March 2004

On the cover: Texas, 1947. Uvalde. Lunch wagon.

Henri Cartier-Bresson
French, b.1908

Born in Chanteloup, Cartier-Bresson started painting in 1923 and began to photograph in 1931, met Tériade, the editor of Verve magazine and frequented members of the French surrealist movement. After a trip to the Ivory Coast he discovered the Leica, since then his camera of choice.

He pursued his photographic career in Eastern Europe and Mexico, later on making films with Jean Renoir, Jacques Becker and André Zvoboda and a documentary on Republican Spain (1937).

A war prisoner, he escaped in 1940 and made portraits of artists: Matisse, Rouault, Braque, Bonnard. In 1945 he photographed and covered the liberation of Paris with a group of professional journalists before filming the 1946 documentary "Le Retour" (The Return) and spending a year in the US to complete a "posthumous" exhibition initiated by New York's Museum of Modern Art out of a belief that he was dead.

In 1947 he founded Magnum Photos with Bill Vandivert, Robert Capa, George Rodger and David Seymour "Chim", then spent three years in India, Burma, Pakistan, Indonesia and China (during the last six months of the Kuomintang and the first six months of the People's Republic of China). In 1952 he returned to Europe and in 1954 was the first foreign photographer admitted into the USSR.

Slot Tech Editorial


Randy Fromm

This month, we are going to carry on where we left off in February. Kevin Noble completes his article about his USA visit to IDX. Sounds like he had a good time in Arkansas. Kevin's article begins on page four. Herschel Peeler's look at Bally's S6000 wraps up as well. You'll find him on page 12.

Slot Tech Magazine's resident mathematics guru, John Wilson, also continues his look at PAR sheets and odds on page 16. For those of you who are planning to attend TechFest 9, I hope to have John there to give a presentation on the subject. I'll post an announcement on the slot-tech.com website when it happens.

And speaking of things on the 'net, a number of you have e-mailed to inquire about difficulties logging in to the Slot Tech Magazine ftp server. The short answer is that I have no idea why you're having trouble. Dozens of folks log in and download stuff every day so obviously the ftp server is working properly.

That having been said, I have established an ftp mirror site on a webserver so that it's "point and click" using just a webbrowser. See page 28 for details.

This month's "Electronics 101" column carries some important troubleshooting techniques for monitor repair. Read "Loaded to Death" beginning on page 29.

And finally, this month's cover art makes this truly a collectible issue of Slot Tech Magazine (aren't they all, though). The cover photograph was taken by Henri Cartier-Bresson at a lunch wagon in Texas.

That's all for this month. See you at the casino.

Randy Fromm

Randy Fromm - Publisher

Randy Fromm's Slot Tech Magazine

Editor
Randy Fromm

Technical Writers
Martin Dempsey
Kevin Noble
Herschel W. Peeler
John Wilson

Advertising Manager
Dennis Sable

Slot Tech Magazine is published monthly by
Slot Tech Magazine
1944 Falmouth Dr.
El Cajon, CA 92020-2827
tel.619.593.6131
fax.619.593.6132
e-mail
editor@slot-techs.com
Visit the website at
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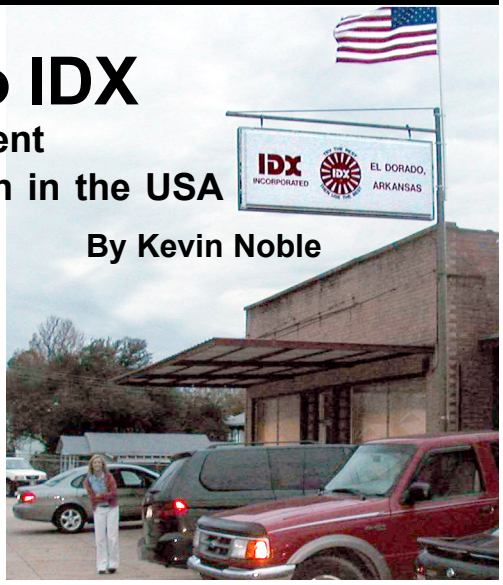
My Visit to IDX

or How I Spent My Christmas Vacation in the USA



By Kevin Noble

Founded in 1987, IDX started its business with many products developed for the car wash industry to prevent counterfeiting and unwanted cross-play of nearby establishments. In 1996, IDX ventured into the gaming industry with the very same concept, thus developing the X-10 Xeptor and the X-Mark token. In 1997, this concept was finally a reality and the X-10- Xeptor was born to validate X-Mark and Smart Mark tokens. Needing now to produce the coin, IDX selected Osborne Coinage as a partner to mint and market this new X-Mark token technology. Having much success in the gaming industry, these same companies teamed up again to install the X-10 Xeptor into the carwash establishments autotellers. These new coin acceptors are now used both in the gaming and carwash industry for high performance, multi-coin acceptance and site security acceptance.

Review

This was the main focus in my article two years ago. X-Mark coin acceptors were developed with an X-Mark minted directly into the surface of the token. The many distinguishing X-Mark types go along with the different diameters and metal alloys to provide much greater security and prevent unwanted cross play. The X-Mark product line includes the X-10, X-50, X-60, and the X-70 Xeptors as well as the X-Mark coded tokens.

The X-20 series has a different concept for your coin accepting needs. The X-20 series are metal sensing Xeptors designed to read the edge and center alloys of bi-metal government issued coins and distinctive readings for the clad and plated alloy layered coin used in the gaming industry.

The H-60 hologram Xeptor may be used to read the X-Mark token but most importantly, the new hologram encoded token. Developed with a unique holographic encoded signature which can not be replicated in metal but only be read by the optical sensors of the H-60 Xeptor.

Also mentioned in my previous article were the person-

The staff at IDX

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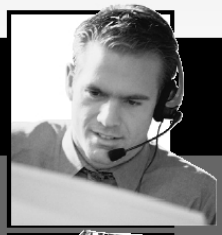

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ality plugs that allow you to use the Xeptors in any machines without rewiring any of the games. The X-Key allows you to lock out unwanted personnel from changing any values programmed into the IDX Xeptor.

The burn-in bench

My Trip

After leaving Osborne Coinage in Cincinnati, Ohio, I made my way to IDX, INC. in El Dorado. Arkansas. Mr. Halsey drove the 2 hours north to pick me up at the airport and proceeded to make the exact same drive back south. We had a great conversation all about the gaming industry, products, Gaming Commissions and manufacturers. I was also impressed with how highly James spoke about his staff that included both management and production staff. At my arrival to the IDX plant, there were many people with whom I had had conversations that I wanted to meet. Tina Rogers was one of the people that help bring accurate information about the IDX products mentioned in my previous article. I also received some refresher training, some new training, took part in a demonstration of the Coin Selector and was able to observe the assembly of an IDX from start to finish. I really wanted to assemble a unit from start to finish all by myself but did not have enough time to do so. Maybe next time (wink, wink).

The Shop

After taking the once around tour of the plant and being introduced to many of the supporting cast that make up IDX, I was able to observe not only the manufacturing and assembly of the product but also all the products used for the car wash side of the business. Before I arrived, I had thought of IDX as a big plant with automated assembly lines assembling all the electronic components with very few people. To my surprise, it was a multi-level, multi-room building with wall-to-wall workstations. There were many workers assembling the products by hand; at times capable of producing thousands every month to keep up with demands of the gaming market. There were many work stations that were set up for quality control and testing. Every IDX was tested, ensuring that any IDX that was shipped out was working. If the IDX failed in the plant, it was repaired and retested.

There were some small little things that caught my eye: The first one was a slant top hopper feeding coins into the IDX on a continuous loop. I was told that they have burned out two hopper motors and still not have put a dent into the IDX case. The other was the workstation where every single IDX was tested on a computer for acceptance before it gets shipped out.

The Selector

The October 2003 issue of Slot Tech Magazine carried an introduction to the new X-20 coin Selector. I was informed, in greater detail, on the operation of and the motive behind this product by a great innovator and the brains behind all these products, Scott Juds. Ron Troeger (IDX trainer/sales of Colorado and surrounding areas) and I spent some time with Scott discussing this neat tool. Scott also was willing to listen to our point of view on how to make this product even better and more "technician friendly." The great thing about this Selector was how accurate and fast this item is capable of coin programming. This is a very easy tool to use but the greatest thing about it is that it is "idiot proof." You cannot alter in any way, shape or form, any of the values in the

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Selector, thus making it easy to reprogram to the correct denomination and codes every time. This tool has a number of different download and upload abilities that make it great for the technician while providing the security needed for all Gaming Commissions.

The Xaminer

The Xaminer is another useful tool for the technician. Without pushing a cart with a laptop on it or lugging around the laptop itself, this handy handheld computer provides a graphical interface to help diagnose and configure your Xeptor. Using the Xaminer, you are able to examine operational parameters, view all self-diagnostic information and the proper operation of the most important parts the sensors.

Hologram or H-mark tokens

Other products that are in different stages of production and marketing are the new H-Mark hologram tokens with many unique designs. You can have any design manufactured into the H-Mark including your company logos, faces, animals, sights of your city, landmarks and promotional events. I was so impressed by these hologram tokens that I scheduled a meeting with my General Manager to introduce and show off the sample tokens that I had received on my trip. There are many possibilities for using these tokens for marketing. You can read all about all these products at www.idxinc.com and/or consult any IDX rep like my new friend Ron.

Additional Training

Happy IDX staff members at the Christmas Gathering

Having a full plate in my normal job as a technician, most times I do not have as much time as I would like to actually troubleshoot and test these acceptors on a bench or in a game. This time however, I was able to spend some quality time with Ed Dixon who took the time to show me stuff that I already knew and stuff about which I did not have a clue. Most importantly, he explained in detail what the figures reported by the Xeptor meant and how to interpret the readings for troubleshooting. Ed covered the theory on the IDX's acceptance, different angles, codes, values, and a lot of dos and don'ts when removing parts and reassembling them. One thing that I now know is how to interpret what all the letters and numbers mean when testing and troubleshooting the IDX. On the IDX, I have always had a problem reinstalling the ribbon cable on the back. When I first arrived, I asked to be taken to that specific workstation. I wanted to see exactly how this was done to see if it was a problem, or just me. Well to make a long story short, the young lady had no problems, but then again she has done these thousands of times.

Off Topic

There was more to this story than just going down south to visit IDX, INC. and reporting about a small company that is making an impact in the casino industry. I was also invited to the IDX annual Christmas party for all the employees and vendors. The unique thing about this was not just that the employees were able to have a great turkey meal presented by the company but they participated in the festivities that happened afterward. After

Scott Juds is presenting James Halsey with one of the latest patents (framed) to be hung in the boardroom for everyone to see

Ed Dixon (Production Manager/ Technical Support) with Ron Troeger (Manager of the Rocky Mountain Territory for training and sales)

the meal, the management team all suited up and became dealers in some fun and games. Every employee was handed $40,000 in play money and was given the chance to build their money up to outbid other employees for gifts. I can honestly say that no employee went home empty handed and many needed a pickup truck to bring merchandise back home. I was lucky enough to both deal and bid on some items that I donated back to the employees.

I must mention Frances. I was told that the day after Christmas, she begins the Christmas shopping for the next year's party. What is amazing is that she usually begins at 3:00 in the morning the day after Christmas when the sale signs go up.

Sales/Training

During my four-day road trip, I met many of the IDX (so I thought) sales team members. Later I found out that they not only they sell and promote IDX and its products, they are also selling and promoting Osborne's tokens.

Two separate companies, employing the same person. What a great idea. Now the same person has been trained on how all acceptors function and also has been trained on how tokens are minted. This eliminates a customer asking about a problem with the acceptor and having the salesmen blame it on the token manufacturer. This concept puts the customer in contact with an individual that understands the technology used in both the acceptor and token manufacturing process. Now the person can guide the customer on what needs to be done to complete the transaction. Why not? The two products go hand and hand.

To The Management of IDX, INC. - Thanks

I could mention every employee that worked at IDX for the kindness and hospitality to make my stay feel like home. I would like to thank James Halsey for the ride from the airport and the trip. I was trusted to roam the facilities without any restrictions, taking pictures and chatting with employees about different aspects of their jobs. I was often asked about my opinion and included in many discussions that I felt any other company would of just blown me off and hidden me in another room while things took place. I was also privileged to tons of information and things that maybe I should not know but out of respect I will not repeat. I was treated like upper level management but best of all, a human being, a brother, a son and an employee.

I cannot go without mentioning Scott and Ron. We got to hang out for a couple of days and had a great time doing it. I think we were all amazed that the three of us clicked. Scott was another that respected me for myself and did not talk down to me. Scott is a very knowledgeable person who discussed things at my level so I could understand many products and the operation of those products. Ron, what can I say about him (Colorado vs. Detroit and we got along)? A former slot technician turned salesman for IDX; he was basically with me the entire time I was down getting training. Ron also drove me back to the airport for my flight and sat around the four hours until his flight was ready to leave after mine. Lastly, I have to mention both Tina Rogers and Britany Templeton (standing in front of the building). These two individuals helped me greatly when working to put this article together. I have to admit that Tina is one of the hardest workers that I have met. She was on top of everything and knew everything that was going on. One of the most thoughtful people that I have meet, she went out the next day and bought me an Arkansas Razorbacks baseball hat, wrapped it and gave it to me the day of the Christmas Party because I had seen one on somebody else. This is just the tip of the iceberg of many of the wonderful people that I have met and the stories that were told to me.

Overview

During my short time at IDX, I wanted to experience many different processes in the building, testing and repairing of the product that I could. I also knew that IDX was also in the car wash market but did not know the extent of the products produced at the plant. I was caught off guard with the displays, timers, and other numerous products that were produced, and even more surprised that the IDX's coin acceptors were also installed in car washes right here in Windsor, Ontario. Knowing myself and my curiosity, I would have done this for JCM, IGT, Ceronix, or VC Slots. I was a bit disappointed that I wasn't able to spend any time in the repairing workstation. This is where my troubleshooting senses were most aroused. I also wanted to build from scratch my own IDX. Again, this is another thing that makes my brain click to satisfy my curiosity. The trip was just the surface of what other things I could have experienced with the limited amount of production time that was available to me. It was an honor being an invited and a pleasure being a guest.

- Kevin Noble
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Bally S6000 Part 3

By Herschel Peeler

Our look at Bally's S6000 concludes with a look at the peripheral boards.

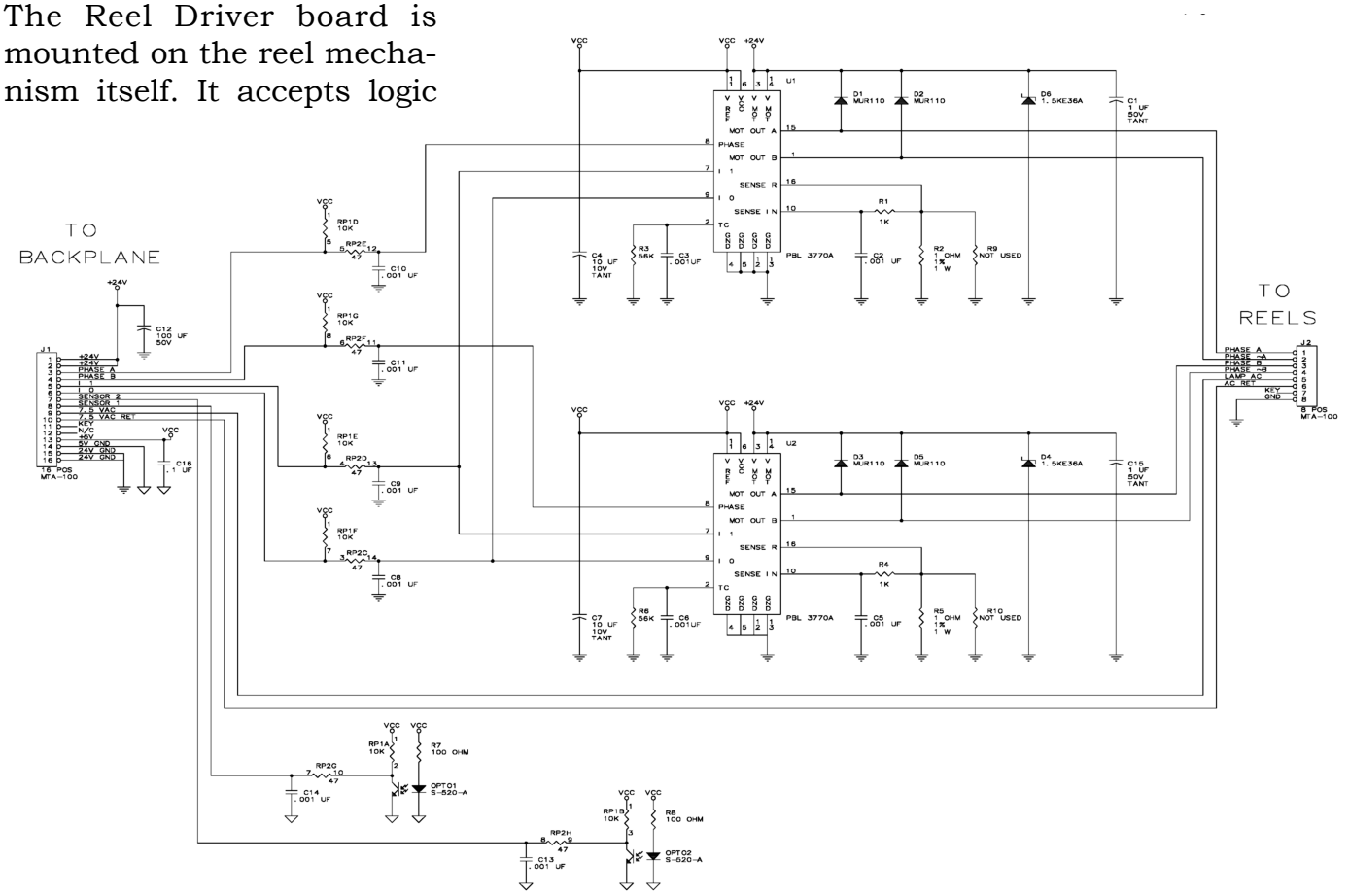
Reel Driver Boards

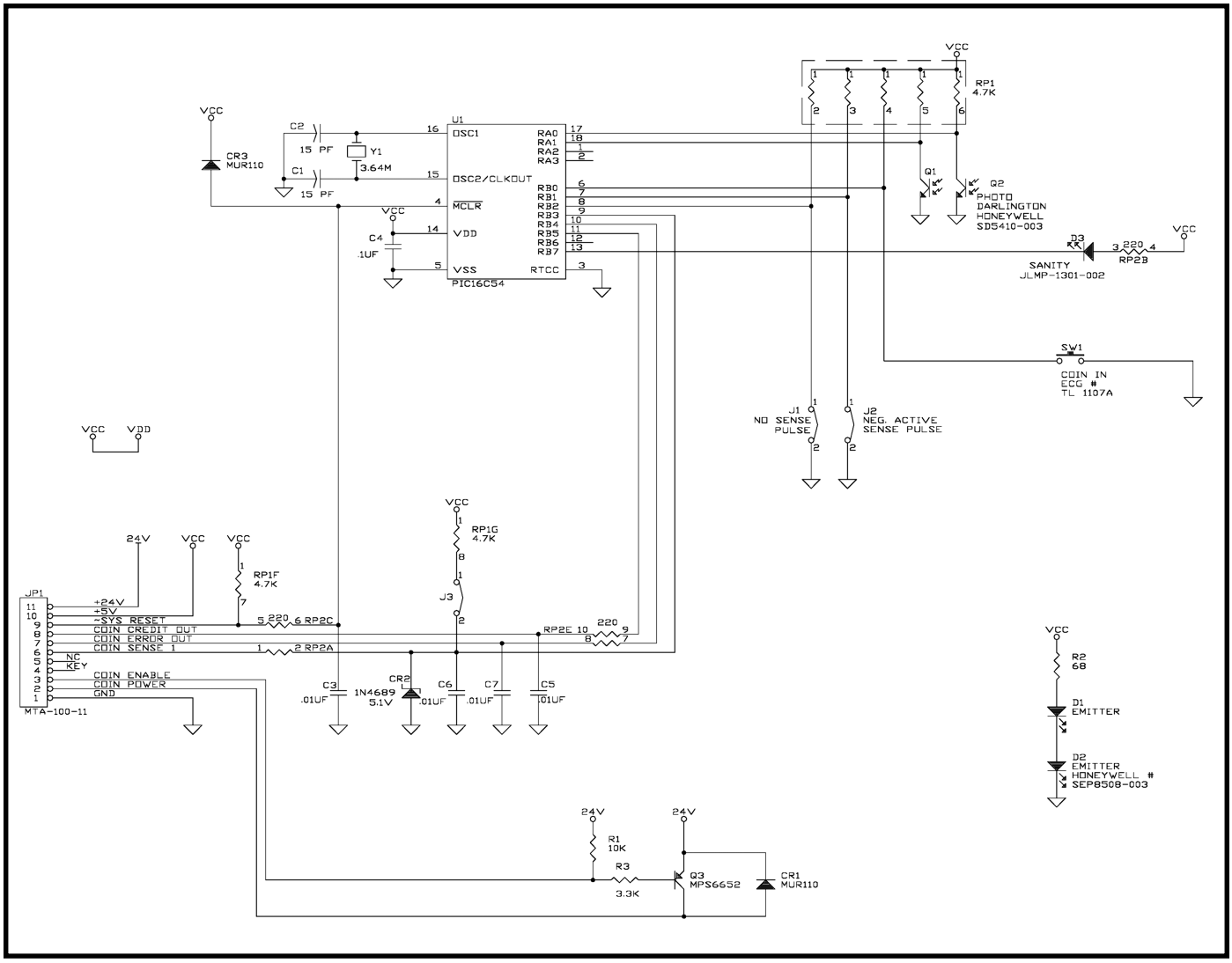
The Reel Driver board is mounted on the reel mechanism itself. It accepts logic level signals (ground or +5 V) and converts the signals to high current drivers designed to drive Stepper Motors in the Reel Mechanisms. This moves these high current, high temperature, high failure rate devices off of the MPU board; minimizing MPU board failures and giving the game better flexibility of design.

Coin-In Board

The Coin-In Optic Board has its own microprocessor (a PIC16C54). This is a one-board design. Where Williams and IGT (and most others) use two boards, Bally just needs one. On most manufacturers, one board has the LEDs and the Phototransistors are lined up opposite the LEDs on another board. On the Bally board, both the LEDs and Phototransistors are on the same board. The LEDs shine through the Coin In path, hit a prism and bounce back to the Phototransistors.

Unrelated to the Coin-In function, a transistor on this board (Q3) controls power to the Coin Comparator.





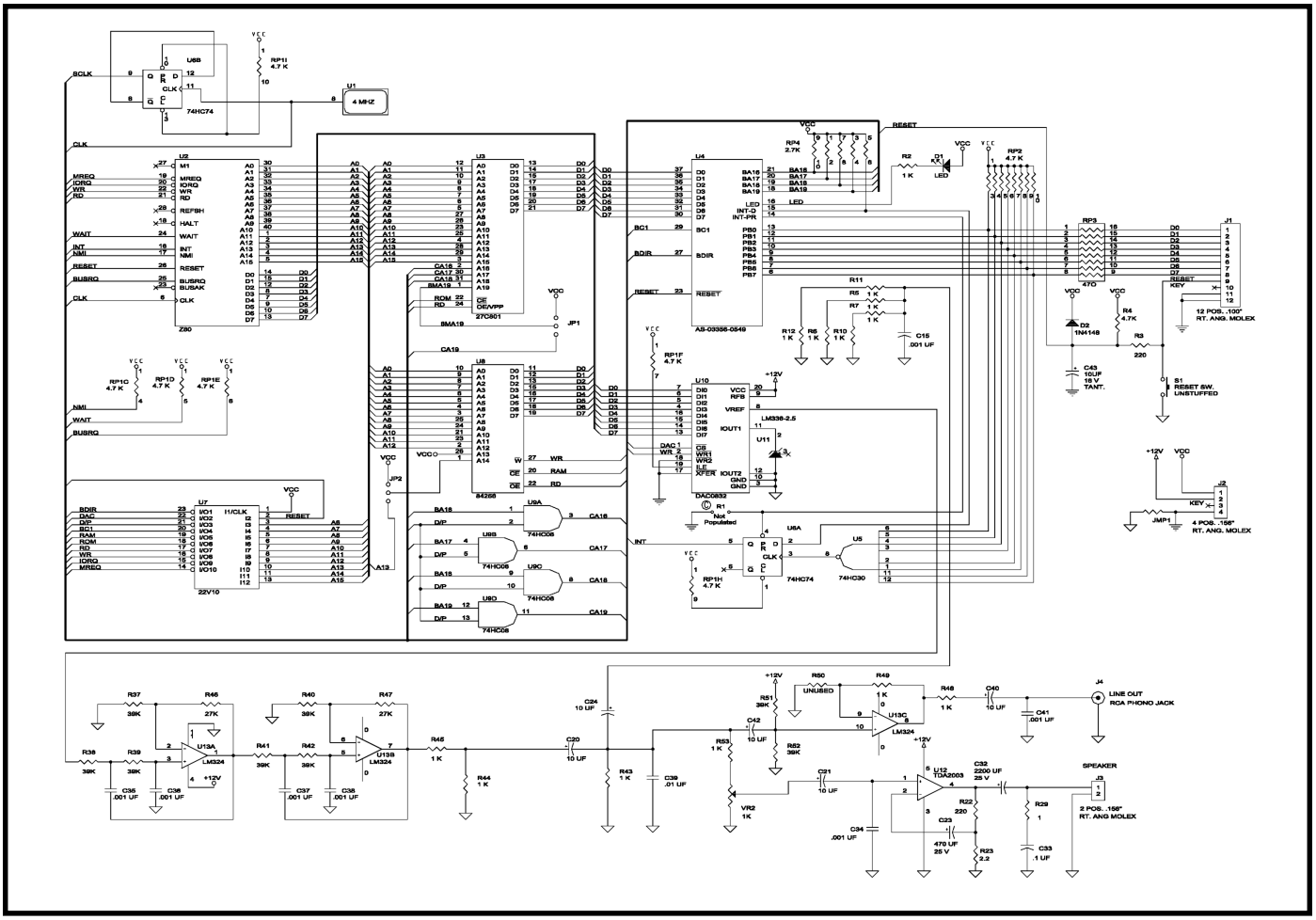
Deluxe Sound Board

The Deluxe Sound Board also has its own microprocessor, a Z80. This is one of the very popular 8-bit microprocessors of an era before the IBM PC XT. Anybody remember CPM, Osborne, or the Radio Shack's first computer (TRS-80)? This is an option and may not be present on all games.

XS-1200 Hopper

Last but certainly not least, we come to Bally's hopper of choice, The XS-1200. This is probably one of the best hoppers on the market (okay, in my opinion). The mechanism was originally an Asahi-Seiko design, but it is Bally's Hopper Control Board that really made it magical. The hopper control board is also microprocessor based. This board has been redesigned a number of times, sometimes using a PIC16C84, sometimes a Motorola MC68HC05. The motor driver circuit may have a number of variations, but operation has always been about the same. There is a circuit that monitors motor current. When the hopper jams during a payout, the microprocessor senses the increase in motor current (caused by the stalled motor) stops the motor and puts the motor in reverse in an attempt to unjam itself. It will repeat this forward and reverse dance a number of times before admitting it is really jammed. Most of the time, it will successfully unjam itself.

The Tech Manual for this game is stuffed with parts breakdowns and part numbers for most of the modifications we run in to. The exception might be parts unique to Wide Area Progressives. It lists most of the Standard Options for Coin Comparators (3 pages full). There are three transformers for operation in various countries. Various tower designs are shown for various jurisdictions. Parts breakdown for the various Bill Ac-



ceptors available for use are shown. In general, Bally just makes a darn good tech manual.

The manual is separated up into sections. Each section may be purchased separately if you wish, at about $20 a section (last time I looked). The Glass and Decals section is the thickest. This is a very well documented listing of glass, decals and overlays for most of the games the S6xxx family can be made into. A big thing to point out here: If you throw away a piece of glass, note the part number and remove decals and stickers. Having the part number sure makes ordering another one easier and the new glass will not come with decals and stickers.

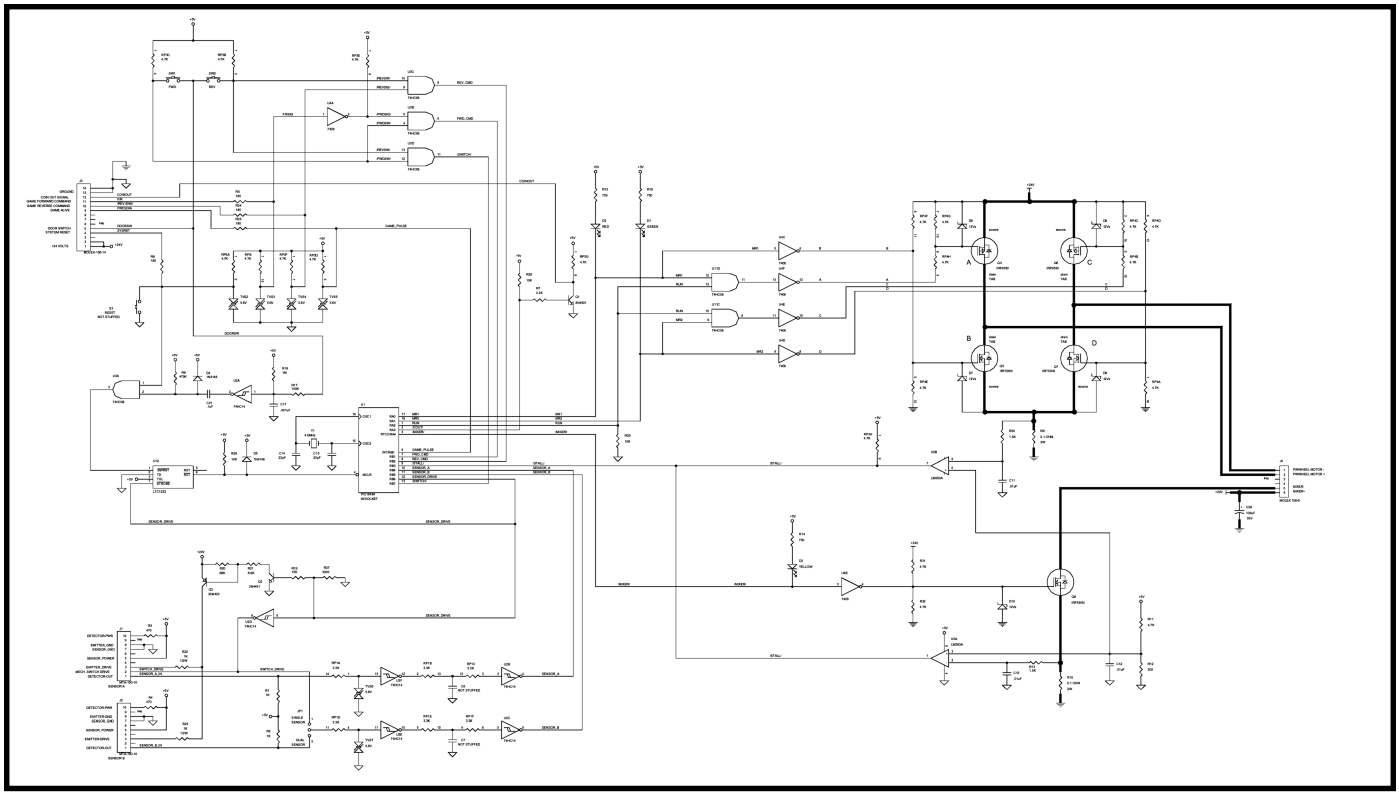
One of the smallest sections of the manual is "Periodic Maintenance." This contains a suggested list of preventive maintenance procedures that should be followed. Yes, we should. No, we don't.

There is also a Glossary that defines terms used in the gaming industry as Bally uses them. Very good. An education in itself!

In Conclusion

Once you have learned a few of the major manufacturer's boards at the electronics level, you will realize that most other games are similar to IGT, Bally, or Williams. If you know these games well, most other games will be easier to learn. The older Williams games (550 and before) are very much like an IBM PC XT. The Williams lamp circuit design is a holdover from their pinball days. Older Bally games are more like a Macintosh. The 8032 series of IGT games are all built around the MCS-51 family, the 8031 / 8051 and its family members are popular in many industries. To make things even more standard, most of the newer games coming out are IBM PCs on the inside (William's Bluebird, IGT and Bally new games). If you get comfortable with an IBM PC Pentium II or III you will be in familiar water with most of the new games.

Where most of the older games are too small for it, most of the new games are



built around familiar operating systems (DOS, Windows or UNIX-like operating systems). In short, there is little original or creative in the games. The more familiar you get with them the easier new ones are to learn.

- Herschel Peeler
-hpeeler@slot-techs.com

PAR Excellance Part 2

By John Wilson

In our continued examination of PAR sheets, we're going to create our own slot game. We will work through all of the details contained in its corresponding PAR sheet. Various manufacturers create their PAR sheets in different formats but they all contain the same basic information. While one manufacturer may include more or less information than another (such as projected game play and revenue, graphs and charts) the common information required by gaming commissions and casino management is included in each one.

A module of VC Slots will be used in order to create a custom slot machine game for this article. We'll generate our own PAR sheet and discuss the most common items that you'll find in the sheets at your casino. While we journey through the tables, columns and formulas, we'll include some definitions so that you know exactly what the terms used represent.

Design a Game

Let's make a simple 3-coin multiplier game. Calling our game Blazin' 7's will create some red-hot player action.

The first thing we have to do

Figure 1 - The Payglass

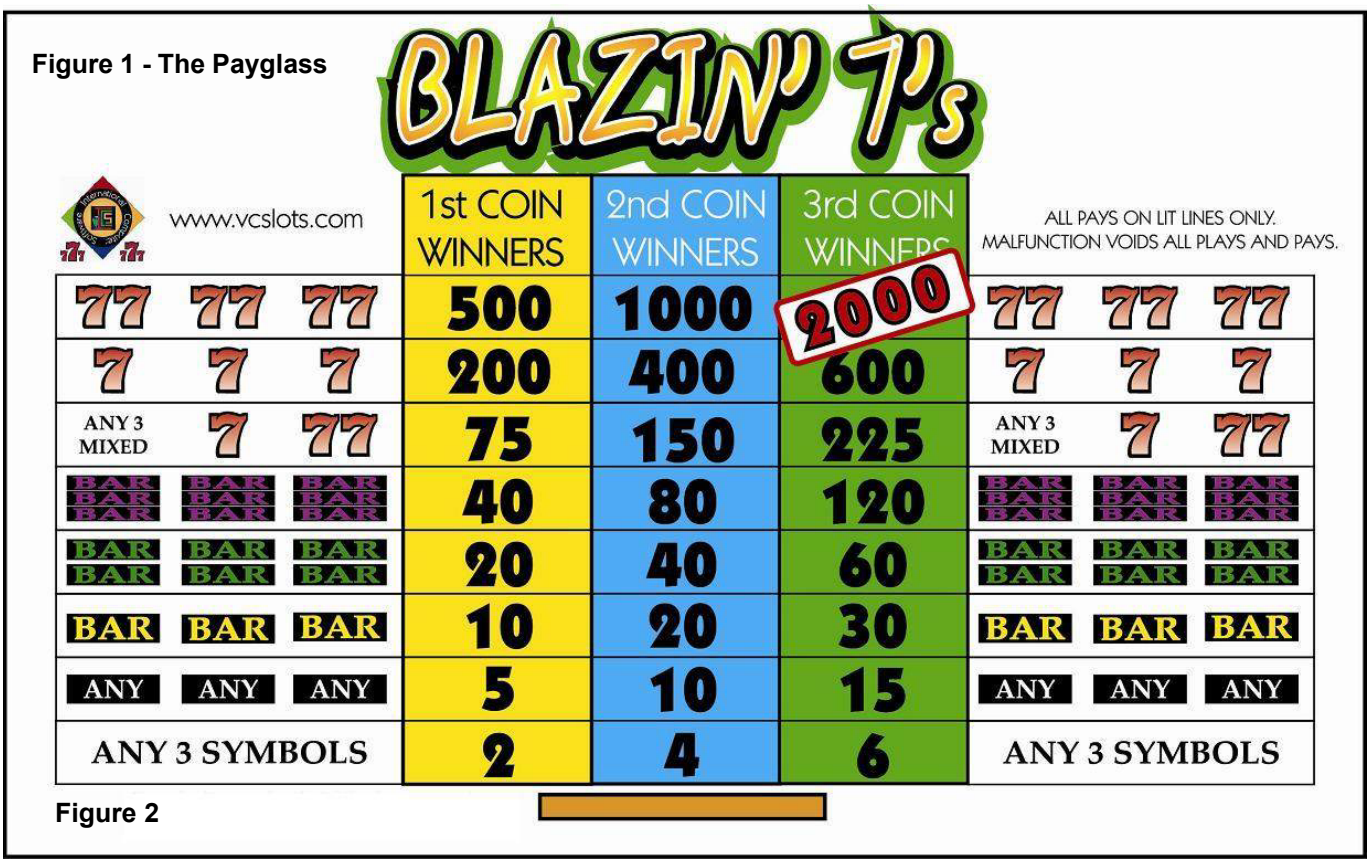


Figure 2

is determine what symbols we want to use, how we want them placed on each of our three reels, and how they will be distributed on the reels - both physically and virtually. It can be quite a bit of work to create a working game but fortunately, just like the cooking shows on TV, I have one in the oven that's just about finished. It uses three bar symbols and single and double red 7s. Figure 1 shows the payglass that has been created for this game.

Reviewing last month's article we'll examine the basic information and determine the game type. We discussed the formulas for coin-in, coin-out, hit frequency and payout percentage so we won't explain them again this month.

Overview

Figure 2 shows our PAR sheet overview for Blazin' 7s. It contains all of the game summary information, the payglass and belly glass graphics, the three reel strips listing and some projections on casino income.

Some of the most important information provided is shown below:

3-coin multiplier, 3 reels, 64-stops per reel. Cycle = 262,144 (64x64x64) Coin in = 262,144 combinations x 3 coins max = 786,432 Coins out = 727,215 (from table shown later on) Payout percent = 727,215 / 786,432 = 92.47016% Winning games per cycle = 44,100 (explained later on) Hit Frequency = 44,100 / 262,144 = 16.82%

This game is your basic 3-coin multiplier with a bonus paid for the 3rd coin. We would expect each coin to have the same hit frequency and the 1st and 2nd coin payout percentage to be the same. With 500 credits for the 1st coin jackpot & 1000 for the 2nd coin, the 3rd coin jackpot should pay 1500 coins. We pay 2000, giving an extra 500 coin bonus. The 3rd coin payout percentage will therefore be slightly higher than the 1st and 2nd. The first and second coin payout is 85.6% and the 3rd coin payout is 92.47%. The extra 500 coin payout raises the payout percentage by 6.87%. Since the increase is more than a couple of percent, there must be a number of primary jackpots - in this case there are 12 jackpots per cycle. If we divide the number of jackpots by the

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Blazin' 7s for Slot Tech Magazine

Single payline, 3 reels, 3 coin multiplier
Cycle = 262,144 (64 stops/reel)
Cycle Duration = 367 days

Coin In = 786,432
Coin OUt = 727,215

Normal Percentage = 92.47
Basic Percentage = 85.60
Maximum Coin Bonus = 6.87%

UMI: E414, Checksum 021F1Ah 4.4.0 2461

Maximum Jackpot Award = 2,000 credits
Jackpot Payout = 9.9%
Jackpots: 12 in 262,144
Odds to Jackpot: 1 in 21,845 games

Hit Frequency = 16.82%
Average Win = 16.490
Average Win/Game = 2.7741
Win every 5.9 games

VI = 23.127

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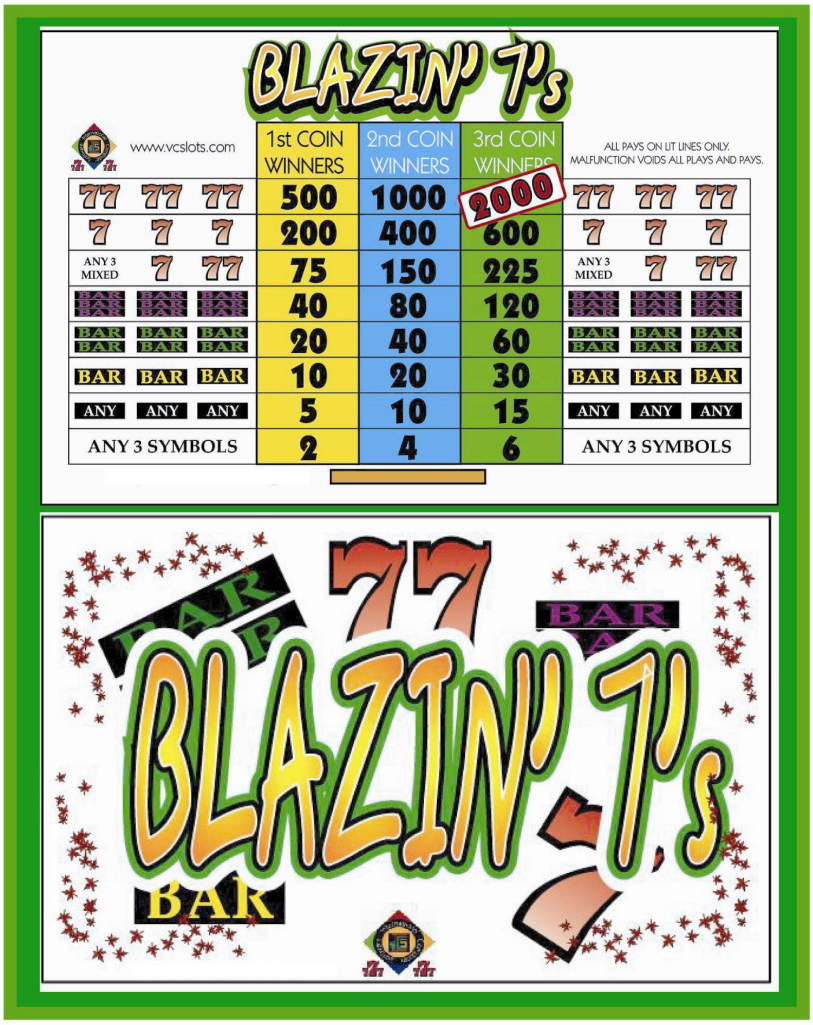
$1.00	$27,741.00

Cycle

5 cent	$36,360.68
25 cent	$181,843.42
$1.00	$727,213.67



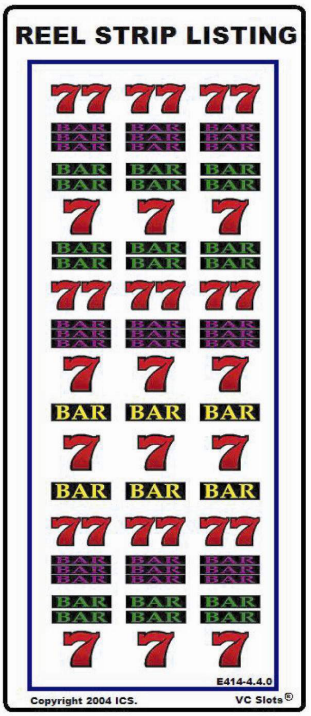


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Figure 2

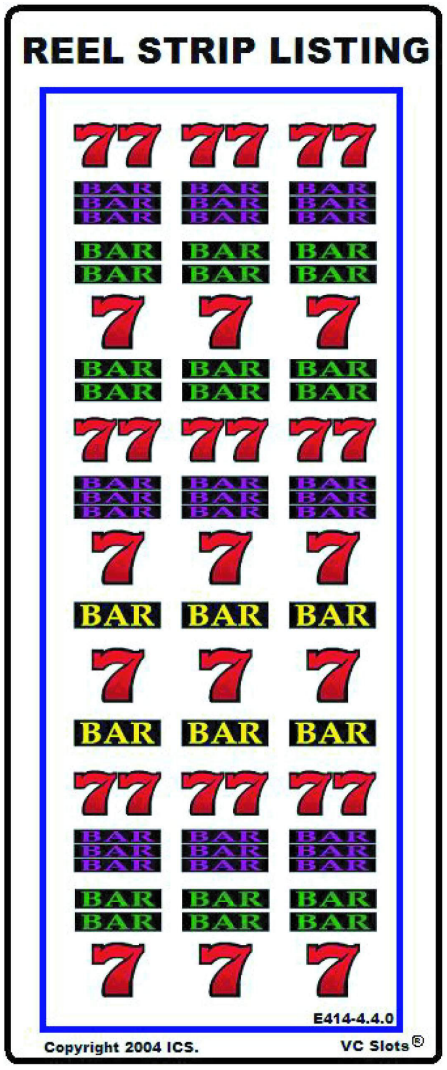

Figure 3

Symbol	Name	REEL 0 #	REEL 0 %	REEL 1 #	REEL 1 %	REEL 2 #	REEL 2 %
77	77	2	3.1	2	3.1	3	4.7
7	7	3	4.7	3	4.7	4	6.3
BAR BAR BAR	Bar3	6	9.4	10	15.6	6	9.4
BAR BAR	Bar2	10	15.6	9	14.1	9	14.1
BAR	Bar1	14	21.9	11	17.2	14	21.9
	Blank	29	45.3	29	45.3	28	43.8
		64	100	64	100	64	100

Figure 4

cycle, we get the average number of games between jackpots (or the odds to jackpot). 262144 / 12 = 21,845 games.

In the past, most games have had the same number of stops on each reel. With increasing jackpot amounts and extra large bonus multipliers, many new games have varying stops on each reel. You may find a 4-reel game featuring extra bonus multipliers and awards on the 4th reel. This would have 64 stops on each reel with the 4th reel having 1000 stops. One recently introduced 3-reel game has 230 stops on the 1st reel, 288 on the 2nd and 1024 on the 3rd reel, for a cycle of 67,829,760 games. With increasingly complex games, being able to read and understand a PAR sheet becomes very important!

Our hit frequency is 16.8% (44,100 winning games / 262,144) which is quite reasonable. As the value is the same for each coin, this confirms that this is a multiplier. If our game had a hit frequency of only 2%, it would be too low to keep the players' interest very long.

Symbols and Reels

On your PAR sheets you will find a basic symbol distribution listing showing you what the reel strips look like. They may be graphical, in the case of Figure 3, or text-based. You'll also find a chart showing you the virtual reel strip layout (see Slot Tech Magazine, Jan. 2004) and the number of stops for each reel. Figure 4 shows you our summary symbol table. The total occurrence for each symbol is listed as well as the percent for each symbol. For example, there are nine double-bar symbols on the second reel, accounting for 9/64 = 14.1% of the total symbols. Glancing at this information, you get a general feel for which winning combinations will occur more frequently and how often a jackpot will happen. Blanks are found on less than 1/2 of each reel so there should be a fairly generous hit frequency on this game. With at least two jackpot symbols on each reel, jackpots will occur frequently as well.

Figure 5 shows the same information that Figures 3 & 4 contain, but it provides a little bit more detail. Here you can see the actual virtual strip layout. This is the most meaningful method to me, but some manufacturers may use a

Reel 0			Reel 1			Reel 2		
	Stops	Position		Stops	Position		Stops	Position
Double Bar	3	1-3	Double Bar	2	1-2	Double Bar	3	1-3
Blank	2	4-5	Blank	2	3-4	Blank	1	4
Single 7	1	6	Single 7	1	5	Single 7	1	5
Blank	2	7-8	Blank	2	6-7	Blank	2	6-7
Double Bar	7	9-15	Double Bar	7	8-14	Double Bar	6	8-13
Blank	4	16-19	Blank	4	15-18	Blank	3	14-16
Double 7	1	20	Double 7	1	19	Double 7	2	17-18
Blank	4	21-24	Blank	4	20-23	Blank	3	19-21
Triple Bar	3	25-27	Triple Bar	3	24-26	Triple Bar	5	22-26
Blank	2	28-29	Blank	2	27-28	Blank	2	27-28
Single 7	1	30	Single 7	1	29	Single 7	2	29-30
Blank	2	31-32	Blank	2	30-31	Blank	2	31-32
Single Bar	6	33-38	Single Bar	5	32-36	Single Bar	6	33-38
Blank	2	39-40	Blank	2	37-38	Blank	2	39-40
Single 7	1	41	Single 7	1	49	Single 7	1	41
Blank	2	42-43	Blank	2	40-41	Blank	2	42-43
Single Bar	8	44-51	Single Bar	6	42-47	Single Bar	8	44-51
Blank	4	52-55	Blank	4	48-51	Blank	5	52-56
Double 7	1	56	Double 7	1	52	Double 7	1	57
Blank	4	57-60	Blank	4	53-56	Blank	5	58-62
Triple Bar	3	61-63	Triple Bar	7	57-63	Triple Bar	1	63
Blank	1	64	Blank	1	64	Blank	1	64
22 symbols	64 stops		22 symbols	64 stops		22 symbols	64 stops	

Figure 5

slightly different format, such as shown in Figure 6.

Volatility Index

We have created a Volatility Index for our game as shown in Figure 7. Our game has a volatility index of 23.127. This means that the payout will vary widely, most likely due to the frequent low-paying mixed symbols and the fairly frequent jackpot hits.

We can test this assumption by changing the basic play of the game. Let's reduce the jackpots per cycle to 1 (from 12). There are less blanks on the reels than symbols. If we change the smallest payout of 2 coins for mixed symbols to 2 coins for three blanks, we'll reduce the frequency of this payout. These changes reduce our Volatility Index to 10.805, confirming our assumption.

	Reel 0	Reel 1	Reel 2
1	B2	B2	B2
2	B2	B2	B2
3	B2	~~	B2
4	~~	~~	~~
5	~~	7	7
6	7	~~	~~
7	~~	~~	~~
8	~~	B2	B2
9	B2	B2	B2
10	B2	B2	B2
11	B2	B2	B2
12	B2	B2	B2
13	B2	B2	B2
14	B2	B2	~~
15	B2	~~	~~
16	~~	~~	~~
17	~~	~~	77
18	~~	~~	77
19	~~	77	~~
20	77	~~	~~
21	~~	~~	~~
22	~~	~~	B3
23	~~	~~	B3
24	~~	B3	B3
25	B3	B3	B3
26	B3	B3	B3
27	B3	~~	~~
28	~~	~~	~~
29	~~	7	7
30	7	~~	7
31	~~	~~	~~
32	~~	B1	~~
33	B1	B1	B1
34	B1	B1	B1
35	B1	B1	B1
36	B1	B1	B1
37	B1	~~	B1
38	B1	~~	B1
39	~~	7	~~
40	~~	~~	~~
41	7	~~	7
42	~~	B1	~~
43	~~	B1	~~
44	B1	B1	B1
45	B1	B1	B1
46	B1	B1	B1
47	B1	B1	B1
48	B1	~~	B1
49	B1	~~	B1
50	B1	~~	B1
51	B1	~~	B1
52	~~	77	~~
53	~~	~~	~~
54	~~	~~	~~
55	~~	~~	~~
56	77	~~	~~
57	~~	B3	77
58	~~	B3	~~
59	~~	B3	~~
60	~~	B3	~~
61	B3	B3	~~
62	B3	B3	~~
63	B3	B3	B3
64	~~	~~	~~

Figure 6

Volatility Index (23.127)					
Games	90% Confidence	Lower	Median	Upper	Range
100	231.215	-138.77	92.47	323.72	462.49
1,000	73.130	19.34	92.47	165.60	146.26
10,000	23.127	69.34	92.47	115.60	46.26
100,000	7.314	85.16	92.47	99.78	14.62
1,000,000	2.313	90.16	92.47	94.78	4.62
10,000,000	0.731	91.74	92.47	93.20	1.46
100,000,000	0.231	92.24	92.47	92.70	0.46

Figure 7

Remember that the Volatility Index tells us how varied the payout level is going to be over time. By limiting the range of payout (lowering the high payouts and raising the low payouts) we will reduce the volatility of the machine.

Removing the mixed symbol payout altogether (and not replacing it with a payout for blanks), our VI is reduced by 0.003. This is hardly noticeable.

Reducing the number of jackpots by 1/2 (down to 6) and leaving the mixed symbol payout the same reduces the VI value by 6.327. This is significant, proving that the frequent jackpot hits are obviously a major factor in the design of this game.

The Heart of the PAR Sheet

The rest of the details are found by analyzing each of the possible paying combinations for the complete cycle. Non-winning games aren't shown in order to save space and winning combinations are grouped together. For example, if there are 300 combinations of single bar payouts, this payout will be listed only once but identified as occurring 300 times.

Depending upon the manufacturer, you'll find a section listing various details of each paying combination. The basic information you will find is the total number of hits, percentage of hits for this combination and the total coins out for each particular hit. You may also see the percent of the winning spins and the percent of the credits this payment makes up. More detailed listings will show you the spins between wins (also called Plays per Hit and Plays per Hit/Higher). You may (in the case of our example) see a few graphs illustrating the information in a visual sense as well. A few manufacturers will provide you with estimated revenue projections based upon the payout percentage of this game and established play levels.

We will go into this section and more in detail next month. We'll even have a chance to compare our PAR sheet with some actual game play to see just how close our projections were. Now that we've created a game with a reasonable hit frequency and payout, we can continue with our investigation.

- John Wilson
jwilson@slot-techs.com

New Location Gives ICE 2004 Extra Edge!

By Martin Dempsey

The total number of ICE-registered visitors at ICE 2004 was 7,322 - 14.6 per cent higher than the previous year's figure of 6,388 - setting a new record-high for the London casino show. In addition, a further 10,453 ATEI-registered buyers (over 70 per cent of the total ATEI attendance) crossed over into ICE, giving the International Casino Exhibition a total attendance of 17,775, an 18.7 per cent increase on the previous year's figure of 14,970.

ICE 2004 was the most international in the show's history, with visitors travelling from 101 territories (98 in 2003) six of which - Bermuda, Ivory Coast, Macau, Malagasy Republic, Mozambique and the US Virgin Islands - were represented at ICE for the very first time. ICE also welcomed back its first visitors from Mongolia and Tunisia since 1999 and its first visitors from Jamaica and Liechtenstein since 2000. The total number of territories represented by ICE visitors over the last decade (since 1995) now stands at 151.

International

The number of international visitors, who accounted for 62 per cent of the total ICE-registered attendance, rose by 9.1 per cent to 4,322. A further 3,690 international visitors crossed over from ATEI, giving ICE a total overseas attendance of 8,012. Constituting more than half of the total attendance, ICE-registered visitors from continental Europe numbered 3,433 - up 6.2 per cent on the previous year.

There were no fewer than 889 intercontinental casino buyers, up 21.9 per cent on the previous year's figure of 729.

Significant increases in visitor numbers were recorded from North America (up 33.8% to 475), South & Central America (up 20.8% to 116), Australasia & Pacific (up 37.5% to 77), Southern & Central Africa (up 44.9% to 71) and Asia (up 166.7% to 24). The number of ICE-registered UK visitors rose 26.5 per cent to 2,920, a figure which rises to 9,683 if including ATEI-registered visitors to ICE.

Individual Nations

34 of the top 50 international visitor territories either increased or maintained their representation at ICE 2004.

Karen Thompson, IGT, with a selection of their games.

"On behalf of Table Mountain Casino I just wanted to express our thanks to you and your team. I couldn't have asked for anything better."

Brian Rankin - Slot Technical Manager

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Randy Fromm's Casino School is a practical, no-nonsense look at how gaming machines work and how to repair them when they don't. **No previous knowledge of electronics is required** to get the most out of the school. The Casino School is geared for those who want to learn how to fix gaming devices without having to learn complex electronic theory or purchase expensive test equipment.

Be prepared for six hours of accelerated learning each day. Class begins at 9:00 am sharp each day and continues until 4:00 pm. The Casino School provides each student with reference materials and troubleshooting guides that will be valuable aids for repairing equipment on location and in the shop.

Students learn how to work with:

THE DIGITAL MULTIMETER

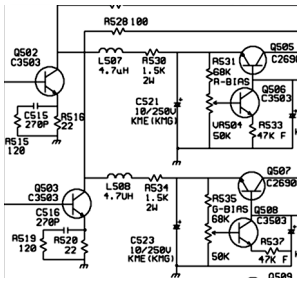
This relatively inexpensive piece of test equipment is easy to operate. Casino School students learn to use the digital multimeter to perform tests and measurements that will pinpoint the cause of a failure down to a single component.

ELECTRONIC COMPONENTS

The individual components used in games are introduced. Parts such as resistors, capacitors, diodes, potentiometers and transistors are covered individually. Students learn how the components work and how to test them using the meter.

SCHEMATIC DIAGRAMS

Schematic diagrams are the "blueprints" for electronics. Learning to read schematics is easy once you know how the parts work!



POWER SUPPLIES

Power supply failure is a common complaint in many different types of systems.. Power supply failures are discussed during the class, along with shortcuts for troubleshooting and repairing them.

MONITOR REPAIR

The monitors used in video slots are designed for quick, easy, and safe repair. Students will learn the theory of operation of all types of monitors and how to repair monitors down to the component level. Of course, monitor safety will also be discussed.

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After the host nation, Spain was the most represented country at ICE 2004 with 386 visitors. A year-on-year increase of 24.5 per cent helped Spain move up two places to top slot in the overseas visitor territory rankings. Last year's table-toppers, the Netherlands dropped five places after a 10.5 per cent decrease in the number of Dutch visitors (332). Also moving up two places were Austria (fourth to second; visitors up 21.9% to 356), the USA (fifth to third; visitors up 40.9% to 355) and Slovenia (eighth to sixth; visitors up 48.5% to 239). A marginal decrease of German visitors (down 6.3% to 343) saw Germany drop two places in the table, from second to fourth place.

Sandra Kaiser, Amatic with Pharao.

Increases

The remaining top 10 places in the table were filled by seventh-placed Sweden (197 visitors, up 30.5%), eighth-placed Italy (179 visitors, up 4.7%), ninth-placed Russian Federation (174 visitors, up 32.8%) and tenth-placed France (164 visitors, down 21.2%). Further significant increases in visitor numbers were recorded by: Canada (118 visitors, up 14.6%), Switzerland (84 visitors, up 44.8%), Australia (76 visitors, up 35.7%), South Africa (56 visitors, up 86.7%), Latvia (54 visitors, up 80.0%), Malta (51 visitors, up 45.7%), the Slovak Republic (35 visitors, up 59.1%), Poland (29 visitors, up 45.0%), Croatia (28 visitors, up 86.7%), Romania (23 visitors, up 109.1%) and Gibraltar (23 visitors, up 91.7%). The net floor space in the new Earls Court 2 location was 10,000 sqm; there were 166 exhibiting companies; 102 (61.4%) exhibitors from outside the UK and 31 nations represented by exhibitors. The Best Stand Award went to Bourgogne et Grasset; the Merit Award to XN Entertainment and the Best Press Pack to Novomatic - Austrian Gaming Industries. ICE 2005 will take place at London's Earls Court Exhibition Centre on 25, 26 and 27 January 2005.

Quotations

TCS John Huxley - "There

The TCS John Huxley team had a very busy show at ICE 2004.

was no doubt that major excitement was drawn by the International Casino Dealer Championship - with dealers competing for a trip to Las Vegas and their place in the world finals. The dedicated tournament area consisted of roulette and blackjack tables featuring the Chipper Champ Plus and King shuffler - and was sponsored by Novomatic Group of Companies, Shufflemaster Gaming, Paltronics and Fournier. The dealer taking first place was Peter Sweet from Grosvenor Gloucester Casino."

WMS Gaming - "Our ergonomically designed Bluebird cabinet was well received by all who visited our booth. Customers were enthralled by the high-quality graphics and colours of the new games, as well as by the excellent quality of sound delivered by the Bose Free Field directed audio system installed in every Bluebird cabinet. The exciting sensory enhancements added to WMS's innovative and entertaining game play to keep the games and the booth packed with excited customers for the duration of the show."

Mikohn Europe - "Fire and Ice was our stand theme and we certainly had the sparks flying during a very busy show. Our visitors were very positive about Power Cash and our new Elite Display series. MediaLink and our Management System CasinoLink were also a hit, with orders being signed on the stand."

Some Exhibitors

TCS John Huxley had one of the busiest stands at the ICE, showing a wide variety of equipment including roulette tables and the e-FX table gaming displays. They also hosted the TCS John Huxley International Dealer Championship which attracted huge crowds to their stand.

WMS Gaming presented their new Bluebird cabinet and a range of machines including X Marks The Spot, Toast Of The Town, Quackers and Wild Wilderness. They demonstrated their CPU-NXT operating system which provides enhanced graphics. You can also buy an upgrade CPU-NXT kit to upgrade and convert games in the 550 cabinets.

IGT tripled the size of their stand and showed over 200 machines including a new product - IPC, which is a programme which hooks up IGT machines on 5c, 10c and 20c play. They also showed Reel Touch - five reel machine which has a 15" LCD touchscreen video screen so the player can play reel and video. These machines can also be changed from 1c to 5c to 10c to 20c play.

Novomatic / Austrian Gaming Industries showed their new Gaminator state of the art electronic gaming machine with games including Roller Coaster, Rock The Croc, Marco Polo and Venetian Carnival.

Amatic showed Pharao, Roulette Grand Jeu, Flying Dragon and Ring of Fire.

Franco Gaming presented Money Tree, Cashin' In, Double Platinum 777 and Buried Treasure.

John Murphy, Service Gaming Europe with GeWeTe change machines.

Capital Gaming showed their mechanical roulette which is interchangeable to a six player horse racing game and a card game.

R. Franco exhibited their range of machines including Lots Of Cash, Hot 7s and Olympic Gold. They also launched Olympic Super Five for the Irish market which is a five reel model.

Cammegh showed a selection of their roulette wheels including Classic, Slingshot, Connoisseur and Mercury ranges and their Matrix displays.

Bally Gaming & Systems presented more than 60 exciting new reel-spinning and video slots and an expansive casino management system.

Kimble presented their Speed PCB, Match n Win poker and a wide range of reconditioned slots which they have become experts in supplying. Kimble are widely regarded as one of the biggest and best suppliers of high quality reconditioned slots worldwide.

And speaking of Kimble . . .

Kimble (Ireland) has announced the launch of their new Match and Win poker. Designed to run on their new SPEED games development platform, Match and Win poker boasts stunning graphics and quality stereo sound.

Most well known for the sale of reconditioned slot machines into the casino sector,

Kimble has years of experience developing successful pokers for the Irish and English markets.

The game will come in two formats, one for the international market and one for the English AWP market. Both host a new and exciting secondary game that allows players to double their money up to five times. The players are shown a screen containing three rows of cards. The top and middle rows have 5 cards each and the bottom 3 cards.

The idea of the game is to select a card from the middle row. If you match a card from the top row, you double your money; match a card from the bottom row and get a push. This allows you to continue the game without losing or winning. Match all five cards and receive a bonus.

The poker game plays just like any other jacks-or-better poker with a familiar feel that players can easily relate to.

Kimble's Match and Win poker will go on general release at the end of March.

The Kimble team presented their SPEED games platform at ICE 2004

Presentation Of Award To Be Highlight Of Ireland's 25th Coin-Op Expo

The presentation of the first Mary Openshaw Memorial Award for Excellence is set to be a highlight of Ireland's 25th Coin-Op Expo - AmEx 2004, which will be held at the Lynch Green Isle Hotel, Dublin on 2 & 3 March.

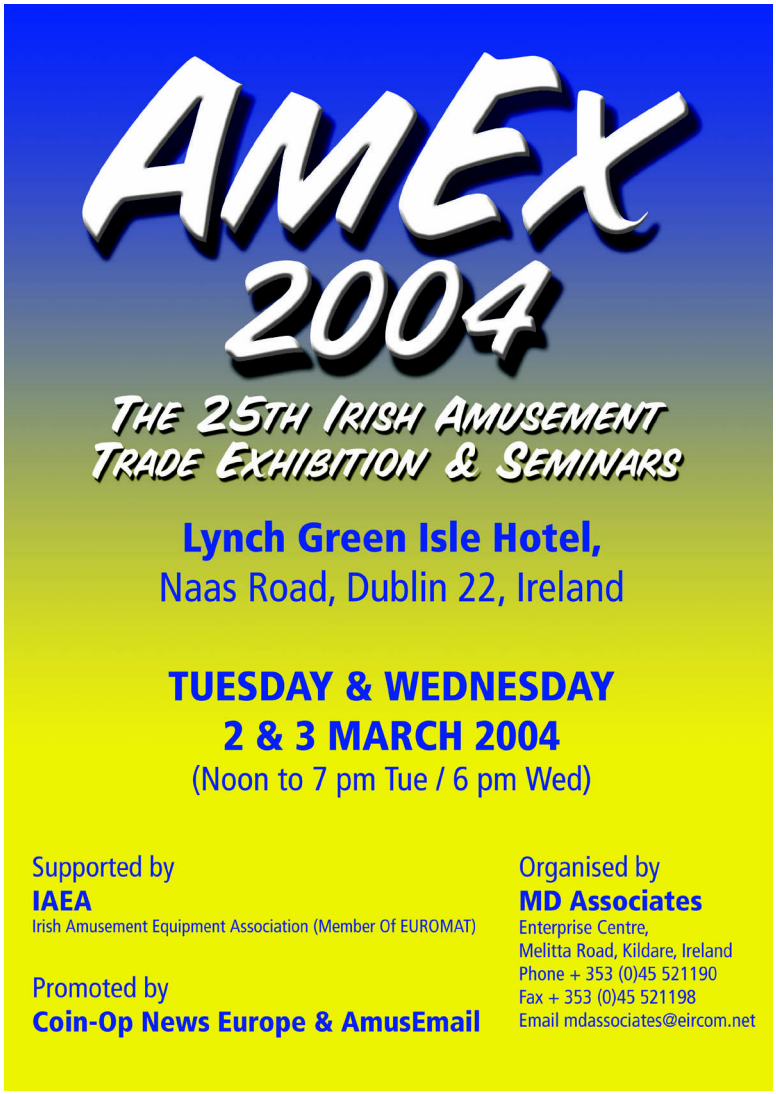
The award, which is sponsored by Coin-Op News Europe, will be presented each year to a person, company, association, publication or exhibition, involved in the international amusement industry, in memory of the late Mary Openshaw, who worked for many years as a journalist in the industry.

Ireland's amusement and gaming industry has been particularly busy in recent months, ahead of AmEx 2004. The demand for a wide variety of product has fuelled interest in the Irish market and representatives of many British based distributors have had to visit Ireland more frequently in order to take care of customer requirements.

On show will be a selection of amusement, gaming, novelty and redemption equipment, all of which continue to play an important role in the fast growing Irish coin-op market. Jukeboxes, pool tables, touchscreen games, pushers, cranes, kiddie rides, pinball, vending machines, currency handling equipment, spares and accessories, will all be presented by exhibitors.

The new Northern Ireland gaming legislation gives AmEx 2004 an added boost and a definite Northern Ireland aspect. The legislation will allow the use of £25 all cash jackpot machines in arcades and deal with a number of other related issues. The ongoing deregulation of the UK gaming industry will also have an effect on the trade in Northern Ireland.

Southern operators have learned to live with the 1956 Gaming & Lotteries Act but



say that the introduction of modern legislation would boost the industry further, protect existing jobs, create additional employment and encourage investment. In spite of many broken promises from successive Governments in relation to updating the 1956 Act, the industry has survived, bringing much needed amusement, leisure and entertainment facilities to Irish people and visitors alike.

Visitors from all over Ireland and further afield will be presented with a selection of equipment to suit their requirements. In addition to the exhibition there will be a full programme of seminars, meetings, business presentations and social gatherings, continuing the show's reputation for bringing together Irish and international manufacturers, distributors and operators in a business-like atmosphere.

Seminars on Tuesday 2 March will include Kiddie Ride Technical & Engineering Seminar by SB Machines from 12.30 to 13.30; Digital Audio & Digital Video Jukebox Technical Seminar by Sound Leisure / Automatic Amusements from 14.00 to 15.30 and Golden Tee 2005 - Sharing The Success by Electrocoin / Incredible Technologies from 16.00 to 17.30 and on Wednesday 3 March there will be an NSM Chameleon Product Presentation by NSM / Q Leisure from 11.00 to 12.30.

Exhibitors at AmEx 2004 will include Almotech, Amusement Machine Services, Amusement Sales & Service, Atari Expo, Brent Sales, Britannia Leisure Services, Cash Automation, Conway Bros, Cromptons Leisure International, Crown Direct, Electrocoin Sales, Excel Leisure, Franco Gaming / RSL, FX Simulation, Genesis, Happ Controls Europe, Harry Levy Amusements, ITM, J.H.S. Associates, Jaybee Blake, JCD, Kimble, Maggi & Maggi UK, Master Billiard Supplies, MDM, Mitchells Childrens Rides, Money Point, Oasis Retail Services, Olympic Sales Bundoran, Pat Gilson, Premier Machine Trading, Pool Ireland, Q Leisure, Rowe International Corporation, Sammy Europe, SB Machines Leisure, Scan Coin, Sound Leisure, Spiros Poker, Star Leisure, Superleague (Ireland), Suzo International (UK), TCS Funtime, The Deith Group, The Novelty Capsule Company, Thomas Automatics and Tobyco.

Trade media supporting the show include Coin-Op News, CoinSlot International, EuroSlot, G3, Gametime International, Highwaygames.com, InterGame, Slot Tech, TRH Zabavy, Vending Times and Your Guide. AmEx is organised by MD Associates and sponsored by IAEA - The Irish Amusement Equipment Association (Member Of Euromat). Opening hours are from noon to 7pm Tuesday 2 March and 6pm Wednesday 3 March.

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Troubleshooting Techniques

Loaded to Death

Here's a look at a real-world troubleshooting situation that pops up fairly often and yet can be more than a little confusing for technicians that are just starting out in the world of component-level troubleshooting in things like power supplies and monitors. This specific example is taken from a monitor repair that was performed at a recent tech training class in North Carolina. Unfortunately, I was unable to obtain a copy of the schematic diagram. The illustrations used in this article are a simplified, composite representation of the monitor under discussion.

In this case, the monitor appeared completely dead. That is to say, there was absolutely no raster. There was no deflection of any kind. There was no high voltage (EHT). There was no glow in the neck of the CRT. There was no heater voltage.

Well, okay . . . There are a number of things that might cause this so let's gather a few more clues. Is the monitor making any sound at all?

Is there a faint ticking or chirping sound? No? Okay, that pretty much rules out a shorted horizontal output transistor, one of the more common failures that creates the "dead monitor" symptom.

As the monitor is first energized, is there a momentary sound of "static electricity" as the high voltage comes on for a brief, scintillating moment and then shuts down? No? Okay, it's not going into x-ray protection (A.K.A. high voltage shutdown).

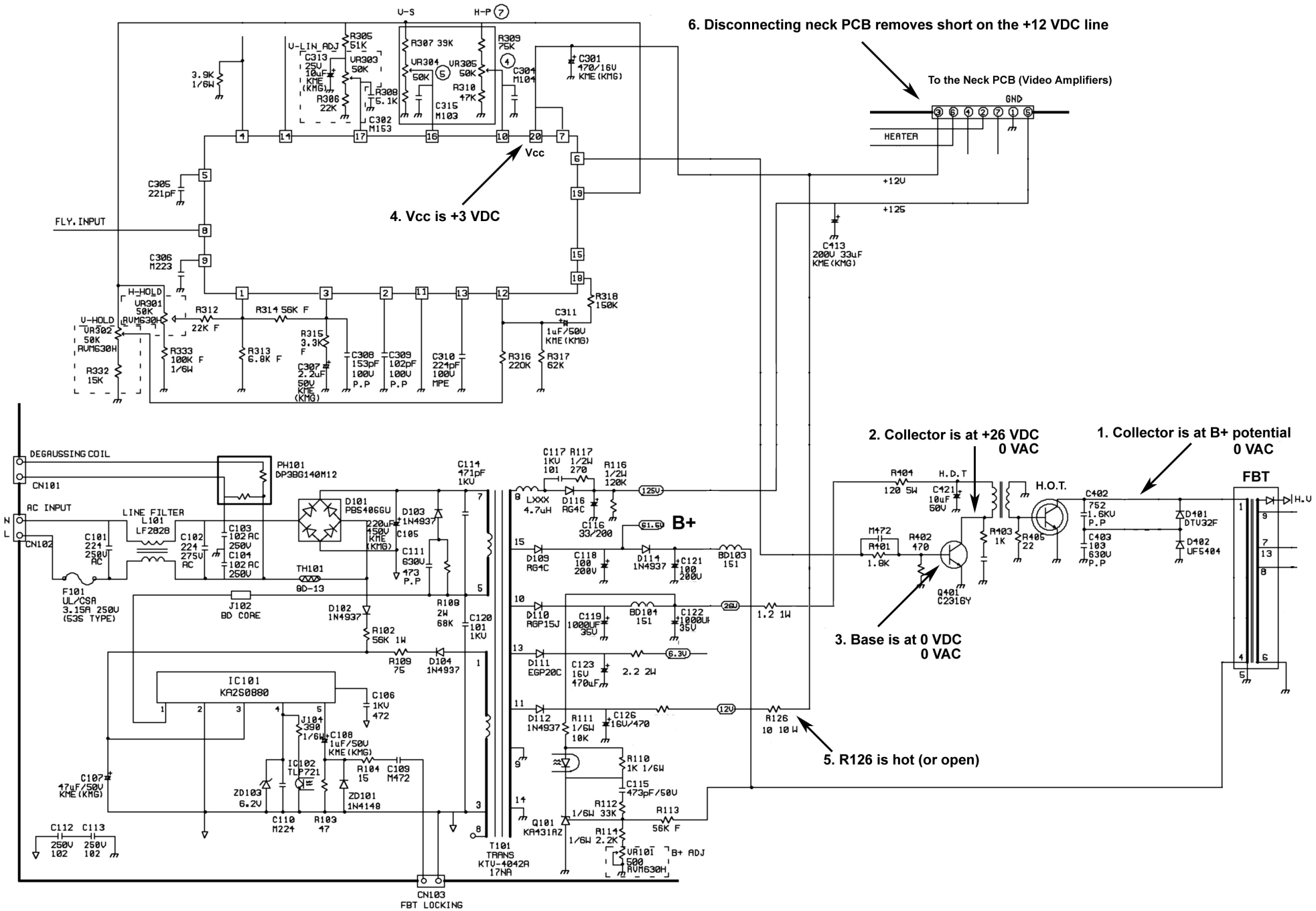
So, it really is completely dead . . . Or is it?

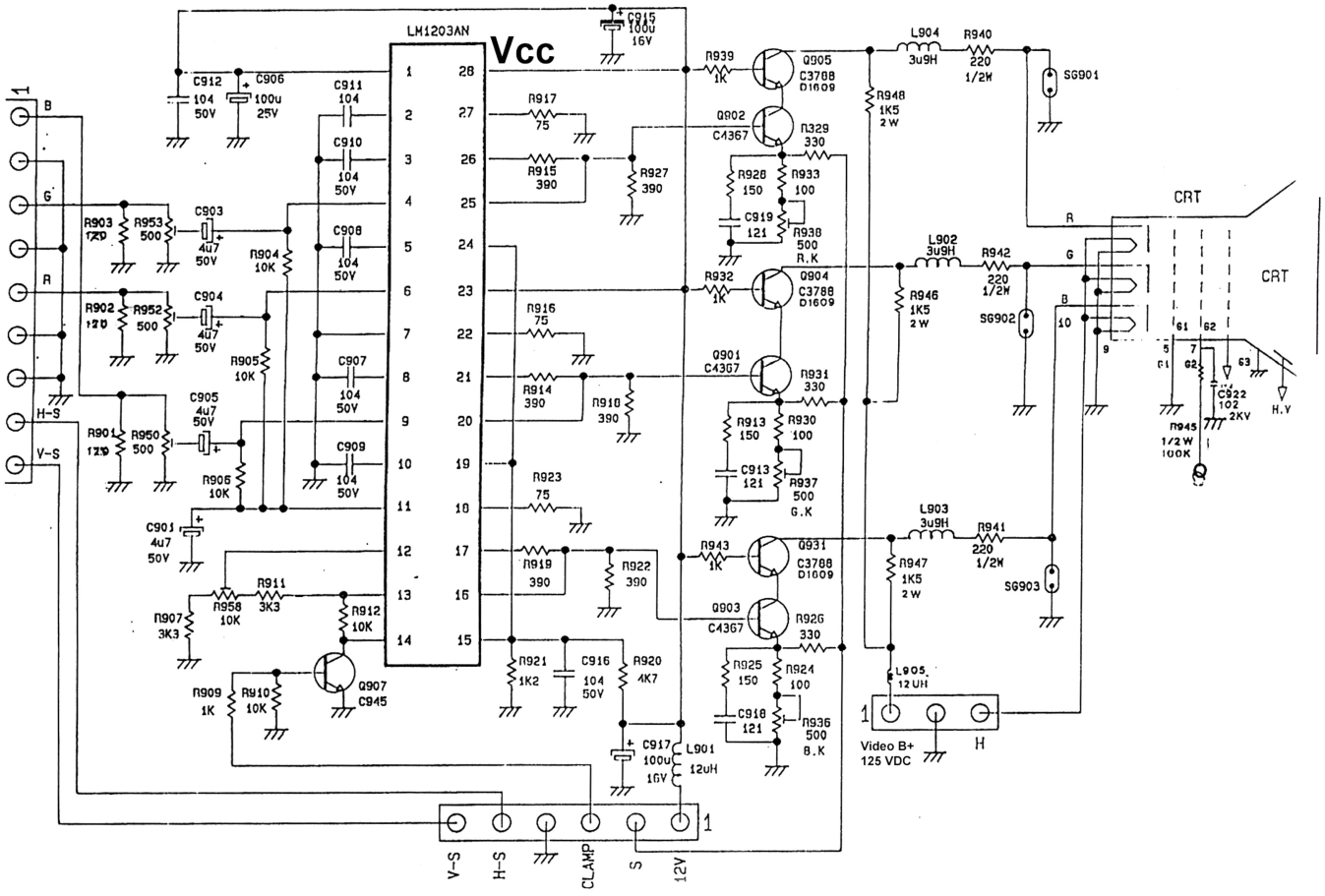
Time to throw a meter on the power supply and check the B+ (see June 2001 Slot Tech Magazine). Hey! The B+ is too high when first measured but after loading it with a 120 volt, 25 watt incandescent lamp, it's fine. It's right where it should be.* The monitor is not completely dead at all. The heart of the monitor (the SMPS) seems, at first glance, to be perfectly fine. A quick run down the other SMPS outputs (+12 VDC for the video amplifier, oscillators and other integrated circuits and +26 VDC for the vertical output stage) confirms that the switched-mode power supply is completely functional. Time to move on and take a look at where the real problem must lie, the horizontal deflection circuit.

Horizontal Deflection Troubleshooting

There are a number of different approaches that can be taken here. At the high end, sophisticated test equipment

Why did I load the power supply? Remember that the horizontal deflection circuit draws the vast majority of the B+ current. Clearly, the horizontal deflection circuit is not working (no static sound, no raster) and so, without the load normally associated with the horizontal output circuit, the B+ rises. I do not suspect however, that this rise in B+ is the cause of my failure because if it was, I'd have heard the momentary static sound of the EHT coming on and then shutting down as the x-ray protector kicks in and shuts down the horizontal oscillator (see Slot Tech Magazine, February 2003 for more on x-ray protection). Connecting the lamp between the B+ output of the SMPS and ground creates a load on the power supply, allowing me to verify that the B+ is perfect. Wherever my problem lies, it's not in the B+ power supply.


6. Disconnecting neck PCB removes short on the +12 VDC line
To the Neck PCB (Video Amplifiers)
GND
HEATER
+12V
+12S
Vcc
4. Vcc is +3 VDC
FLY. INPUT
V-S
H-P
V-LIN ADJ
H-HOLD
V-HOLD
C313 25V 10uF KME (KMG)
R305 51K
R306 22K
R308 5.1K
VR303 50K
VR304 50K
VR305 50K
R307 39K
R309 75K
R310 47K
C315 M103
C301 470/16V KME (KMG)
C302 M153
C304 M104
3.9K 1/6W
C305 221pF
C306 M223
VR301 50K RVM630H
VR302 50K RVM630H
R312 22K F
R314 56K F
R315 3.3K F
R313 6.8K F
R333 100K F 1/6W
R332 15K
C307 2.2uF 50V KME (KMG)
C308 153pF 100V P.P
C309 102pF 100V P.P
C310 224pF 100V MPE
C311 1uF/50V KME (KMG)
R316 220K
R317 62K
R318 150K
C413 200V 33uF KME (KMG)
2. Collector is at +26 VDC 0 VAC
1. Collector is at B+ potential 0 VAC
3. Base is at 0 VDC 0 VAC
5. R126 is hot (or open)
FBT
H.O.T.
H.D.T
R401 120 5W
C421 10uF 50V
M472
R401 1.8K
R402 470
Q401 C2316Y
R403 1K
R405 22
C402 752 1.6KV P.P
C403 103 630V P.P
D101 DTV32F
D102 UF5404
H.V
DEGAUSSING COIL
CN101
AC INPUT
CN102
N
L
F101 UL/CSA 3.15A 250V (53S TYPE)
LINE FILTER L101 LF2828
C101 224 250V AC
C102 224 275V AC
C103 102 AC 250V
C104 102 AC 250V
TH101 8D-13
J102 BD CORE
PH101 DP3BG140M12
D101 PBS406GU
220uF 450V KME (KMG)
C105
D103 1N4937
C111 630V 473 P.P
D102 1N4937
R102 56K 1W
R109 2W 68K
C114 471pF 1KV
C120 101 1KV
R109 75
D104 1N4937
IC101 KA2S0880
C106 1KV 472
J104 390 1/6W
C108 1uF/50V KME (KMG)
IC102 TLP721
R104 15
C109 M472
ZD103 6.2V
ZD101 1N4148
C107 47uF/50V KME (KMG)
C110 M224
R103 47
C112 C113 250V 102
C117 R117 1KV 101 1/2W 270
R116 1/2W 120K
LXXX 4.7uH
D116 RG4C
C116 33/200
B+
D109 RG4C
C118 100 200V
D114 1N4937
C121 100 200V
BD103 151
D110 RGP15J
C119 1000UF 35V
BD104 151
C122 1000UF 35V
1.2 1W
D111 EGP20C
C123 16V 470uF
2.2 2W
D112 1N4937
R111 1/6W 10K
C126 16V/470
R126 10 10W
R110 1K 1/6W
C115 473pF/50V
R112 1/6W 33K
R113 56K F
Q101 KA431AZ
R114 1/6W 2.2K
VR101 500 RVM630H
B+ ADJ
T101 TRANS KTV-4042A 17NA
CN103 FBT LOCKING



can be used for signal substitution. The August 2002 issue of Slot Tech Magazine carried a feature about Sencore's remarkable HA2500 Horizontal Analyzer that can substitute any of the drive signals or power supplies in the horizontal output circuit. Sweet.

At the low end of things, the novice technician might be relegated to simply testing all of the "testable" parts in the horizontal deflection circuit with the power off and replacing those (such as the horizontal IC) that cannot be tested this way. This technique allows novice technicians to repair the greatest number of failures with the least amount of knowledge (and it's a great way to begin learning about electronics repair) but it's barely qualified to be called "troubleshooting."

Somewhere in-between is a fairly simple, power-on troubleshooting technique that can pinpoint most "no horizontal deflection" failures in just a few minutes, using a DMM to take a few key voltage readings.

Start by measuring the DC voltage at the collector of the horizontal output transistor. WARNING: Never do this if

the horizontal deflection circuit is functional. When the horizontal deflection circuit is functioning properly, the collector of the horizontal output transistor can have as much as 1200 volts on it, all-but-guaranteed to have a detrimental effect on your meter. If you draw a big arc as you touch your meter lead to the collector, you don't have a horizontal deflection failure.

What you're expecting here is one of two things: Zero volts - meaning you have a broken connection or open component between the B+ power supply and the primary winding of the flyback transformer or between the primary winding of the flyback transformer and the collector of the horizontal output transistor - or you will measure the same B+ voltage at the collector of the horizontal output transistor as you have coming out of the SMPS - meaning that all of the above mentioned stuff is okay and you need to move back toward the beginning of the horizontal deflection circuit.

Logically speaking, the next check would most likely be to see if the horizontal output transistor has its base drive but quite frankly, if it did, you'd most likely have high voltage. Depending on the type of meter you're using, you might read around one volt AC on the base.

So, assuming the base drive to be missing (or measuring it and finding it so) the next step is to move back to the primary side of the horizontal drive transformer and measure the AC voltage at the collector of the horizontal drive transistor. The power supply for the horizontal drive comes from either the B+ or from the same +26 VDC power supply that drives the vertical output IC so the voltage here might be around 50-60 VAC or 10-15 VAC depending on the design.

Your big clue here is AC. If you have AC, the circuit's working. If you have DC, (either B+ or +26 VDC) it's not. If you have zero volts, you have a broken connection between the +26 VDC power supply (previously verified, remember?) and the horizontal drive primary circuit. Perhaps the resistor that is connected in series between the power supply and the primary side of the horizontal drive transformer is open. In rare circumstances, the primary winding might be open.

In the example under discussion, we had full DC on the collector with no AC at all. Clearly, the horizontal drive transistor was not operating. Either the transistor itself is bad (certainly possible but not too likely) or the horizontal drive transistor isn't receiving a drive signal from the horizontal oscillator IC. A quick check on the base of the horizontal drive transistor confirms that the drive is missing. The base of the horizontal drive transistor is sitting at zero volts AC and zero volts DC.

Of course, you can see what we're doing here. We're starting at the output and working our way back. Since there's nothing coming from the horizontal oscillator IC, either the IC itself is bad (WAY not likely) or one or more of the discrete support components has failed (also not likely) OR we have somehow lost power to the horizontal oscillator IC, which is a much more likely scenario. A quick DC voltage measurement confirms (in this case) that the +12 VDC that powers the horizontal oscillator IC measures at just a few volts DC. No wonder the entire horizontal deflection circuit is not working.

But hang on just a dang minute here. The +12 VDC power supply was tested at the outset of our troubleshooting and was found to be good. What the heck has happened to the +12 VDC between the output of the power supply and the Vcc (the power supply) input to the horizontal oscillator IC?

It's pretty typical to see a low ohm, high wattage resistor in series with low-voltage power supplies. This resistor serves to limit inrush current and to act as a sort of protection device in case something on the line shorts to ground. Instead of dragging the power supply all the way to ground and causing the SMPS's Over-Current Protection (OCP) to kick in (as it does when the horizontal output transistor shorts) the series resistor will

either dissipate the energy as heat or will simply open circuit. FYI, this will almost always be a non-flammable, metal-oxide resistor.

Could this be what's happening here? Obviously the resistor isn't open as we have a few volts DC. Let's find that pesky resistor and see what's going on. A quick peak at the schematic and we find resistor R126 in series with the +12 VDC power supply between the SMPS and the Vcc input of the horizontal oscillator IC. Even without a schematic diagram, this resistor would have been easy to locate. A wave of the hand above the component side of the PCB and you can feel the heat being generated by this resistor.

So, here we have a resistor with the full +12 VDC on one side but only a few volts on the other and while it's possible that the resistor might have increased in resistance (thus accounting for the severe drop in voltage) the fact that the resistor is really hot belies that theory in favor of the REAL problem (and the actual point of this discussion) that something has shorted and is loading down the +12 VDC power supply. The +12 VDC supply has been loaded to death. This is easily verified with a quick power-off resistance check. The resistance between the +12 line and ground is only 10 ohms. It should be thousands. Bingo! We can now do the remainder of the troubleshooting with the power off.

All we have to do is find the shorted component.

This has now become very interesting. We began by troubleshooting the inoperative horizontal deflection circuit but unless the horizontal oscillator IC is the one loading the +12 VDC power supply, this may not be a horizontal deflection failure at all.

Our next step is to look at the schematic in order to see where the +12 VDC power supply goes and try to speculate which component might have failed. This is one of the places that a schematic diagram is absolutely mandatory for troubleshooting quickly. We're looking for components that are likely to short circuit so we can rule out resistors. When resistors fail, they open circuit or rise in resistance. Electrolytic capacitors are also low on my list of potential failures. Although an electrolytic capacitor can short-circuit, in my personal experience, it is unlikely.

That having been said, a peek at the print reveals that the +12 VDC power supply snakes around the monitor to the horizontal/vertical IC and the sync amplifiers. It also goes to the neck board where the video amplifier circuits live. One of the ways to locate the short circuit is to "divide and conquer." You're looking for easy ways to disconnect the loaded +12 VDC line in order to see which part of the circuit is still loaded and which is not. Since the +12 VDC is connected to the neck PCB through a connector, this is a logical place to start in narrowing down the location of the short. With the connector pulled, the excess load on the main PCB disappears! We now know that the problem lies on the neck PCB and not on the main PCB where we have been doing all of our troubleshooting so far.

Have we been wasting our time? Absolutely not! We have been following the logical process of troubleshooting. When properly performed, good troubleshooting techniques will always lead you to the fault. Guesswork works too. Sometimes it's even faster. It's never as educational, fun or interesting.

On the neck PCB there isn't much that's connected between the +12 VDC and ground. In fact there are only a couple of capacitors and the video amplifier IC itself, in this case, the ubiquitous LM1203. The caps were pulled and found to not be shorted. That only left the LM1203, which turned out to be the actual cause of the problem. Go figure! A short in an IC on the neck board in the video circuit has caused the symptom of "loss of horizontal deflection" which is a totally different section. The common point here is of course, the +12 VDC power supply that is common to the both of them. With the LM1203 replaced, the monitor fired-up and worked perfectly.

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

Subscription rates:

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