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## FutureLogic Challenges Transact Patent Application

FutureLogic, Inc. has announced that it is challenging allowance of Transact Technologies' patent application on the basis of FutureLogic's currently pending patent applications with the U.S. Patent and Trademark Office, which cover various features of FutureLogic's GEN2 promotional printer.

FutureLogic's original patent application filing on the GEN2 promotional printer, submitted in March 2002, discloses promotional printer communications, database storage, and coupon triggering in a cashless game. Most importantly, the pending patent application incorporates broad claims related to a dual-port technology that allows the printer to communicate simultaneously with both the gaming system and the gaming machine. This technology enables simultaneous printing of both vouchers and promotional coupons with a single device.

Transact did not disclose FutureLogic's pending patent applications or other related gaming technologies before obtaining an allowance of Transact's patent application.

"Before allowing some claims in Transact's patent application, the USPTO was not given the opportunity to consider the true chronology of the development of dual port printing of coupons and vouchers within the gaming industry," said Anthony DiMarco, President and CEO of FutureLogic, Inc. "As our pending patent applications have earlier effective filing dates than Transact's patent application, we fully expect to be the senior party in any future proceedings before the USPTO."

## Octavian buys 50% stake in WIN Systems

Octavian International, has acquired a 50% stake in WIN Systems, the Barcelona-based downloadable games platform and lottery systems specialists. WIN Systems is an established global provider to the gaming industry, offering software, networks and support services that power online lottery systems, server-based gaming devices and VLTs (Video Lottery Terminals). WIN's customers include national and state lotteries, racetracks and casinos in Spain, India, Russia and Latin America, while its technology partners in recent years include Octavian, Motorola, Tecnost Sistemi Olivetti Group and Oracle. Octavian CEO Harmen Brenninkmeijer described the move as, "A natural next step" in the two companies' collaborative working relationship.

The WIN Systems offering is a natural extension of Octavian's Casino Network Systems. With our acquisition of WIN Systems and Ishir Infotech we now have the capabilities to market our existing solutions while simultaneously redefining the systems in line with the predicted integration of lotteries and casinos. We can now offer systems for casinos, lotteries and arcades, including our own or third-party content. In addition to extending the scope of our solutions, we now have close to 200 developers, which makes us one of the largest and most versatile independent turnkey gaming software suppliers", said Brenninkmeijer.

"Octavian has previously worked with WIN on a number of joint projects, notably CreLOT, the world's first fully transparent lottery system, and we are currently working with one another on new projects in Eastern Europe and Latin America", added Brenninkmeijer. "WIN's operating system has proven to be successful and is well established in many countries where they meet legislative requirements and operate as an approved and well-known supplier. WIN's market presence and technological leadership gives us an enhanced platform for the further development of Octavian's own downloadable games and VLT offering." Commenting on the deal, WIN Systems CEO Dario Zutel said: "Since 2001, a particular focus for WIN has been our WIN VLT platform, a cutting-edge product developed specifically for the emerging market for server-based downloadable games. When you add that to Octavian's extensive experience in the development of server-based game content and their centralised systems for auditing, tracking and enhancing gaming operations, you can see why it made sense for WIN and Octavian to forge even closer links."

### Randy Fromm's Slot Tech Magazine

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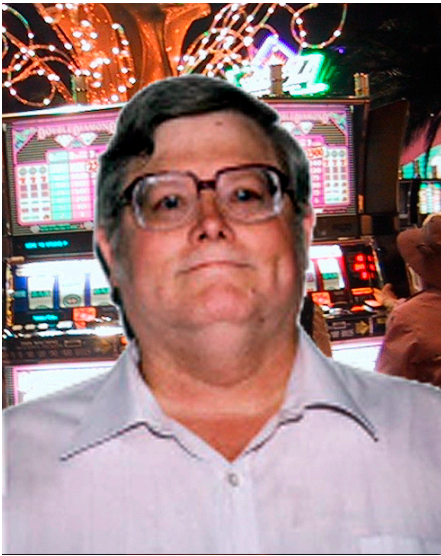
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## PuLsE GeNeRaToR

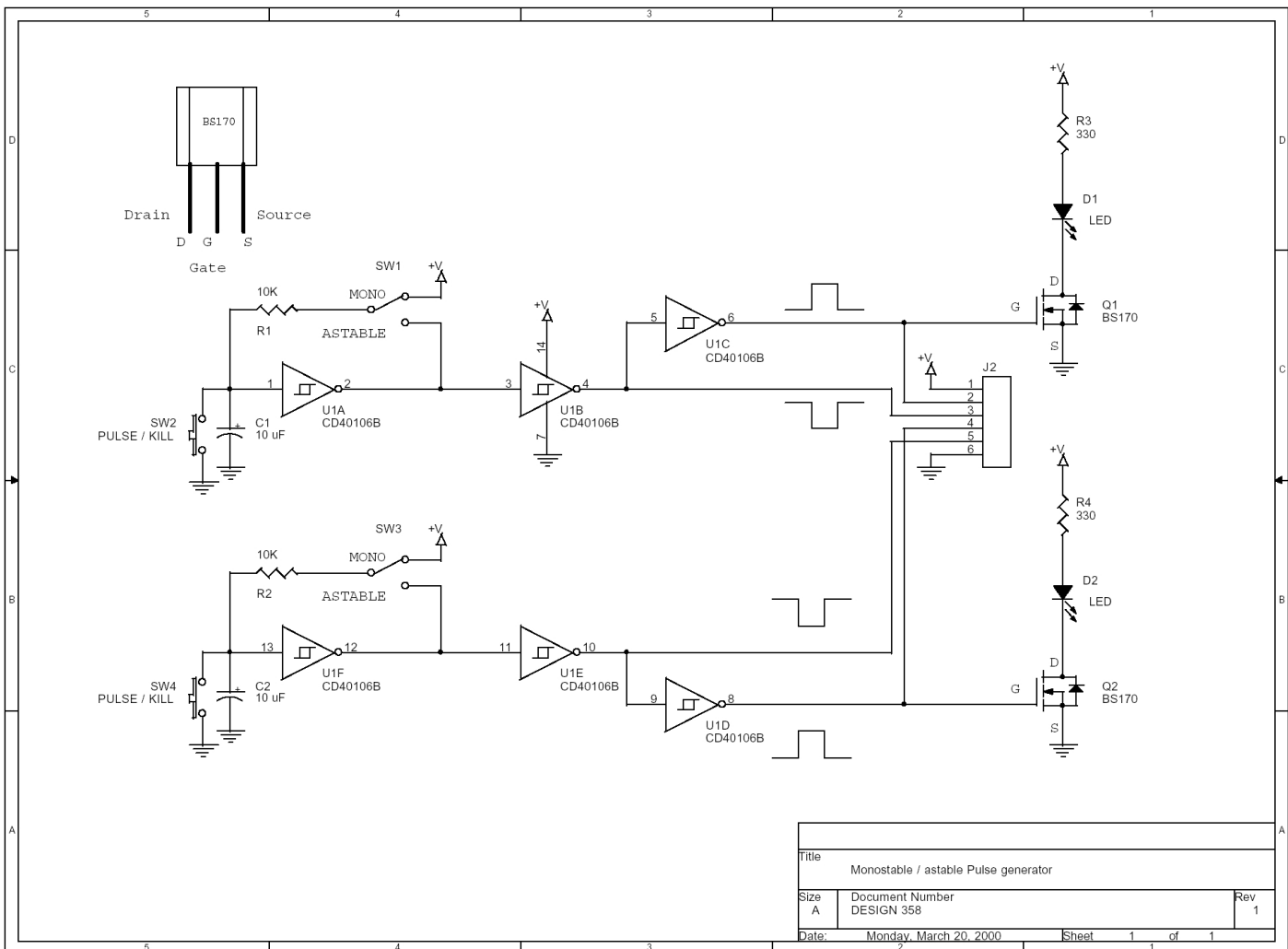
By Herschel Peeler

fixtures or Lab Exerciser in our training course. Here is one we use for generating pulses. It will generate single pulses at the push of a button, or a string of pulses.

**W**e have just a pot full (well okay a small pot) of circuits we build to use with our test

Using one IC (CD40106 or 74C14) the whole thing can be built for about \$1.00, not counting a board or box. Like

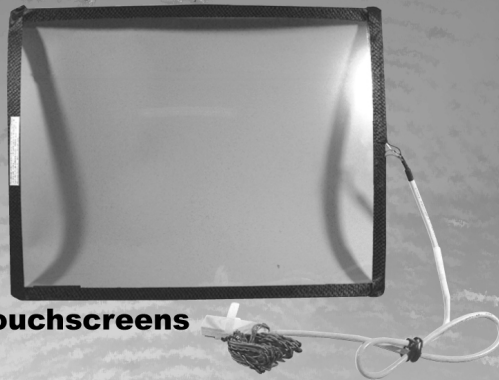
most of our circuits, this is built with parts on hand that are found in most slot machines. If you work in a shop, you should have all these parts on hand. Using the CD40106 (which is a CMOS device) the circuit will run on just about anything from 3 Volts to 12 Volts. You may also use a 74xx14 and be



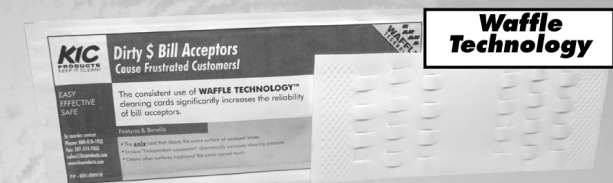


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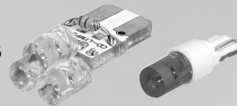


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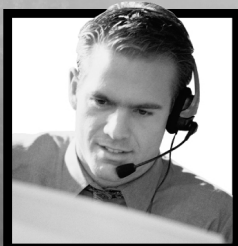


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## BS170 / MMBF170

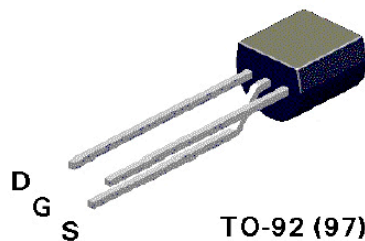
### N-Channel Enhancement Mode Field Effect Transistor

#### General Description

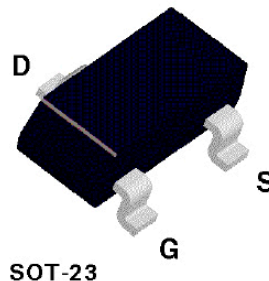
These N-Channel enhancement mode field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. These products have been designed to minimize on-state resistance while provide rugged, reliable, and fast switching performance. They can be used in most applications requiring up to 500mA DC. These products are particularly suited for low voltage, low current applications such as small servo motor control, power MOSFET gate drivers, and other switching applications.

#### Features

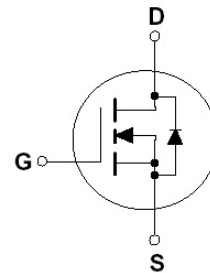
- High density cell design for low  $R_{DS(ON)}$ .
- Voltage controlled small signal switch.
- Rugged and reliable.
- High saturation current capability.



TO-92 (97)



SOT-23



#### Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	BS170	MMBF170	Units
$V_{DSS}$	Drain-Source Voltage	60	60	V
$V_{DGR}$	Drain-Gate Voltage ( $R_{GS} \leq 1M\Omega$ )	60	60	V
$V_{GSS}$	Gate-Source Voltage	$\pm 20$	$\pm 20$	V
$I_D$	Drain Current - Continuous	500	500	mA
	- Pulsed	1200	800	
$P_D$	Maximum Power Dissipation	830	300	mW
	Derate Above $25^\circ\text{C}$	6.6	2.4	mW/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to 150		$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purposes, 1/16" from Case for 10 Seconds	300		$^\circ\text{C}$

#### THERMAL CHARACTERISTICS

$R_{\theta JA}$	Thermal Resistacne, Junction-to-Ambient	150	417	$^\circ\text{C/W}$
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limited to 5 Volt operation. I have successfully run TTL devices on 4.5 Volts or 6 Volts with no problems in simple circuits. For the LED driver transistors I used a BS170. Most any N-Channel Enhancement Mode MOSFET that will turn on at the voltage you are running the circuit at will do. The LED and LED Ballast resistor can be of your choosing. Nothing is critical in this circuit.

### How it Works

The circuit has two identical sections so we will only describe one. We have two switches: a Pushbutton switch (E-000108-368A from a Bally COD board) and an SPDT toggle switch. You may use other switches at your prerogative. With the switch in the Astable position, the first Inverter (U1A or U1F) becomes an oscillator and the circuit generates a string of pulses. With the components as chosen, it oscillates at about 10 Hz. In Astable Mode, pushing the pushbutton kills the signal. With the switch in the MONOstable position, the circuit will generate one pulse with good rise and fall times when you push the pushbutton.

The whole circuit easily fits onto a Radio Shack 276-168B circuit board.

Changing the capacitor or resistor will change the timing. It is a simple formula.  $T = R \times C$ . The time (in seconds) is equal to the resistance (in megohms) multiplied by the

capacitance in microfarads.

On initial power up, the capacitor is discharged, so the input to pin 1 is Low, which gives a High out on pin 2, a Low out on pin 4 and a High out on pin 6. In astable Mode, pin 2 being high charges the capacitor through the resistor ( $T = R \times C$ ). When the capacitor finally charges up, pin 1 is seen as a High, pin 2 goes Low, pin 4 goes High and pin 6 goes Low. Now that pin 2 is Low, the capacitor is discharged through the resistor (another  $T = R \times C$ ).

When the input finally gets Low, pin 2 goes High and the process starts all over again.

In Monostable Mode, one side of the resistor is always high. When you push the pushbutton, pin 1 goes Low for as long as you are holding the switch. When you release the switch, pin 1 eventually goes High and stays. We get a Low pulse out of pin 4 and a High pulse out of Pin 6.

If you choose to use the BS170, the pinout of it is included in the schematic.

- **Herschel Peeler**  
**hpeeler@slot-techs.com**

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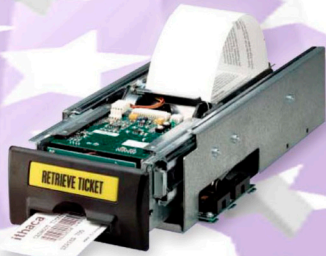
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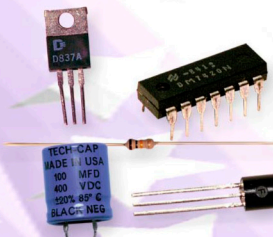
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# NIGA 2005

## Highlights from the 2005 National Indian Gaming Association Show, San Diego, California

by Loren Adams

This year's NIGA Show, April 11-13 in Slot Tech Magazine's home town of San Diego, had the feel of an organization and an entire market that is clearly on the move. Kicked off with a golf tournament and well-attended Chairman's Reception, the show featured two days of seminars, meetings and the trade show itself. Here are some of the people, products and companies who contributed:

### Risk-Free Bill Validation

Mars Electronics International brought its CashFlow SC Series bill validator with an extra feature: a 90-day risk-free trial.

"Most people don't think of a bill validator in terms of return on investment," said Rick Lopez, new Western Regional Sales Director for MEI. "Our offer is truly risk free. When [an operator] agrees to participate, we'll come and put the validators in there and let them use them for 90 days. If their ROI does not increase during that time period, we'll simply come and take them out again."

Lopez says the new CashFlow is able to increase incoming cash with a new, "overengineered" transport system combined with an advanced note recognition system; this means the unit almost never rejects a bill even if it is crumpled or damaged. The cash box is now made of welded plastic, meaning less maintenance, fewer replacements and lower cost of ownership. According to Lopez, the risk-free trial is designed to highlight the increased cash flow the new unit provides.

### New Name, New Products

One of the main topics at the Sodak booth this year was to announce the name change from Sodak to IGT.

"IGT and its Native American Gaming division, Sodak Gaming, have responded to growth and changes in Indian and commercial gaming by reorganizing their resources to best serve customer's needs," said Kenny Putnam, Vice President of Marketing for Sodak Gaming. "This reorganization is designed to



Philip Wesel - Global Gaming Market Manager for MEI, stands behind his product (literally) the CashFlow SC66 bill validator at the recent NIGA show in San Diego, California.



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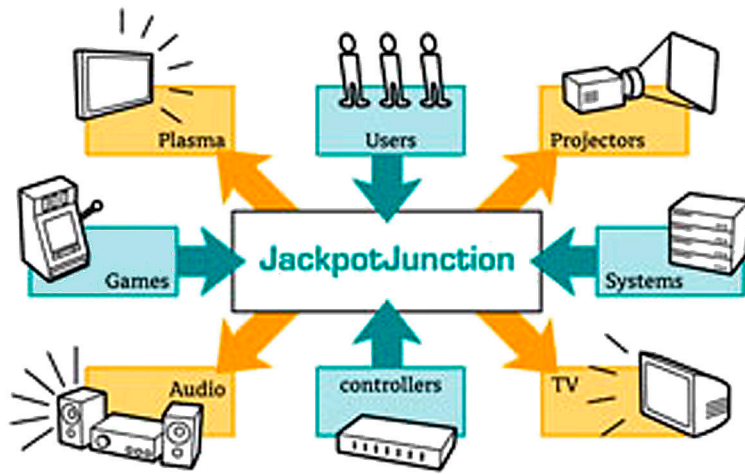


maximize the proximity of corporate, sales and service resources to customers, thereby allowing IGT to be more responsive to customer needs and concerns.”

The company also brought two attention getting new additions, Fort Knox Progressives and the Star Wars video slot machine. Fort Knox links multiple banks, including spinning reel alongside video slots, and allows independent banks of IGT machines. A progressive controller can operate up to 63 games simultaneously. An overhead, 40-inch LCD continually displays jackpot amounts as well as messages to jackpot winners. A four-level mystery progressive jackpot, featuring on-screen vault doors that give players the chance to win any of four jackpots, shows on each machine's LCD.



The system is currently available as 25-line, 500-coin games, with 30-line, 600-coin penny themes coming soon. The Star Wars machines are themed after the legendary film series, including the original “Star Wars” and the new film “Star Wars: A New Hope.” Both five-reel,



30-line, 300-coin penny games operate on the Advanced Video Platform (AVP) and allow players to experience the game with original stereo sound and high-resolution clips from the films. The “Star Wars” unit features a unique spinning “Death Star” top box bonus.

### **New Ways to Display**

Gaming Support, manufacturer of display equipment that links into and enhances slot systems, showed JackpotJunction, a multi-tiered, audio/visual promotional engine that allows operators to configure and broadcast jackpot data through a wide variety of media outlets. The system can connect to plasma displays, closed circuit television, exterior displays or a variety of overhead projectors, and collects raw outputs from all networked devices. It then converts the data and sends it to the media outlets when a triggering event occurs. The result: a stunning multi-media display, in specific areas or throughout the operation as configured by the user. JackpotJunction is delivered in the form of a simple hardware and software package.

### **Automated Table Games**

JCM American Corporation displayed the latest in table game automation with the Trident™ table safe system. It includes modules for each key station in the casino, including an “intelligent” cash box at the table and a docking station for the soft count room that audits by cash box. It also provides live drop information and continuous table status to the pit and operational trends as well as performance and financial reporting to the back office. According to JCM, the Trident system also includes a Set Ticket Program & Printer station, and a module for downloading software.

# Why have a slot down?

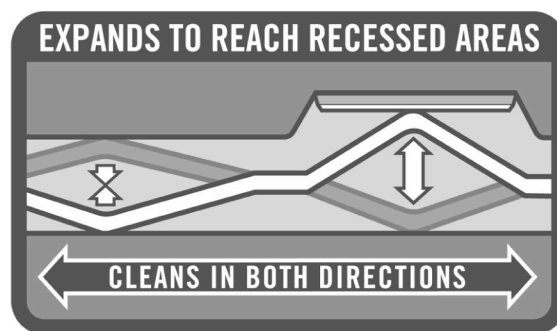
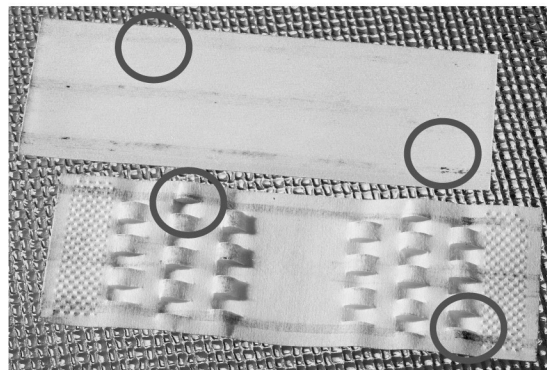


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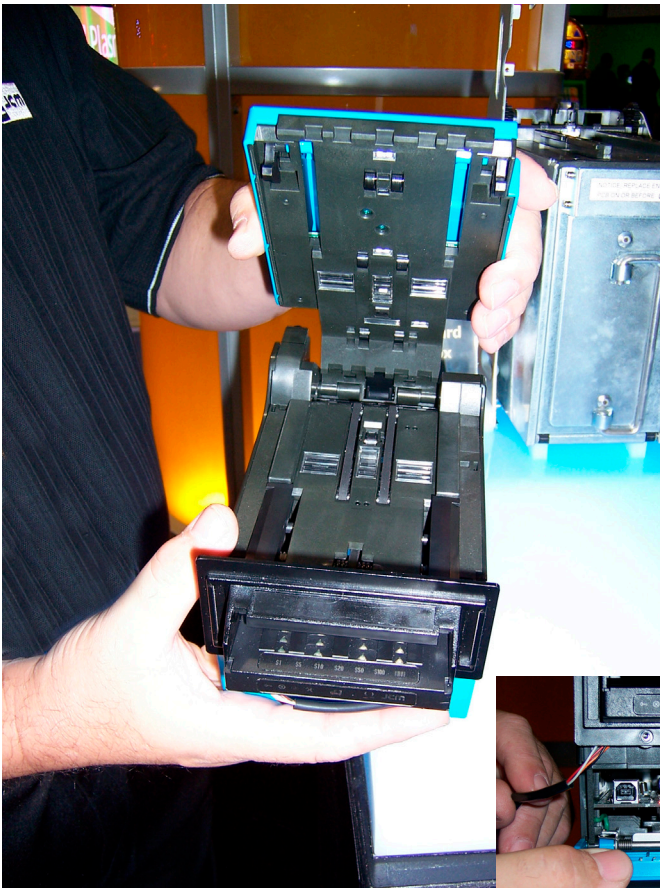
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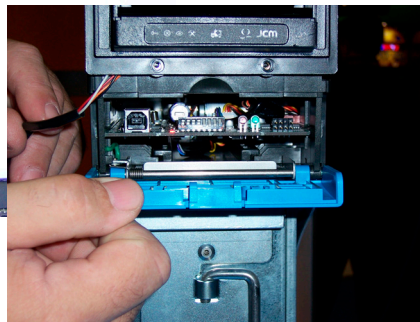
JCM showed its UBA bill validator with eight-megabit memory, downloadable Flash or Socketed EPROM and a 500-note capacity.

JCM says the new Trident system will minimize operator processes and reduce operating overhead cost.

The company also showed its UBA bill validator with eight-megabit memory, downloadable Flash or Socketed EPROM and a 500-note capacity. The main feature of the UBA is its bill sensing technology; it uses both magnetic and optical sensors including infrared, red/green LED, phototransistors, UV, reflective, transparent and bar code sensors. According to JCM, the UBA can accept any valid bill in the world up to 85 mm wide, simultaneously without having to change the software.

## Back to the Basics

AC Coin & Slot arrived with its first five-line game, Jumbo Popcorn Slotto®. The new five reel, 27-coin slots appeal to the traditional, lottery-based customer. Jumbo Popcorn is a follow-up to the company's popular Popcorn Slotto theme, larger in size and offering more paylines and low coin-in. Jumbo Popcorn Slotto is based on AC Coin & Slot's S2000 theme in penny denomination. The product is part of a "back to basics" marketing strategy that the company is pursuing in 2005, according to Chris Strano, AC Coin & Slot's vice president of marketing.



"We've seen a market where everybody is chasing video," said Strano. "We thought, let's go back and get the quarter players." The strategy reflects "more of a retail approach," said Strano, who has a retail marketing background. The approach will be supported by basic, non-licensed product that targets the 62-year

old female who most plays slots, according to Strano.

NIGA show report courtesy of Casino Enterprise Management Magazine [www.casinoenterprisemanagement.com](http://www.casinoenterprisemanagement.com)



AC Coin & Slot showed their Jumbo Popcorn Slotto®. and Bankroll

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## Random Ramblings - Part 3

By John Wilson

In previous months, we examined the random number generator found inside many of today's electronic devices, including slot machines and gaming devices.

We have learned that our slot machine random number generator is strictly a mathematical equation that requires a number to be 'fed' to it as an input. It performs some op-

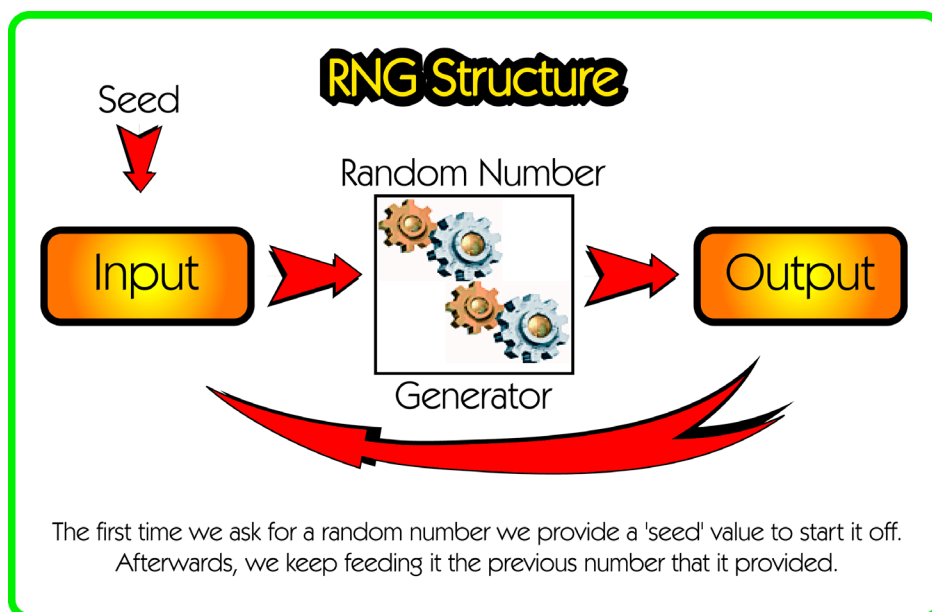
eration on this value and then returns another numeric value 'output.' This output value is then used to generate the next random number. In this means we have a linear list of random numbers that is derived by repetitive calls to this formula. This results in a finite set (aka group or cycle) of numbers that repeats itself.

A roulette wheel is a random number generator - there are 39 possible outcomes and the device is made to provide an unpredictable outcome. Strictly mechanical, it works with the same theory as the electronic counterparts. It is designed to provide a numerical value that you cannot determine beforehand. It must provide equal opportunity to

each value and not favor one or more values.

As you can imagine, the creation of a random number generator creates a great deal of problems for the random number generator engineers. Not only is the resulting number(s) not random (and technically it is called a pseudo-random number), it/they is/are actually very predictable. By keeping our formula secret, we reduce the chance of hackers learning our pattern. We make the cycle very long so that it is almost impossible to discern the pattern. And we can do other operations on the number to make it even less predictable. If we create a formula that has a set of over 4 billion numbers, we can be pretty sure that it won't be memorized.

However, this security is only part of the random number generator process. There are a number of tests (that we will study next month) to ensure that the random number generator is fair,



ACME RANDOM NUMBER GENERATOR

49

43 53



treats all numbers equally (and, consequently, doesn't treat any unfairly) and has no underlying pattern that we aren't aware of that could be easily learned by others. For example, our random number generator could result in every fifth number being an odd number. This would be a repeatable pattern that we might not notice, but someone else might.

### Gentlemen, Start Your Engines

There is another commonly used method that we haven't discussed. While sitting idle, the slot machine is constantly cycling through random numbers. This is cause for a common misconception - that the random number generator is a 'device' that spits out random numbers. We picture a physical object that works similarly to the production line at Krispy Kreme. The numbers are formed, processed and otherwise created

so that at the end of the line, the finished product (a shiny new random number) comes off the conveyor belt. This analogy is actually pretty good, with one exception. The random number generator isn't a physical device - it is a mathematical formula that simply takes an input, processes the input, and returns some output (our random number). Rather than thinking of a large donut-making machine, think of a mathematical function. In this regard, you cannot 'turn on' or 'turn off' our random number generator. You simply call it from a computer function and it responds with your number. It's much like calling a number on your telephone, speaking the last number you have received, and then you are told the next number. Repeat this again to get the subsequent number. In the case of the slot machine, we would make such a telephone call every

10 milliseconds (or 100 times per second).

The slot machine processor is designed to call this function over and over again. It may ask the random number generator to generate a new number every 10 milliseconds whether the number is required or not. In this regard, the random number generator is producing a long string of random numbers, one after another. Figure 2 (overleaf) illustrates how this works.

When we initiate a slot game and the processor requires a random number, it simply picks the next one of our 'stream' of numbers. This means that hundreds and thousands of numbers are missed - that is, not used in game determination. This provides great security and makes the slot player an integral part of the random number generator, without them even knowing it!



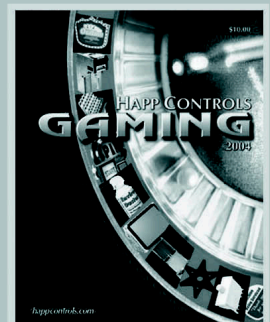
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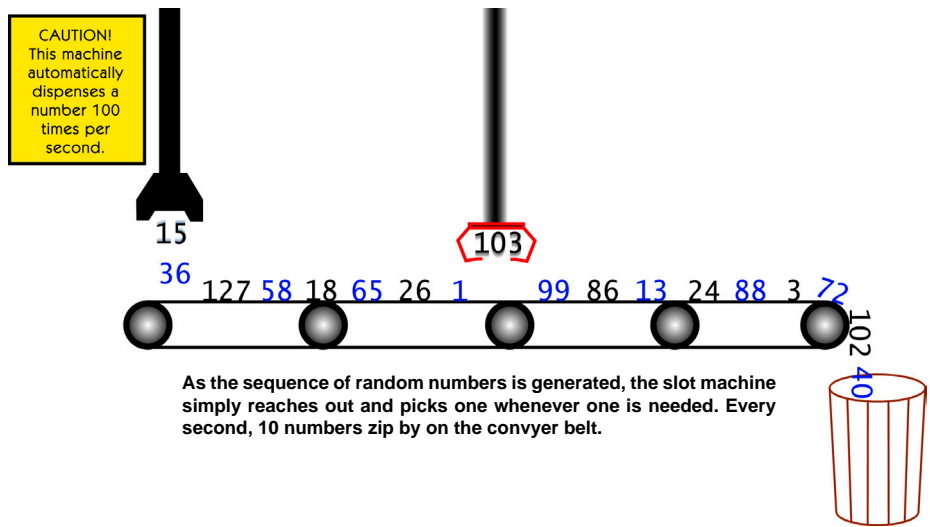
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Consider the example of a random number being generated 100 times per second. For a 32-bit set (4,294,967,296 numbers) it will take 497 days to work through the entire set. If a player pauses 5 seconds between games, a total of 500 numbers will pass by. Even with a printed listing of all possible numbers, you would not be able to determine the outcome with any accuracy. Should you be able to identify the location within the list, thousands of numbers would have passed and you would not know where you were in the list when you started the next game.

In this list, however, we want our numbers evenly distributed. We don't want one number coming up more than another one. They must appear evenly. There was a well-known bug in a version of an early home computer back in the late 1970's. The random number generator favored small numbers, meaning that over the long-term, smaller numbers would be chosen slightly more than larger numbers would be.



Does it matter if the number 1 occurs twice as frequently as the number 10,000,000 does? In the case of our slot machine, yes! How many games will your slot machine play? The cycle may be over 250,000 games. The volatility index is often quoted with a range for 10,000,000 games. The long-term significance is important.

Consider another sinister point. Suppose we have 64 stops on our game. If we know that the random number generator slightly favors smaller numbers then we put the jackpot symbol at the very end of the reel strip - number 64. This number will be picked slightly less over the

long term of the machine - exactly the long term that we used for our revenue projections. This means that our theoretical payout will be skewed - because of a flaw in the design of our random number generator and the application of it into our machine. Similarly, if we put the jackpot symbol at the very first position of the reel, it would be selected more frequently, skewing the results in the opposite direction. In the first example, the casino would make more money than is reported in the PAR sheet. In the latter, the player would come out ahead. In both cases, this isn't right. We don't want to favor the casino or the player. We want the

## The Simpsons (Episode "The Front")

**Lisa:** Look, there's only one way to settle this! Rock-Paper-Scissors.

**Lisa's Brain:** Poor predictable Bart. Always picks rock.

**Bart's Brain:** Good ol' rock. Nothin' beats that!

(Bart shows rock, Lisa shows paper)

**Bart:** Doh!

It's difficult to be 'random'!

games to play fairly. It doesn't matter what the payout is, as long as it is reported, meets approval of your local gaming commission, and is fair. Don't cheat the player but don't cheat the casino, either!

**People are very poor Random number generators. Machines, however, are even worse.**

It's time to try and make our own random number generator. We need some form of a formula to generate these numbers. I've come up with a simple formula that uses 4-digit numbers. We give the Random number generator a 4-digit number, it does some form of mathematical magic and spits out a different 4-digit number. We then send this number back to the formula and it gives us a new number. At a quick glance, it looks like it should mince up the numbers quite well and create a random value. However, we won't know until we test it. Let's examine our formula (figure 3). It's our top secret random number generator formula.

INPUT -> 4 digit number, in the form ABCD. Eg: 8133. A=8 B=1 C=3 D=3

Take each digit and add it together. We will use the last 2-digits of the sum, in case the number has 3 or more digits. Multiply this sum by the first digit of the number. Subtract this value from the last 3-digits of the number. Use the last 2-digits of this result to form the answer.



#### FORMULA:

- (1) Add  $a+b+c+d$
- (2) Multiply a by #1
- (3)  $bcd - \#2$
- (4)  $\#1 + \#3$

*Will this crazy formula make a good random number generator?*

Take the first 2-digit sum and append the answer to it, to create a new 4-digit random number.

Let's try an example and see if this works. I picked the number 8133 at random to be the 'seed' value of our random number generator. Let's manually step through a number of iterations and see if it works!

8133 Sum =  $8 + 1 + 3 + 3 = 15$   
 Multiplication =  $8 \times 15 = 120$   
 Answer =  $133 - 120 = 13$  New number = 1513. Ok, we give the Random number generator the number 8133 and it gives us 1513. This seems pretty random.

Now, we want another random number. We give it the previous number and see what it does.

1513 Sum =  $1 + 5 + 1 + 3 = 10$   
 Multiplication =  $1 \times 10 = 10$   
 Answer =  $513 - 10 = 503$  New Number = 1003

That seems pretty random as well. The first number was

6,620 smaller than the seed value. The second number was 510 smaller than the first number. I don't recognize a pattern, which is a good thing. Let's get another number.

1003 Sum =  $1 + 0 + 0 + 3 = 4$   
 Multiplication =  $1 \times 4 = 4$   
 Answer =  $003 - 4 = -1$ . (Drop the negative sign) New number = 0401 I think I see a problem. The numbers keep getting smaller!

0401 Sum =  $0 + 4 + 0 + 1 = 5$   
 Multiplication =  $0 \times 5 = 0$   
 Answer =  $401 - 0 = 401$  New Number = 0501 Ok, now they are getting larger. Whew!

Here's the numbers we get, if we start with 8133:

8133, 1003, 0401, 0501, 0601, 0701, 0801, 0901, 1001, 0201, 0301, 0401, 0501, 0601, 0701, 0801, 0901, 1001, 0201 ...

See the problem? Sigh. The pattern starts to repeat. That means that we only get 11 different numbers. And, they repeat in a very predictable pattern. This Random number generator fails and fails miserably. If we tried using a different 'seed' value, we might have a better set. However, this formula doesn't look very good. It does, however, show us what we need to look for.

(1) The Random number generator must eventually provide every number within its range. We used a 4-digit number, so we should expect to get any number between



0000 and 9999 inclusive. We don't.

(2) The Random number generator must select them evenly. 1003 is picked only once, 1002 is never picked, and 0201 is picked over and over and over again.

### **Consider a New Definition of a Random Number Generator**

A random number generator is said to generate truly random numbers when it produces a set of numbers which cannot be described in any way other than to list the entire set of random numbers. In other words, if I can take 1 million random numbers and represent the entire set of 1 million numbers using a formula (no matter how complex it is), then it isn't random. If there is no easier or shorter way to tell you the numbers other than actually listing the 1 million numbers, then it is random. As long as you can express the set with a formula you don't have random numbers. You have pseudo-random.

There are many types of pseudo-random number generators. You have your basic LCG (linear congruential generator), the inversive congruential generators, multiple recursive generators, combined LCGs, add with carry, subtract with borrow, multiply with carry and like the CD infomercials, there are many, many more. It doesn't matter what type they are or what terms are used. We'll examine the most commonly

used one, the basic linear congruential generator. Your slot machines don't use this type, but most of the software on your computer that uses random numbers will use the LCG.

The LCG uses the mathematical formula:  $N(x) = [a * N(x-1) + c] \bmod m$

Now, don't worry about what this means or try to figure it all out. We'll break it down into bite-sized pieces, but the finer points of how it works really aren't important. Besides, we have a piece of cool software to download that will do all of this for you.

$N(x)$  is the random number we will receive. It is the  $x$ 'th number in our set. This really just means 'your random number.'

$A$  is some number that we pick. It will affect how the numbers are generated and some values work better than others.  $C$  is another constant.  $M$  affects the size of the set and the values we receive more than anything.

The 'mod' refers to a modulus function. Basically, we multiply the previous random number by our one constant  $[a]$  and then add the second number  $[c]$ . The number is then divided by  $[m]$  and the modulus gives us the remainder. If our answer is  $5 \frac{1}{8}$  then the modulus gives us the remainder, namely "1". In short, don't sweat how this works.

$N(x-1)$  is the previous random number. In order to obtain a number, we feed the equation the previous one. For the first time, we use our seed value and provide it as our  $n(x-1)$  value.

There have been numerous studies done on the variables and some work better than others. Let's use:  $a=100,000$   $c=1$   $m=2147483647$  This will give us a set with a period of 195,225,786. In other words, with these values our random number generator will give us 195,225,786 numbers and then start over at the beginning of the list.

You may note that the period of the random number generator sometimes seems to be the same as the value you put in for ' $m$ '. This isn't always the case, however.

Use  $m=131072$ ,  $a=1024$ ,  $c=2$  and you will receive one number and then the next number repeats forever. Use  $m=131072$ ,  $a=211$ ,  $c=1$  and the period is 65,536. Use  $m=4296769$ ,  $a=1$ ,  $c=11$  with a seed value of 1 and the period is 4296769. However, the numbers are in the pattern: 12, 23, 34, 45, 56, 67, 78, 89, etc. Not very good!

In some cases the program never seems to find the period. Does this mean that the period is very, very long? Perhaps, but not necessarily. In some cases a single number will repeat over and over again. Even if you find parameters that provide an ex-

tremely long period, it doesn't mean that the numbers generated are any good. Perhaps some numbers are skipped, some repeat more than others, or there is a definite underlying pattern to the numbers?

There are also cases where you will have a small period (perhaps 50,000) but the random numbers being picked are in the billions. If you are picking a number between 1 and 1,000,000,000 but the cycle contains only 50,000 numbers, then you are missing quite a few. This would fail as a valid random number generator.

Random number generation is such a large subject that we're barely scratching the surface of the topic here. As we've started to see, just generating the numbers doesn't mean that they are any good.

Let's take a look at some more software that will let us play around with the random number generator. Download it from the home page of Slot Tech Magazine ([www.slot-techs.com](http://www.slot-techs.com)) or from ICS Gaming's homepage ([www.icsgaming.com](http://www.icsgaming.com) and click on 'Downloads').

The software is fairly simple to use. It takes some parameters for the random number generator and lets you run with it. It shows you the first 200 numbers generated (based upon the seed value you provide) and will determine the period of the set.

You can also take a 'snapshot' of the random numbers at any point.

In order to simulate the slot machine, you can start and stop the process of generating random numbers. Once you click on START, random numbers are constantly generated until you press STOP. As the process is fairly CPU

intensive, you must actually STOP it before exiting the program (by clicking on CLOSE).

Any time the random number generator is running, you can click on SNAPSHOT. Inside the snapshot area, you tell the program how many random numbers you wish to sample and provide the range.

<http://www.eds-inc.com/88users.html>

page 3

"I like the speed, accuracy, and more income from sale of more capacitors and satisfaction knowing you've eliminated all bad capacitors" -Electronic Service Depot, Lethbridge, Alberta, Canada

"I've been using the Sencore Z meter, but I had a dog and no schematic, and I had given up...when my CapAnalyzer came in, I tried it and found 3 bad caps; it paid for half its cost" -Saxton Electronics, Potsdam, NY

"Your CapAnalyzer is much more accurate than my Creative Electronics ESR meter...less false readings...very quick to use. I have recommended it to many other shops" -D&D Electronics, Pueblo, CO

"In circuit speed of testing allows the time to check many "unrelated" caps and usually finds and fixes an "unrelated" problem..." -Precision Elex, Mt. Vernon, WA

"The speed and accuracy of checking caps in-circuit helped me solve 2 problems on IBM monitors...it's a great tool" -Stateside Data, Greensboro, NC

"I use the Sencore LC102 and a Creative Electronics ESR tester. I like the CapAnalyzer more than the Creative unit (the Sencore is best for out-of-circuit tests for cap value). I like best the CapAnalyzer's feature that it is automatic and it works. It is such a timesaver, I bought two more for my techs. Thanks again..." - Electronics Service Labs, Wethersfield, CT

"After receiving my CapAnalyzer, I showed it to my college teacher...he bought one and has since recommended the CapAnalyzer to others" -Chuck Ganze (student) Baytown, TX

"It's faster and more accurate than my B&K in spotting the weak caps in power supplies, especially when there are multiple "ganged" filters. Inexpensive and very reliable" -Town & Country Electronics, Hightstown, NJ

next month... conclusion.

The simulator will tell you the period of the random number set once it has determined it. A large period doesn't mean that the numbers are necessarily distributed randomly, though!

Pick a seed value to start your random numbers!

When the simulator is running (click on Start), you can take a small sampling of the numbers and even select the range that your numbers will fall into.

Set your constants for (m), (a) and (c) here. See the article text for some further suggestions.

Raw numbers directly from our random number generator will appear here. The first 200 numbers show up. See how changing the seed value changes the value of the numbers. Also change 'm' to see how it affects the size of the numbers. Don't forget to play around with (a) and (c), too!

as the generator is spitting out numbers.

“The sequence has started to repeat” This means that the random number generator has started coming up with the same value each time it generates a new number. It likely will not find the period as it's in a 'loop'. Press STOP and enter some new values.

Hint: If you want to, you can copy the numbers shown in the lower box. Highlight the numbers then use CTRL-C to copy,

and paste them (using CTRL-V) in a word processor, etc.

Next month we will study some of the tests that determine if the random number generator is good, bad or ugly. And, perhaps another piece of software will help us do this (with graphs, no less).

- John Wilson  
jwilson@slot-techs.com

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provide is the largest random number which will be returned. If you enter 100, you will receive random numbers between 1 and 100. This will automatically 'scale' the numbers into this range. Your random number generator might be picking numbers between one and one million.

The seed value, as we have learned, simply tells the random number generator where to start. In essence, it is the first number fed to the generator. If you wish, you can make this a random value by clicking on the button labeled “Pick a random seed value.”

Try different values for 'm', 'a' and 'c' as well as the seed value. During the simula-

tion, there are a number of messages which might appear on the screen. The explanation for these is below.

“Determining period....please wait” The random number generator is running and it is looking for the point where the numbers repeat and start over at the beginning of the list again. For the numbers shown on the screen when you start, the period will be 2,147,483,647. Be patient!

“Iteration 3,123.203” This tells you have many iterations of the random number generator have occurred. In other words, this number is how many random numbers have been generated. It will update every second as long



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DVI Theory – DVI Interface  
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3-Day Hands-On  
LCD Troubleshooting

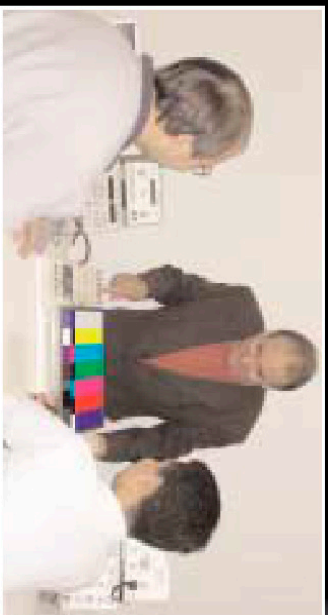
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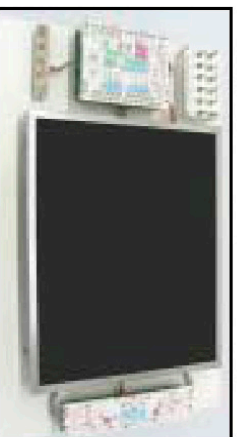
In terms of size, weight, and power consumption LCD displays are far superior to their old CRT counterparts.

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- 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
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## Course Description:

### 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 1

#### 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 2

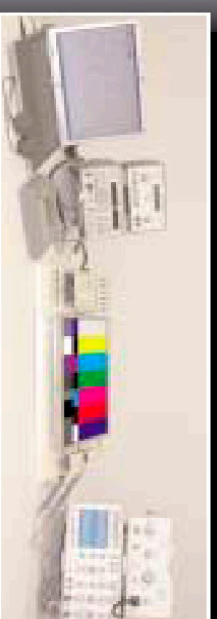
#### LCD Inverter power supply and SMPS Troubleshooting

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.

### DAY 3

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**Nick Micalizzi**  
*Vice President – Sales & Marketing*

FutureLogic Promotes Micalizzi to Vice President  
of Sales and Marketing



**F**utureLogic, Inc., has announced the promotion of Nick Micalizzi to Vice President of Sales and Marketing. Working closely with product and sales managers, global distributors and the company's executive management team, Nick will develop and execute strategic initiatives to enhance customer service.

"Nick is a proven performer with an impressive track record of leading sales operations, particularly in the area of defining and meeting customer needs," said Anthony DiMarco, President & CEO of FutureLogic, Inc. "His appointment will help us meet the growing demand for thermal printer solutions and strengthen our position as a leading provider of value-

added equipment."

An experienced technical sales and marketing professional, Nick joined FutureLogic in 2003, as Director of Gaming. Prior to that appointment, Nick oversaw sales for Sieko's Micro Printer Division as Western Regional Sales Manager and then as Senior Sales Manager. During his career he has distinguished himself by consistently meeting or exceeding sales, budget and margin goals.

Nick graduated from the State University of New York in Morrisville. He can be reached at (949) 487-4829 or [nick.micalizzi@futurelogic-inc.com](mailto:nick.micalizzi@futurelogic-inc.com).

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# Quick & Simple Repairs #3

By Pat Porath

### I.G.T. S-plus code 61 or RAM tilts.

Once in a while on an IGT S-plus, you may get a code 61 or a code 62. There is a fix that could resolve the problem. It is called "scratching the RAM." Scratch what? On the main processor of the game, the RAM chip is located near the game chip or chips. It is in socket U-51. Remove the chip and turn the board over. Gently take the RAM chip and slide it back and forth on the steel frame of the processor, with the chip legs all touching. Scratch the RAM back and forth for about a minute. Install the chip back into socket U-51 and power up the game. Then go through the RAM clear procedure. Hold the TEST button of the game for at least five seconds and you should hear a "ding" type of tone. The jackpot reset key is also used in clearing the RAM. Once it is cleared, be sure to check your game options. You wouldn't want a dollar machine to be set up as a quarter machine. A customer puts in a \$1.00 bill and gets four credits, instead of one. Not good.

**Editor's note:** Pat, are you sure there's not some sort of voodoo chant you're supposed to say while you're "scratch-



ing the RAM?" I can understand (maybe) shorting all the pins of an IC with conductive foil but scratching it back and forth for a minute? Readers? Do

you perform a similar repair? What is YOUR technique?

### WBA stacker boxes. New "skins" for WBA stackers?

When the outside or "skin" of the box gets damaged, it can be straightened out but once it gets dropped on the floor again . . . the same thing. It needs to be repaired. Happ Controls has a "stacker case" which is part number RE-7AJ06. With the removal of a few screws, which are located in the stacker, the guts slide right out and can be put into the new stacker box skin. A lot of the times, the inside guts of the stacker box are fine. It is all mechanical.

You might wonder how it ever worked at all, considering how dirty it probably is. I CAREFULLY use the cordless Dremel and clean off the plastic rollers. Then I use a narrow paintbrush to wipe away more of the dirt and grime. Canned air works well for a final touch. If the exterior

doesn't look too bad but the stacker isn't working properly, more than likely it is dirty and grimy. At first, I was a little hesitant about taking one apart but it was very easy. A lot of the times they only need to be taken apart and cleaned.

### Bally 6000 Stepper Slot

Some error codes you may not run into every day but are quite simple to fix. As a slot attendant, some codes you run into time and time again throughout the day. As a tech, you get called for codes you run into quite a bit. The usual code 21 for a coin-in tilt, a code 33 for a hopper empty, code 50 when the door is open. It is really nice when a customer says to you "Hey, I just had 21 credits on here, what happen to them?" Umm, sir that was just an error code. But, it is all part of the fun.

Now, what about the not-so-familiar codes that arise? It is ten minutes into your shift and then comes the call from the slot attendant. "Could I have a slot tech over here? The machine is showing a code 80."

I have been there, shaking my head, not really sure how to get the game back up and running. It isn't really that

hard at all. The majority of the 80s codes that come up can be cleared with a set of RAM clear chips. Code 80 is a ROM error. Code 81 is battery is below 2.5 volts on the main processor and a RAM clear will need to be done. A code 83 is an EPROM or RAM error. Sometimes the code 82 or 83 will flash on the display of the game. What you need to resolve the problem is the set of RAM clear chips. The ICs are clearly marked where they need to go on the processor board. One of the first things you need to do, of course, is to power down the game, then remove chip U28 and chip U43. On the set of RAM clear chips, they are each marked with U28 or U43 right on them. The U28 clear chip is also marked S6S1000CLR07-01. The U43 is S6S4000CLR07-01. Of course, these are the ones that we use at our casino. Depending on your main EPROMs, the number may differ.

Remove game chips U28 and U43 and install the clear chips in the proper sockets then with one finger on the pseudo button and the other on the test button, power up the game (yes it takes two hands for this procedure). The display should show something on the order of CL-P. Once the display changes to CLC, the RAM has been cleared. Now you can let go of the pseudo and the test buttons. Close the slot door and the reels will usually do a little dance move, jump and bounce a little bit. The reels stop and now on the display you will see a bunch of weird numbers. What in the world? May 2005

You clear RAM and now all you see is a bunch of numbers on the display? Well, the trick is to PRESS THE CHANGE BUTTON. I have felt like a real dandy of a tech on this one. A fellow tech would come along and press the change button and the machine would be ready to be played by a customer; with the exception of checking the machine options. With this procedure and PRESSING THE CHANGE BUTTON, checking your options, the game is back up and running.

### **Bally 6000 Code 81, Battery Voltage Low**

Battery voltage low? Aren't slots plugged into an outlet?

Battery for what? When a customer has 800 credits on a nickel game and the power goes out for five seconds, the battery is what holds the memory intact. If the battery of the processor is good, between 2.5 and 3.5vdc, the memory of the game will be fine. If not, the customer will lose their credits and the game will have to be re-optional. Simply unsolder the old battery and solder in the new one and option the game.

### **CDS Sentinel and SMI boards**

Changing chips and doing repair work on the Sentinel boards and SMI boards DEPENDS A LOT on what kind of maintenance agreement



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your casino may have set up. It may be that you send out the bad units and receive good replacements back. It ALSO DEPENDS on how the CDS contract is set up. MAKE DARN SURE TO CHECK INTO IT BEFORE DOING REPAIRS.

### C.D.S. Sentinel Board

On the Sentinel board, there are quick repairs that can be made. Some of the key areas are as follows:

U4 is the communication chip. U6 is the E-square chip (which holds info like machine number, SAS setting, machine type of communication, denomination, etc.) U8 is the EPROM and U9 is the RAM. Then there are the connectors. J3 is for a fiber board. J4 is for bank-in communication. J5 is for bank out communication. J9 is the power-in connection. Another connector is J11, which is used a lot for newer slot machine communication from the game to the computer system.

If some unusual things are happening with the Sentinel, try a RAM clear. First of all, power down the Sentinel and remove the RAM chip. It is in socket U9. Then, power the Sentinel back up WITHOUT the chip in it. What? Power something up without a chip in it? Yup! I don't really know why but it works.

This also works if there isn't a proper CDS display. It may look only a little bit green and there are no alphanumeric graphics. If the display is barely readable, try a RAM clear. If there are still problems with the display, try replacing it. If a new one doesn't do the trick, I would try a different E square chip. It is in socket U6.

Communication problems with a game? Try replacing the com chip which is located at U4. I have had a game where it would communicate and a few seconds later, it wouldn't, then it would again. It could very well be a weak com chip. Also with "in and out" communication, you might want to check the connections at the bank in and out. I've found where the wires have come a little bit loose and simply pushing them in with a little screwdriver will make the connection good

again. Sometimes only a "reboot" of the Sentinel fixes a lot of problems too.

### **Sigma video game won't load up? The monitor keeps showing "loading?"**

A quick fix that may work with these games, such as "Full of Sheep" or "Throw the Dough" is to swap the CD, located at the top of the game. Power up the game that isn't working long enough to take the CD out of it and swap it with the one next to it. The CD can be removed from the game that is working fine, with the power on. Not a problem. Put the possibly bad CD into it and close it up. Now put the good CD into the game that isn't working properly and power it up. If the original CD is bad the other will bring the game up just fine. But BE SURE TO ORDER A REPLACEMENT for the bad one. As a note, you cannot copy the CDs. They are encrypted.

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## Bally Alpha Operating System & M-9000 Cabinet

by John Wilson

In March 2004, Alliance Gaming (parent of Bally Gaming & Systems) completed the acquisition of Sierra Design Group (SDG). SDG would provide inroads into the Class II market as well as a new Class III platform. SDG was the design group responsible for WMS Gaming's CPU-NXT operating system, also known as Alpha. WMS Gaming designed the BlueBird cabinet to house the Alpha OS. Now Bally is able to introduce their next generation of games.

The Alpha engine development paralleled the online system protocol development. Together, SDG provided a well-designed package to offer game manufacturers and Class 2 gaming establishments. It followed the business plan of Video Lottery Technologies (Bozeman, Montana), Multimedia Games (Austin, Texas) and GTECH. The companies developed the lottery host system then contracted with other manufacturers to build cabinets to house the operating engine specifically designed to integrate with the online lottery host.

The Alpha uses the Linux operating environment, which is also a stable platform for Class 3 games; especially those requiring Player loyalty monitoring systems (player tracking), accounting systems, and TITO simultaneously.

### Bally at TechFest 11

There are two offerings from Bally that will be covered in TechFest 11 in May. The first is the Alpha Operating System Platform and the second is the M9000 video cabinet.

The M9000 video cabinet can house either an EVO III platform or an Alpha platform. The M9000 is a modern, stylish, ergonomic case. With blue LEDs aimed down towards the coin tray, in the bill validator bezel, ticket printer and around the monitor, the case provides a soothing look for the players. White LEDs

in the buttons add to the effect. The case will also hold the Bally iView® player tracking module, complete with a small, coloured LCD panel. EVO III - A quick look

The EVO III, in the M9000 case, features the following technology:

- Microsoft® Windows® XP-embedded operating system
- Intel® Pentium® driven motherboard - CD technology that can be upgraded to DVD \* V8700 EVO cabinet can be upgraded to Alpha

The Alpha platform has a



number of hardware components that have been customized specifically for Bally/SDG.

- The motherboard is an Intel® celeron® custom processor assembly
- There are three flash memory cards for the system

1 OS compact flash - contains the Linux OS, secondary boot record, VT operating system (which includes meters), peripherals, I/O support, host system protocols. It is a 64MB memory card.

2 Game compact flash - contains all game parameters and coding, such as symbol graphics, pay tables, sounds and game logic. This is also a 64MB memory card.

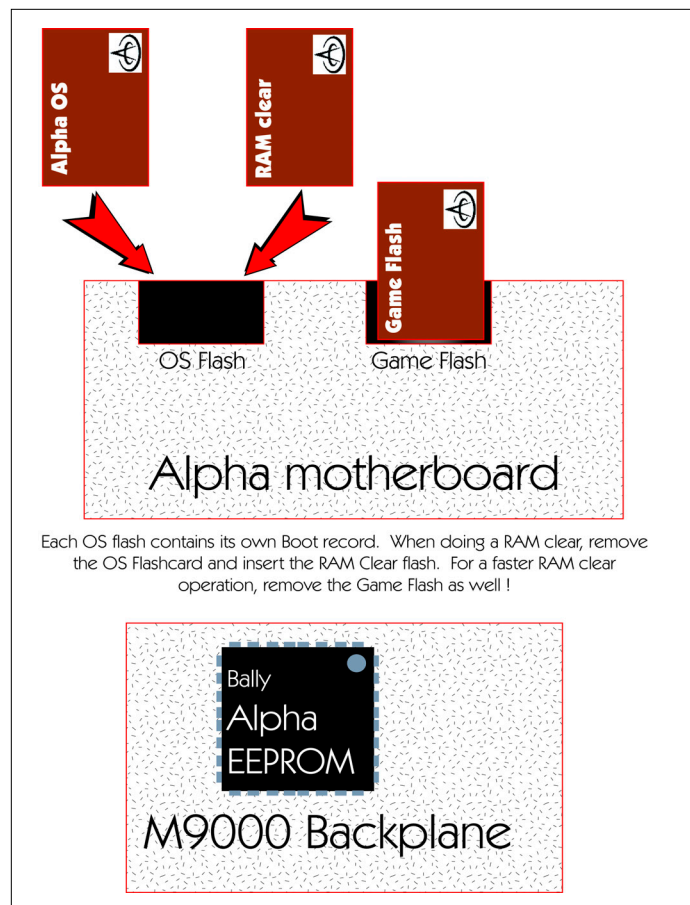
3 RAM clear compact flash - It has a secondary boot record that allows a tech to clear the NVRAM and/or the EEPROM of the VT. In order use this, the OS flash is removed and this flash is put in its place. Both have a secondary boot record allowing the machine to boot up from either compact flash to perform operations programmed in either card. TIP: if you also remove the game flash card, the machine will boot up faster.

Depending upon the case, you may have one of two standard monitors. For the VT-200 and M9000 cabinet, a Tatung LCD touch screen display comes standard. The VT-100 cabinet uses a ClearTEK 3000 MicroTouch screen and MicroTouch SMT3E controller

An Ithaca 750 printer is the match for the VT-100, 850, VT-200 and one of the printers available for the M9000. The Seiko printer comes with the A8700 or the M9000.

The Alpha OS is coded in C++.

In the M9000, there is a main power switch and then the logic board power switch. Figure 1 shows the main power switch and the ATX power supply. The ATX power supply has multi connections and a digital display. There is an RJ45 Ethernet network connector with two USB connectors below. The video output connector is located here as well. Just above is the cooling fan and the power connector. The power connector is similar to those used on your home computer. On the front of the ATX power supply



you will also find the power switch, test button, reset button, drive activity LED and two coloured LEDs to provide temperature warning... Inside the case, however, there is plenty of room. Behind the top door, you will find a lot of empty space, complete with two fans located on the right and left sides of the case. Thermal problems should be minimal in this case.

The Alpha contains both NVRAM and EEPROM.

The NVRAM (non-volatile ram) is used to store primary game information. This is how a game will recover after a power failure. Located on the motherboard, the NVRAM consists of two redundant 1 MB static RAM devices and two batteries for memory backup. The batteries can retain the memory contents for 1 year without power applied to the motherboard. The Game software (on the game flash card) controls the NVRAM and performs checksum calculations on both banks of memory. If one bank fails the checksum verification, it is not used. If both banks fail the checksum verification, the game is suspended, an NVRAM error is displayed on-screen and a RAM clear is required before continuing. This RAM clear will erase

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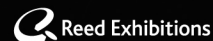
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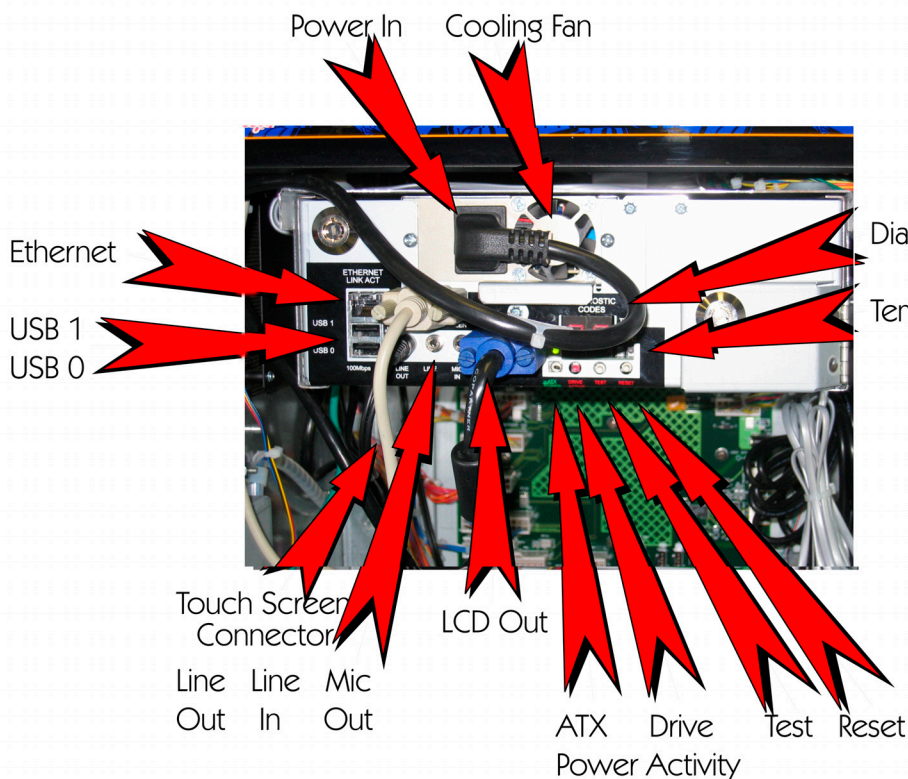
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## ATX Power Supply



the NVRAM banks.

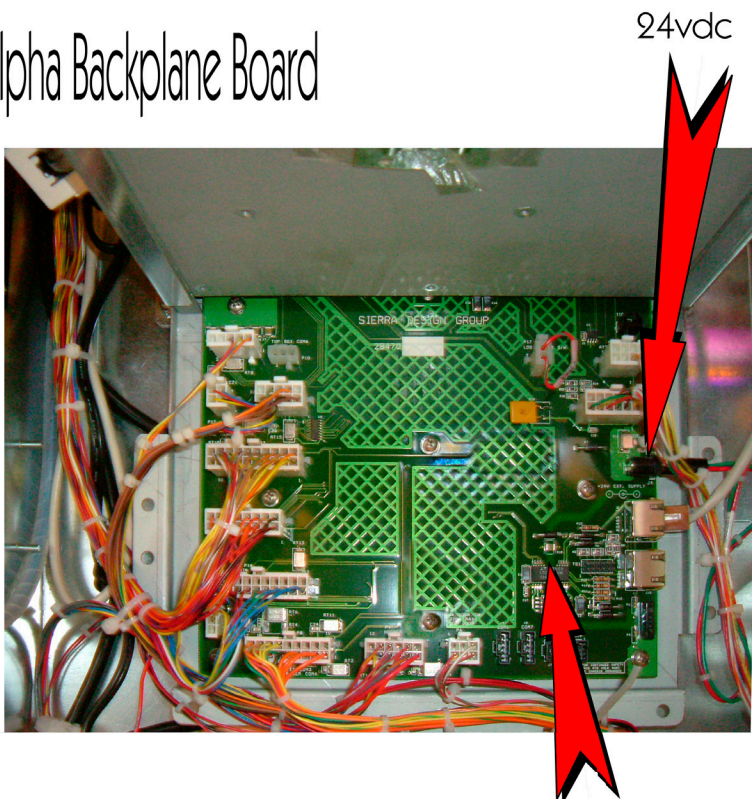
The EEPROM is located on the backplane of the machine. It has 512 bytes of storage and retains power indefinitely when power is removed. Critical game configuration pa-

rameters are stored in this memory. By this means, the components of the machines can be replaced without affecting the critical accounting information. This includes the motherboard and ATX power supply. Electronic meter information is also stored in the EEPROM.

Some parameters are 'one time' parameters which can only be set once. For example, the denomination is set once and then left. If these parameters are required to be changed, a RAM clear must be performed. This restriction protects the game integrity so that the information cannot be easily changed.

A comprehensive study of the Alpha system would take more space than is available in this magazine. I hope that this has provided a brief overview to make you familiar with the Alpha platform and the M9000 cabinet. For those attending TechFest 11 at the Mystic Lake Casino, you will have a basic understanding of the system and be able to gain some in-depth knowledge when you attend Leonard Smith's presentation.

## Alpha Backplane Board



LTC1535 - RS485 Transceiver

- John Wilson  
jwilson@slot-techs.com

## TOVIS

Part 5 - Intelligent Deflection  
An Introduction to Digital Monitors

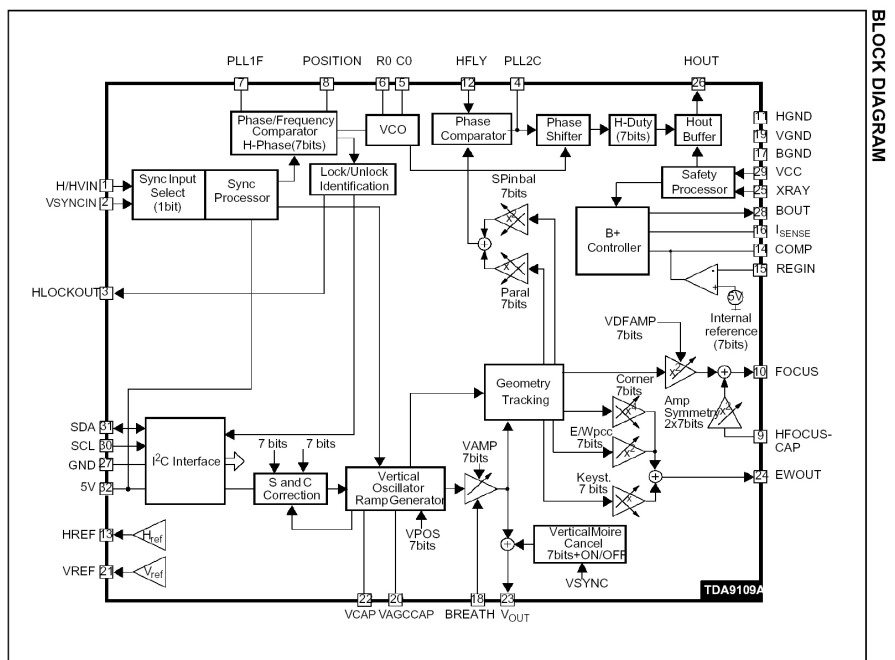
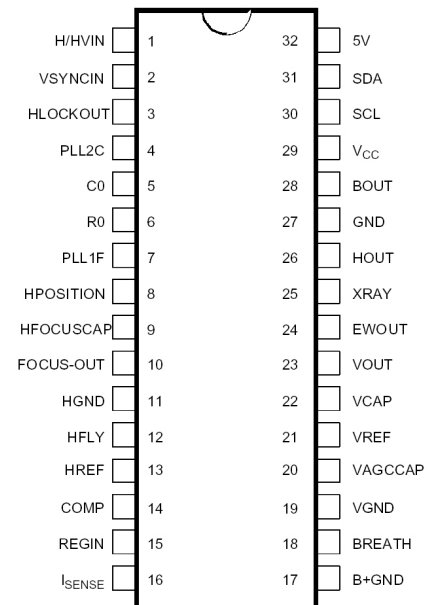
Deflection is really a critical part of monitor design. While circuits like the power supply and video amplifiers are really quite straightforward in their design and operation, it is in the deflection circuits that a monitor engineer really shows what he/she is made of. Good monitor design leads to a product with excellent geometry and linearity and cool-running circuitry that doesn't wipe itself out. Bad design produces the opposite effect, resulting in a lousy looking display and a monitor that's always in the shop for one thing or another.

The deflection circuits in the Tavis monitor represent the ultimate refinement of CRT-based display technology, replacing a myriad of waveform correction circuits with a - you guessed it - microprocessor-controlled system that operates under the guidance of the I<sup>2</sup>C bus. In this case, our hero is the ST Microelectronics TDA9109 Low-cost I<sup>2</sup>C Controlled Deflection Processor for Multisync Monitors. Whew! That title's a mouthful but it completely describes the device.

We know all about the I<sup>2</sup>C bus from last month. We know  
May 2005

all about deflection from previous issues of Slot Tech Magazine. Combine the two and let's take a look at the TDA9109. We can only begin to scratch the surface this month. We'll look at the deflection circuits in greater detail in the coming months so please keep the schematics and diagrams presented in this issue at hand for future discussion.

In a very real sense, the TDA9109 is the same as any other TV H/V chip. That is to say, there is the vertical oscillator and the vertical drive circuitry, as well as the horizontal oscillator, AFC and sync inputs. Let's hop around



the pins and take a look at the familiar stuff first.

The TDA9109 requires a couple of power supplies. The +5 VDC is connected to the corner pin 32. The +12 VDC supply is connected to pin 29. Pin 27 is ground.

Pins 30 and 31 are the I<sup>2</sup>C connections. Pin 31 is the data connection (SDA). Pin 30 is the clock (SCL).

The sync inputs (H&V) are input at pins 1 and 2. The horizontal output comes from pin 26. It is connected to the horizontal drive circuit which ceases to be “normal” at this point but is of an advanced design that allows us to control the horizontal linearity in

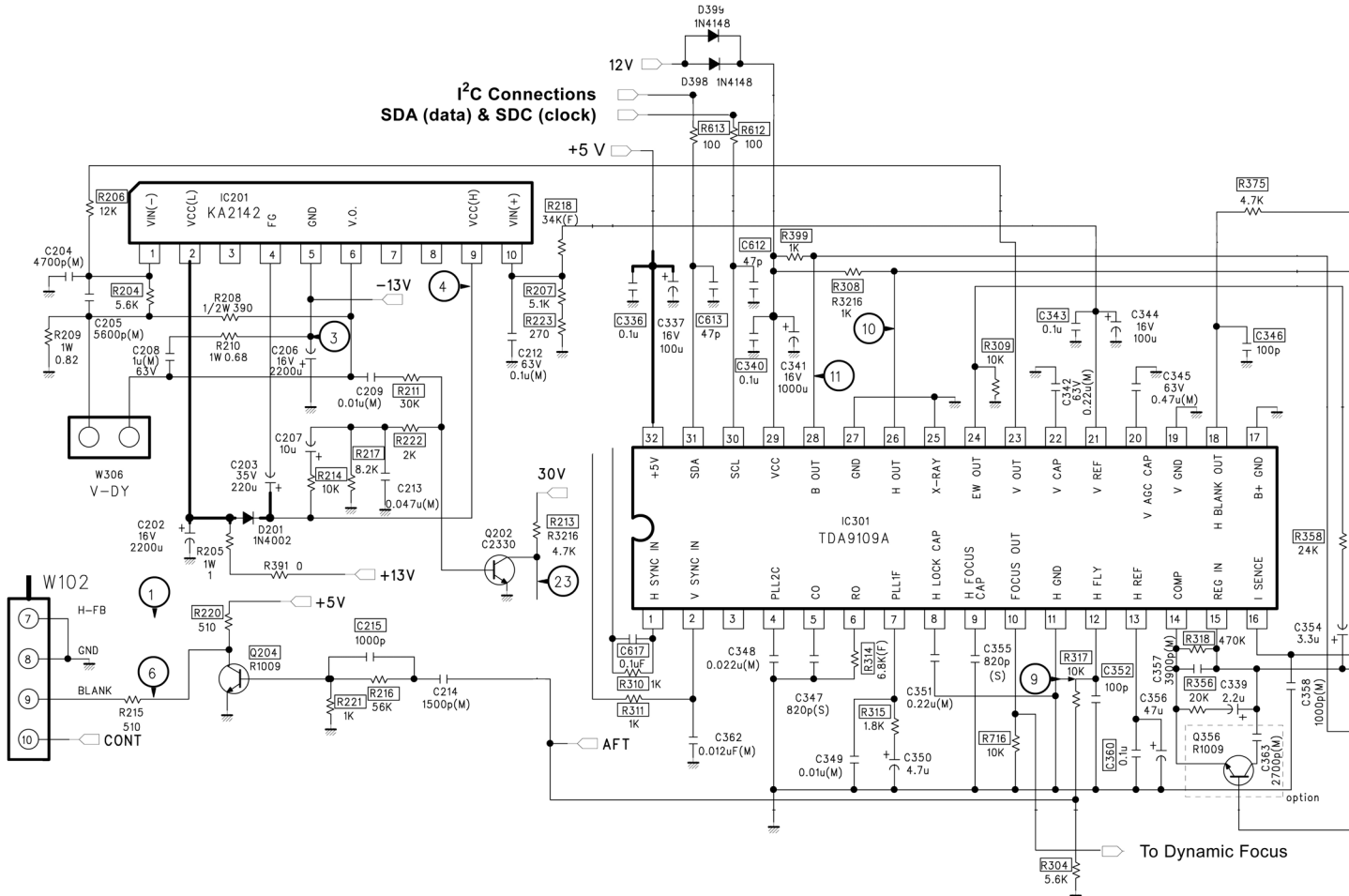
ways that we never could before. More on that in the future.

Likewise, the vertical output comes from pin 23 and connects to the input of the vertical output IC, a KA2142. This is, of course, what drives the vertical deflection coil in the deflection yoke. Even here, we’ll see a little twist as we look at the vertical output circuit in the future.

Pin 25 is the X-Ray input. Like other X-Ray protector inputs, it is looking for a voltage to appear at this pin to indicate an excessive EHT condition. In this case, it’s looking for 8 VDC. If the TDA9109 sees 8 volts at pin 25, it will kill the horizontal

drive output.

In this case however that’s never going to happen, is it? No way. Pin 25 is grounded. This monitor must implement X-Ray protection in some other way. Do you remember it from last month? Pin 36 of the microcontroller is monitoring the +30 VDC output from the flyback transformer. If the EHT rises for some reason (due to SMPS over-voltage or a change in component value(s) in the EHT circuit) the microcontroller will know it and inform the TDA9109 through the I<sup>2</sup>C bus. The TDA9109 will then shut down the horizontal drive output which, in turn, kills the EHT.





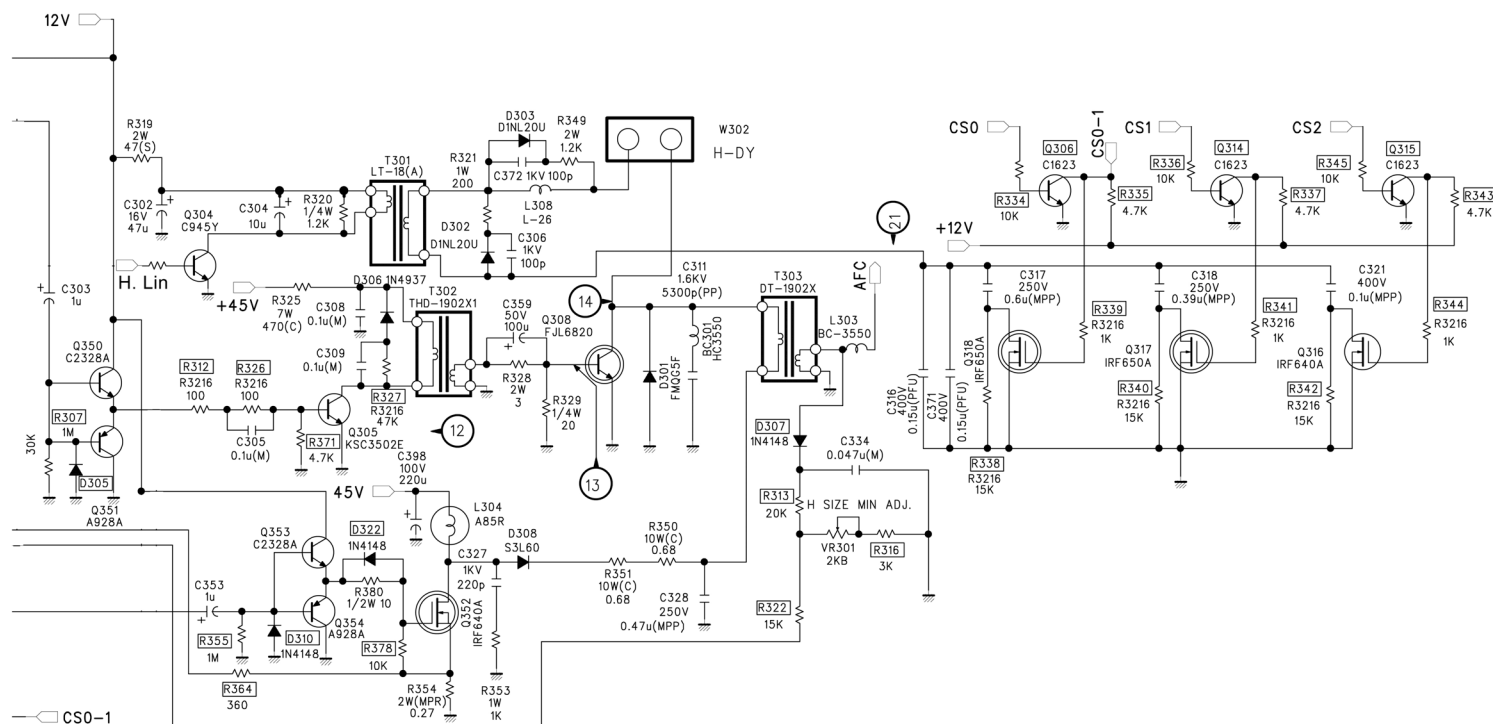
So what the heck are all those other pins for? Normally, the H/V integrated circuit has 16 pins. The TDA9109 has 32! In addition to the main, power ground, there are a number of isolated ground pins as well. There is one for the horizontal section (pin 11) and one for the vertical section (pin 19). There is one for the B+ section of the IC (more on this later) as well.

Will take a look at all of the remaining pins (including the mysterious pin 18, which is labeled “Breath” in the datasheet but called “H Blank Out” on the schematic diagram) in the coming months.

**- Slot Tech Magazine**

## PIN CONNECTIONS

Pin	Name	Function
1	H/HVIN	TTL compatible Horizontal sync Input (separate or composite)
2	VSYNCIN	TTL compatible Vertical sync Input (for separated H&V)
3	HLOCKOUT	First PLL Lock/Unlock Output (0 V: Unlocked - 5 V: Locked)
4	PLL2C	Second PLL Loop Filter
5	C0	Horizontal Oscillator Capacitor
6	R0	Horizontal Oscillator Resistor
7	PLL1F	First PLL Loop Filter
8	HPOSITION	Horizontal Position Filter (capacitor to be connected to HGND)
9	HFOCUSCAP	Horizontal Dynamic Focus Oscillator Capacitor
10	FOCUS OUT	Mixed Horizontal and Vertical Dynamic Focus Output
11	HGND	Horizontal Section Ground
12	HFLY	Horizontal Flyback Input (positive polarity)
13	HREF	Horizontal Section Reference Voltage (to be filtered)
14	COMP	B+ Error Amplifier Output for frequency compensation and gain setting
15	REGIN	Regulation Input of B+ control loop
16	ISENSE	Sensing of external B+ switching transistor current, or switch for step-down converter
17	B+GND	Ground (related to B+ reference adjustment)
18	BREATH	DC Breathing Input Control (compensation of vertical amplitude against EHV variation)
19	VGND	Vertical Section Ground
20	VAGCCAP	Memory Capacitor for Automatic Gain Control Loop in Vertical Ramp Generator
21	VREF	Vertical Section Reference Voltage (to be filtered)
22	VCAP	Vertical Sawtooth Generator Capacitor
23	VOUT	Vertical Ramp Output (with frequency independant amplitude and S or C Corrections if any). It is mixed with vertical position voltage and vertical moiré.
24	EWOUT	Pin Cushion - E/W Correction Parabola Output
25	XRAY	X-RAY protection input (with internal latch function)
26	HOUT	Horizontal Drive Output (NPN open collector)
27	GND	General Ground (referenced to V <sub>CC</sub> )
28	BOUT	B+ PWM Regulator Output
29	V <sub>CC</sub>	Supply Voltage(12V typ)
30	SCL	I <sup>2</sup> C Clock Input
31	SDA	I <sup>2</sup> C Data Input
32	5V	Supply Voltage (5V typ.)



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