servicing techniques*
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- *Understand how to thoroughly performance test an LCD computer monitor*
- *Be familiar with switch mode power supply (SMPS) and LCD Inverter power supply operation and troubleshooting*
- *Relate SMPS and Inverter power supply block diagram test points to the equivalent schematic test point*
- *Understand multi-mode formats and circuit operation*

- *Understand analog (RGB) and digital signal formats and connectors (DVI)*
- *Explain the advantages and limitations of CRT vs. LCD displays*
- *Understand the theory and operation of fixed pixel displays, including LCD panel operation, signal processing, and backlighting*
- *Perform an LCD backlight replacement*
- *Perform LCD video calibration , including chromaticity (color temperature), black level, white level and geometry*

## Course Description:

**DAY 1**

***Equipment Familiarization/LCD Displays***

The course begins with equipment familiarization and an overview of LCD displays. Students will discover how LCD panels work by learning the major functional blocks of an LCD monitor. Sencore has developed specific LCD trainers for hands –on demonstrations and troubleshooting exercises.

**DAY 2**

***Hands-On LCD Monitor Troubleshooting***

The second day of this course provides an introduction to troubleshooting LCD monitors. Entry level technicians and seasoned veterans will learn troubleshooting techniques and short cuts by using block diagrams and hands – on lab exercises.

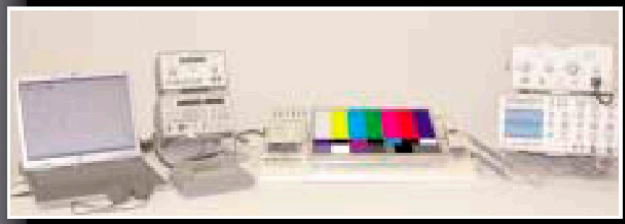
**DAY 3**

***LCD Inverter power supply and SMPS Troubleshooting***

The last day of the course provides an introduction to power supplies and their uses. The students then learn how each type of SMPS and inverter power supply works by performing experiments on a working model. This course is truly a hands-on course with approximately 70% devoted to lab time performing tests utilizing an exclusive Sencore power supply trainer.

***Students will also be presented with Certificates of Completion following the Tech School.***

***This course is eligible for Continuing Education Credits (CEU).***



# SUZO-Happ Controls Merger Yields Full Line of Happ Gaming Products Available in South America

The distribution of the full line of Happ Controls products is available by SUZO International's branch offices in South America, following last month's merger between SUZO International and Happ Controls. Offices in Buenos Aires, Argentina and Joinville, Brazil and their corresponding distribution networks will market the new products, which include among many others the Microtouch touchscreen product line, and spare parts for coin and bill validation products to the South American gaming and amusement marketplace.


**(l) Patrick Suverein, CEO, SUZO International; Jens Peiler, general manager for SUZO International in Argentina and Brazil; and Tom Happ, President, Happ Controls**

The availability of the products in South America will give clients easier and faster access to a new and wider range of spare parts for various slot machines.

"With the existing distribution channels of SUZO in South America we are more than pleased to be able to include the products from Happ Controls," said Jens Peiler, general manager for SUZO in Argentina and Brazil. "Many of these products are of interest to clients in South America, and thanks to the merger will now be available locally."

SUZO International merged with Happ Controls in January 2005. The combined company is the global leader in the manufacture and distribution of gaming and amusement parts and accessories with nearly 400 employees in 12 locations serving customers in over 70 countries.

# FutureLogic Expands Phoenix Plant

FutureLogic, Inc. has announced the expansion of their FutureLogic Manufacturing facilities in Phoenix, Arizona.

As the company's lead production site, the new 30,000 square foot facility comprises six assembly lines and includes space for further expansion. FutureLogic Manufacturing's dedicated, high-volume production lines, state-of-the-art test and inspection equipment and skilled personnel will ensure efficient, high-quality production of the company's award-winning thermal printers.

The expansion is also intended to help FutureLogic improve delivery times and meet surge demands.

"Over and above the significant investment we are making in developing new printer technologies and implementing emerging OEM design requirements, we have invested heavily in upgrading our manufacturing facilities," said Anthony DiMarco, president of FutureLogic. "The new facility will help FutureLogic continue to deliver innovative and reliable products, in a more timely and cost-effective manner."

The FutureLogic Manufacturing facility has received its quality certification for ISO 9001:2000 and currently employs 52 people, with projections to 67 employees within the next three months.

About FutureLogic Founded in 1983 and headquartered in Glendale, Calif., FutureLogic designs and builds high-reliability electromechanical assembly solutions for nearly every engineering need. As the undisputed leader in super-robust thermal printer technology, FutureLogic is the industry's premier supplier of thermal printers for casino gaming, promotional equipment, kiosk, industrial, parking, gas pumps and medical applications. In July 2004 the company founded FutureLogic Europe Ltd to provide direct sales and engineering support for the growing OEM thermal printer markets in Europe.

FutureLogic Expands Printer Manufacturing Facility

For further information, contact:
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Nick Micalizzi, Director of Gaming
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Glendale, CA 91205
949.487.4829
nick.micalizzi@futurelogic-inc.com
www.futurelogic-inc.com

For technical service, call 702.597.5355.

# *Quick* & Simple Repairs #2

By Pat Porath

First of all, I'll give you a little bit of my background in slot repair. I began as a slot attendant in December of 1994 - Wow! A little over ten years already - and worked my way up from there. I went from slot attendant to helping with floor supervising, tech trainee, regular tech and now my title is assistant lead technician.

Over the years, I've had some training with Sencore, Sodak, and Aristocrat. Other training classes I've been to were good as well. Last fall, we held a two week slot tech course at our casino and it was the best I have been to yet. I went to a TechFest last spring and that was a lot of fun too. Anyway, back to some general slot repair.

**IGT S-Plus Reel Slots**

We still have some on our gaming floor and customers love to play them. Some of the problems I've run into and repairs are as follows:

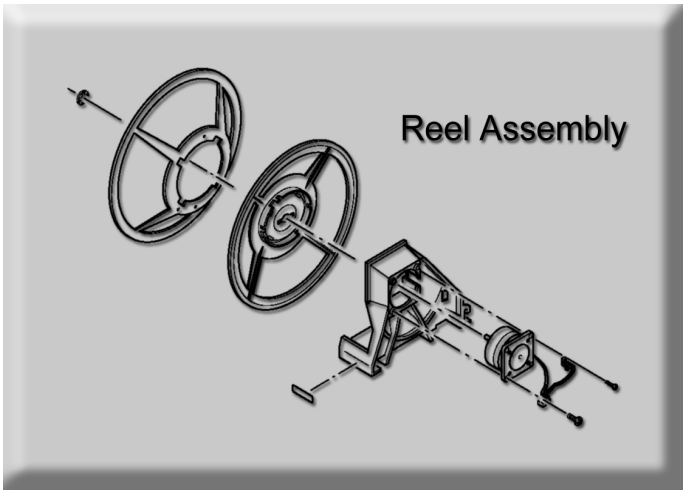
Code 41, 42 or another reel tilt? One thing to look at is the reel "basket." It is the part that the reel strip sits on. Pull the suspected reel out of the game and take a look at where the reel basket meets the stepper motor shaft. Sometimes there will be a couple of small cracks around that area and will cause reel tilts. This is somewhat more common in "nudge" games such as the IGT Fourth of July program with the rockets pointing up or down. After the reels stop, if the rocket points up or down it will nudge one step to the payline.

The best thing to do is to replace the bad reel basket if it does have cracks. Be sure to put the reel strip back on properly. IGT uses two notches on their reel strips and there are corresponding notches on the reel baskets but they are kind of hard to see. On the side of the basket, sometimes you can feel with your finger a little bump where the notches are or simply use a flashlight.

**I.G.T. S-Plus Hoppers**

These hoppers use a 110vac motor to drive them with very low gearing. The 110vac motors are square looking with a brake unit on them.

Code 31s or 32s? Some of the problems we ran into with the code 31s are that a coin is sometimes in the coin-out optic. The hopper brake didn't stop the motor in time. When you look at the hopper motor assembly, there will be a small spring on it. This spring is very important. It can't be stretched out or miss-



ing. The brake assembly has to be clean as well. If there is a bunch of coin dust and grime, the brake can't work as fast, therefore giving you hopper tilts. What I do with them is clean the area where the break is, inspect the spring and turn the pinwheel with the brake released and test it out. When you let go of the brake, the pinwheel should stop instantly. Code 31 or 32 maybe even 33 could also be caused from dirty coin-out optics. The coin optic needs to be taken off to be checked. On the older games it is only one screw. In the newer models, IGT put an optic cover on it but still it is only a few screws. Sometimes these optics will crack, maybe because of a real bad coin jam or whatever. The optic assembly is simple to replace. Just remove a few screws, a ground wire and a couple other wires.

**ARISTOCRAT with the CBV type bill accepters and black stacker boxes**

Are you having "stacker box missing" faults or a bill accepter that won't accept a bill at all? Maybe it won't "cycle" properly. Some of the problems that we have run into are the stacker boxes. I have pulled out the box and noticed that one of the eight pins was pushed in a little. Well, if the pin is pushed in, it can't make a good connection. You may look at it and ask, "How can I repair this thing?"

It isn't very hard at all, nothing too it. There are four screws on the top of the box and sometimes two rivets. Remove the screws and pop the rivets to take off the box cover. On the pin that is pushed in, tug a little bit on the inside of the box and the pin should come out.

What needs to be done.....CAREFULLY... is to bend in the two sides towards the wire. If the connector is completely square looking, it will push out easily again. At the bottom of the pin (near the wire) the pin should have a " V " look to it. When the pin is put back in the connecter, it will be snug. A small screwdriver is needed to push it back in. Then, pull on it a little bit to make sure that it is secure.

I also check the other pins to make sure that they are snug. Again, take a small screwdriver and gently push on them to make sure they are good to go. While the stacker box is apart, why not clean it up some? Ours always have a bunch of dust balls in them. Use canned air or a small air compressor to blow out the dust and dirt. To test the stacker box, trace the red and black wires from the stacker box motor to the pins on the outside of the box. The motor runs on around 9VDC, so if you have a variable DC power supply, it can be connected to the red and black pins and bingo! You can now see how the inside of the stacker box works. The "bill pusher" should move straight up and down and such. If you don't have a variable DC power supply around, a Test Cable is easy to make. Simply use a nine-volt battery, a connecter and two alligator clips. It works great.

**- Pat Porath**
**pporath@slot-techs.com**

# Ireland's 26th AmEx Continues Successful Run

**AmEx 2005 - The 26th Irish Amusement Trade Exhibition was held on Tuesday 1 and Wednesday 2 March 2005 at the Lynch Green Isle Hotel, Dublin. Visitors from all over Ireland and further afield converged on Dublin for the two most important days in the Irish Amusement Trade Calendar.**

In addition to the exhibition, the event also included a programme of meetings, business presentations and social gatherings, continuing the show's reputation for bringing together Irish and international manufacturers, distributors and operators in a businesslike atmosphere, to discuss important issues and engage in an exchange of views with their peers.

Returning international exhibitors and visitors noticed a re-emergence of the Celtic Tiger, with road building and widening, hotel construction and expansion, the arrival of the Luas light rail system, work on a Port Tunnel and many other projects indicating that the Celtic Tiger is alive and well and living in Dublin!

Apart from exhibitor to visitor sales, business was also transacted between exhibitors and even between visitors. A programme of post show publicity, put in place by the organiser, means that exhibitors will continue to benefit from their participation in the show, long after the event.


**Siobhan Breen, Martin Woods, Seoirse McCann and Jim McCann, Kimble with Match 'n' Win poker.**


**Anthony Boulton, Project Coin with Casino King.**

On the social side the Happy Hour exhibitor party, sponsored by Kimble, was its usual success, followed by live music in the hotel lounge. The hotel restaurant, along with other local hostelries and city centre dining and night spots, entertained both exhibitors and visitors in the manner they have become accustomed to.

## Gaming

There was considerable interest in gaming, especially in view of the recent announcement from the Minister for Justice, that it is his intention to provide a basis to update stake and prize money limits in the Gaming & Lotteries Act, by way of regulation, which will require primary legislation (an Act of The Oireachtas / Parliament).

It is believed that limits in other EU countries will be one of many considerations to be taken into account when deciding on the new

Derek Lynch, Carnaby Gaming with Ruby 7's.

limits. As this is not the first time this promise has been made, the important question is when will it happen?

2006 is the 50th anniversary of the introduction of the Gaming & Lotteries Act. It is unbelievable that the industry is governed in the 21st century by a piece of legislation introduced in such different circumstances in 1956.

**Conclusion**

**At the conclusion of the show, organiser, Martin Dempsey, thanked exhibitors and visitors for their support. He said: "Thank you in particular for bearing with us in relation to difficulties caused by the ongoing building programme at the Lynch Green Isle Hotel!"**

The programme, which involves the addition of a further 114 bedrooms and suites, health and leisure facilities including a swimming pool, a 350 space multi-storey car park, meeting rooms, the expansion of the existing foyer area and the addition of a new lobby area adjacent to Clifton Ford Suite, will be completed this summer. This will enable the show to expand further and offer top class facilities.

Once the building work is complete, the organiser will invite exhibitors to an Information Day, to view the new facilities and launch the new floorplan for AmEx 2006 - The 27th Irish Amusement Trade Exhibition, which will be held on 7 & 8 March 2006. The organiser also plans to work with exhibitors to address attendance and other issues ahead of next year's show.

AmEx is organised by MD Associates and sponsored by IAEA - The Irish Amusement Equipment Association (Member Of Euromat). For further information email mdassociates@eircom.net or go to **http://tinyurl.com/43clv**

Gerald Steinberg and John O'Farrell, Oasis Retail Services with King Roulette.

# TransAct Technologies Receives Notice of Allowance on Patent Critical for Casinos That Want to do Promotions or Coupons


**Technology Available as an Option on New Epic 950 Thermal Slot Machine Printer**

TransAct Technologies Incorporated has announced that it has received a notice of allowance from the U.S. Patent and Trademark Office that provides claims for its dual port printing technology for the gaming industry. The technology covered by the newly allowed patent application is important for casinos that want to do promotions or coupons.

Included in the newly allowed patent application are claims that cover a dual port printer that can print cash vouchers and also coupons or promotions which can be utilized by casino operators to target marketing programs directly to the slot player. In the printer, one driver or port receives data indicative of voucher information from a local controller and the second driver or port receives data indicative of coupon information from a central system controller. The dual port technology allows the same printer to be used to print both vouchers and coupons.

"This latest patent is extremely important to TransAct because it validates and serves to protect the intellectual proprietary printer technology we offer to the casino industry," said Jon Berkley, TransAct Technologies' Senior Vice President and Business Manager of Worldwide Gaming. "But just as important, it continues to demonstrate our expertise in developing innovative solutions for the casino and gaming industry. This technology, which is an option that is available with our new Epic 950 thermal slot machine printer, enables casinos to utilize slot machine printers for highly effective marketing and promotion activities. We expect that as casinos continue to refine their promotions and marketing initiatives, slot machine printers will continue to play a central role in their efforts. TransAct has the printer line, proprietary technologies and intellectual property portfolio to benefit from this trend."

**About TransAct Technologies Incorporated**

TransAct designs, develops, manufactures and markets transaction-based printers under the ITHACA® and MAGNETEC® brand names. In addition, the company markets related consumables, spare parts and service. The Company's printers are used worldwide to provide receipts, tickets, coupons, register journals and other documents. The Company focuses on the following vertical markets: point-of-sale (POS), and gaming and lottery. All of TransAct's products are manufactured in ISO 9001 certified facilities.

Visit www.transact-tech.com for more information.

# TOVIS

## Part 4 - The Microcontroller
## An Introduction to Digital Monitors

The "brain" of a digital monitor is its microcontroller. The microcontroller has a hand in many factors of monitor operation including synchronization, color temperature, remote control inputs, LED outputs and even raster geometry and rotation.

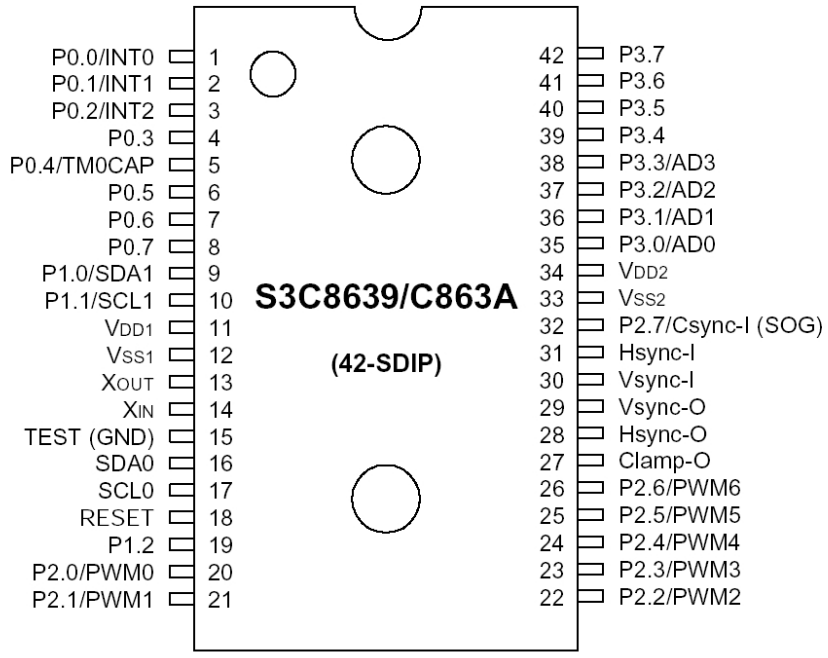
In this case, the microcontroller is a Samsung type KS88C6348 or S3C863A. At first glance (see figure 1) this IC doesn't look much like anything you'd find in a monitor. Of course, you see the usual power ($V_{DD}$) and ground ($V_{SS}$) pins. There's a "reset" input at pin 18 and a couple of pins marked "Xin" and "Xout" which are connected to an 8 MHz crystal. This is the "clock" oscillator for the microprocessor that is embedded in the device. These are all things that you'd expect to find in any microprocessor system.

Of course, since this system uses the $I^2C$ bus, we see our SDA (data) and SCL (clock) connections as well. There are actually two sets of $I^2C$ connections. One is the Multi-Master $I^2C$ bus (SDA0 and SCL0) that goes to everything in the monitor, such as the two video ICs on the neckboard (as covered last month) and other ICs on the deflection board as we will see in subsequent articles. There is a second, "slave only" pair (SDA1 and SCL1) that will allow the microcontroller to communicate with a peripheral device in the outside world. These two signals are actually routed to the Amp MetriMate Drawer Connector that connects the monitor to the rest of the slot machine.

Closer inspector does reveal a small handful of pins marked "sync" at pins 28-31. Since we know what sync is (Slot Tech Magazine, November 2003, page 30) this is a good place for us to continue looking at just how this digital thingy fits into our formerly 100% analog world of monitors.

As covered previously, there are standards for monitor resolution and sync polarity (see figure 2). Depending on the resolution of the monitor, the sync polarity for both vertical and horizontal sync may be either positive or negative. Monitors need to be able to handle both types of sync. In the past, this has been the job of a sync processor circuit (typically made from a 7486 quad, exclusive-or gate,

**Figure 1**




**The microcontroller is a Samsung type S3C863A. At first glance, this IC doesn't look much like anything you'd find in a monitor.**

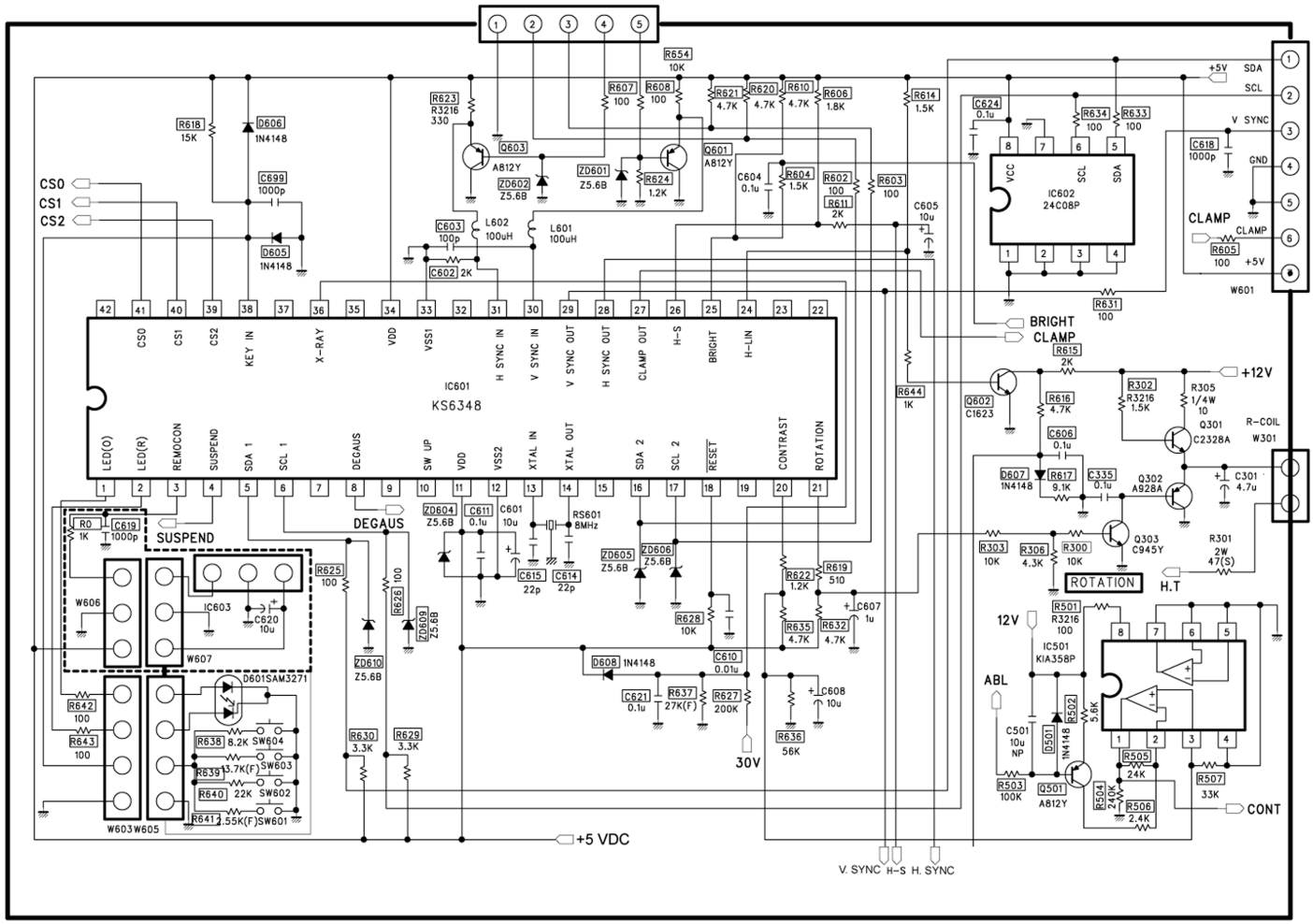
which was, for a time, the only digital IC in an otherwise analog monitor) or a dedicated sync processor IC such as the WT8041, featured in the aforementioned November 2003 issue.

Responsibility for sync processing now lies with the microcontroller. The microcontroller accepts sync pulses of either polarity at its inputs and delivers positive sync (only) at its outputs. The device actually generates its own output pulses (it's not simply processing the inputs and spitting them back out) so the sync pulses are always perfect, regardless of how ratty the input sync might be.

The monitor uses a neat (and simple) way to accept sync inputs of a variety of levels and input types. The sync signals are applied to the bases of transistors Q601 and Q603. Notice that these are both PNP transistors where we are used to seeing NPN transistors in this application. The collectors are grounded, making this a "ground switch" but instead of requiring the incoming sync to "source" the base current (as it would with an NPN configuration) this circuit is looking for the incoming sync pulse to "sink" the base current.

This is a somewhat better design in that all we have to do (from a driver standpoint) is pull the sync input low. We don't have to provide a current source. Any time an interface has to source current, you can run into problems. Pinched wires, for example (a common fault that is no stranger to slot techs) can pierce the insulation of a wire and ground it out. This is no problem if the wire is meant to go to ground at some time anyway but if the wire is carrying current from a source and it becomes grounded, the source has to be protected (current limited or fused) in some way or the driving device will be damaged by the short. These are some of the little things that separate good designs from bad ones. They both function properly under normal circumstances but "what if . . .?"

There are quite a few pins labeled "P0.x, P1.x" etc. What



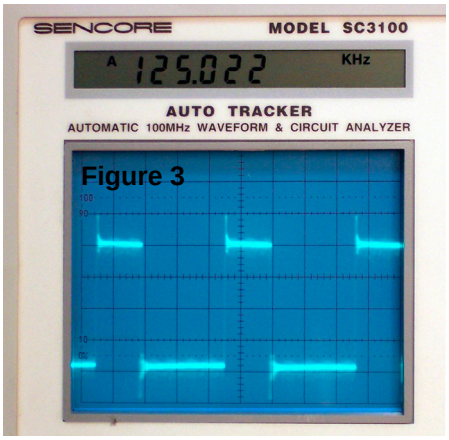
are these all about? These are the microcontroller's "ports" through which it communicates with the outside world. Most of the ports are "bi-directional" allowing the microcontroller to both talk and listen on the same pin. This is used (among other things) for communication between the microcontroller other ICs in the monitor.

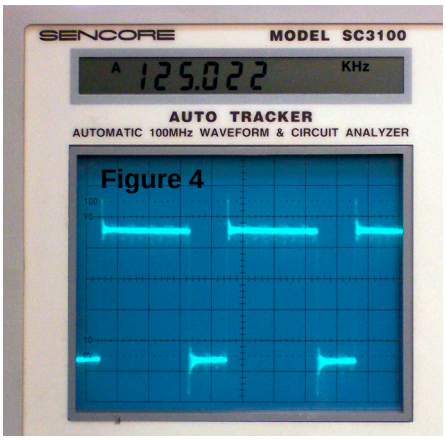
Some of the ports are outputs only. These outputs are pulse-width modulated. If you're a regular reader of Slot Tech Magazine, you already know about PWM and how it is used to regulate the output voltage of a power supply. However, PWM is not limited to just power supplies. PWM is handy for all manner of things. We see a good example here in the way the monitor handles the task of raster geometry, in this case, raster rotation.

The entire raster can be rotated by means of a rotation coil that is built into the deflection. This coil is completely separate from the horizontal and vertical deflection coils in the yoke. By applying DC to the yoke, it creates a magnetic field that rotates the raster. Pin 21 of the microcontroller is used for the rotation output. This is a PWM output. The duty cycle of the output is set by the microcontroller. This can be observed by 'scoping the output at pin 21. Figure 3 shows the PWM output when it's at its minimum duty cycle. By entering the menu and adjusting the rotation, we can watch the duty cycle increase to its maximum as shown in figure 4.

Hey! Wait a second here. It takes DC to drive the rotation coil and all we're getting out of the PWM output is a bunch of pulses! That's not gonna work, is it?

No, it's certainly not. So, the next trick is to somehow turn that string of pulses into DC. That's going to require a lot of complicated circuitry, isn't it? Nope! All you have to do to turn PWM into DC is hang an electrolytic capacitor on it. That's it! On the other side of R619 is a small electrolytic capacitor, C607. This changes our pulse train into a DC voltage that varies from 1.8 to 3.3 volts, depending on the duty cycle of the PWM output. This variable DC voltage is then used to control the base bias of transistor Q303 which, in turn, controls the base of Q302 which, in conjunction with transistor Q301 controls the current to the rotation coil.




What we're doing here is using a digital device (the microcontroller) to control an analog circuit (the DC bias on the rotation coil). Using PWM

| | | Resolution | H(kHz) | V(Hz) | (H/V) |
|---|---|---|---|---|---|
| 1. | VESA(r) | 640 x 400 | 31.47 | 70.00 | -/+ |
| 2. | Ind VGA | 640 x 480 | 31.47 | 80.00 | -/- |
| 3. | VESA | 640 x 480 | 37.50 | 75.00 | -/- |
| 4. | VESA | 640 x 480 | 43.28 | 85.00 | -/- |
| 5. | VESA | 800 x 600 | 35.13 | 56.00 | +/+ |
| 6. | VESA | 800 x 600 | 46.87 | 75.00 | +/+ |
| 7. | VESA | 800 x 600 | 53.68 | 85.00 | +/+ |
| 8. | VESA | 1024 x 768 | 48.34 | 60.00 | -/- |
| 9. | VESA | 1024 x 768 | 60.00 | 75.00 | +/+ |
| 10. | VESA | 1024 x 768 | 68.68 | 85.00 | +/+ |
| 11. | VESA | 1280 x 1024 | 63.96 | 60.00 | +/+ |
| 12. | VESA | 1280 x 1024 | 79.96 | 75.00 | +/+ |
| 13. | VESA | 1280 x 1024 | 91.12 | 85.00 | +/+ |
| 14. | VESA | 1600 x 1200 | 75.00 | 60.00 | +/+ |
| 15. | VESA | 1600 x 1200 | 87.50 | 70.00 | +/+ |

**Figure 2. Monitor resolution, horizontal and vertical frequencies and sync polarity for various VESA standards**

and an electrolytic capacitor is a nifty way to convert our digital signal into an analog voltage.

But what if we want to go the other way around? What if we want to monitor an analog voltage? The microcontroller can do this for us as well because four of the input ports (P3.0 - P3.3) have the ability to perform analog-to-digital conversion (ADC).

X-Ray protection is a good example of how we can use ADC to monitor an analog voltage. We monitor the EHT by looking at the output voltage from a low-voltage winding on the flyback transformer (Slot Tech Magazine, February 2003. Page 30). In this case, there is a 30 volt winding. The output is rectified and filtered as usual to create a DC supply that is directly proportional in voltage to the EHT voltage. That's the input you see on the schematic marked "30V."

After passing through a voltage divider made from R627 and R637, we apply 3 volts DC to pin 36. You'll notice that this pin is labeled "X-RAY" on the schematic diagram while the pinout labels it for what it really, is: P3.1 which is analog-to-digital channel 1 or "AD1." See how that works?

With the microcontroller performing the conversion, the device can now monitor the EHT through the low voltage at pin 36. We no longer use a Zener diode and potentiometer to set a "trip" point for x-ray shutdown. The microcontroller always knows what the voltage is and the "trip" point is set in software.

Another example of ADC is the "KEY IN" input at pin 38. In this case, the "key" to which they are referring is really the remote control PCB and the four push buttons that are on it. This is another of the ADC ports (P3.3/AD3). Each of the buttons is connected to a resistor that becomes part of a voltage divider. When each button is pressed, the voltage at pin 38 changes. When all of the buttons are open, the voltage is 5 volts. When the "mode" button is pressed, the voltage drops to .725. The "select" button produces 3 volts. "Up" is 1.75 volts while "down" produces 2.4 volts. There's even a sort of "Easter Egg" here in that depressing both "up" and "down" at the same time puts two resistors in parallel and produces 1.25 volts.

Of course, you can see where all of this is leading. This scheme allows us to read four buttons (plus the bonus "Easter Egg" combination) using just a single wire with no active components at all. The microcontroller simply reads the analog voltage at pin 38 and responds accordingly, as set in software. The "Easter Egg" actually triggers a factory set-up menu that is more-or-less like the conventional menu (entered by pressing the "mode" button) but remains on the screen rather than shutting off automatically after about 8 seconds. This is handy when you're setting up a monitor in a machine.

Naturally, there are other things happening at other ports as well. Pins 1 and 2 are simply general-purpose ports that are used to drive the LED on the remote adjustments PCB. This LED, combined with the on-screen display, give you important information about the operation of the monitor, specifically, the sync. If you are missing both sync signals (vertical sync and horizontal sync) the monitor scans at its "native" resolution (48 kHz H/72 Hz V) blanks the video inputs and displays only the OSD which reads "No Signal" and reminds you to check the cable. You will not be able to enter any menu nor invoke any operation through the remote PCB. The green LED will be lit continuously.

If you have one sync but not the other, the screen will be completely blank (in fact, the monitor will go to sleep, shutting down the high voltage and deflection) but the green LED will blink. In other words, this monitor will not let you see an out-of-sync picture.

If you have both sync signals but for some reason you have no video input (an admittedly rare condition) you will have a blank screen but the green LED will be continuously illuminated.

**- Slot Tech Magazine**

# TechFest 11 Mystic Lake Casino - Minneapolis, MN May 10th - 12th 2005

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This is a technical presentation. This TechFest has an even greater emphasis on monitor repair with the addition of a full day of Ceronix monitor repair, presented by Paul Alexander of Ceronix. This follows on the heels of the first two days, where attendees will learn the basics of monitor repair, followed by a detailed look at the monitor circuitry and common monitor faults presented by Slot Tech Magazine publisher Randy Fromm.

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