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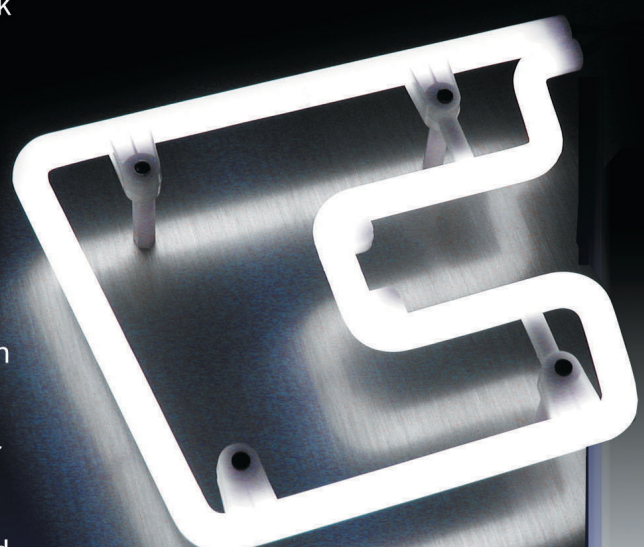

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Slot Tech Editorial

Wow! I'm really excited (can you tell?). There are a couple of things that kind of have me all fired up 'cause they're new and really pretty exciting. One is the introduction of a new column in Slot Tech Magazine, penned by Atronic's Michael Brennen. Michael is in charge of Atronic America's technical publications division. His premier offering is a piece entitled "The Atronic Slot Doctor Is In" and I couldn't be happier with a first contribution from a new correspondent. I am looking forward (as should you) to hearing from Michael on a monthly basis on the subject of Atronic slot machines. His column begins on page 22.

The other thing is a new wrinkle in our popular TechFest series. Since the very first TechFest, I have invited Sencore to come and demonstrate their test equipment. I do this, not because they are an advertiser in Slot Tech Magazine (although I appreciate their support) but because I believe that they make really nice equipment that is ideally suited to the type of work we do on the bench in a casino and I want you all to see it in action. I have made no bones about calling it TechFest's only sales presentation.

But that was then and this is now. When I sent Sencore an invitation to present at TechFest 13 (to be held May 16 - 18, 2006 at the Mystic Lake Casino in Minnesota) I received a reply from their gaming guy, Don Multerer. Don told me that he wanted to ditch the sales presentation in favor of providing some real, hard-core technical training.

"You have an opportunity to see how good Sencore really is," he said. "Plan a tech presentation and give us enough time to do it."

"OK," I thought to myself. "Game on. How about a hands-on training class in

LCD repair?" Sencore is based in Sioux Falls, South Dakota, only a couple of hundred miles from where the TechFest will be held. They have a van full of test equipment that they can drive over to the TechFest and set up a working, hands-on training lab that can accommodate 12 students at a time.

And so, the deal is set. Sencore will be presenting a limited attendance, LCD repair class each day at TechFest 13. It will be the same program each day (from 1:15 PM to 5:30 PM) which means that just 36 people will be allowed to attend this limited portion of TechFest. Attendance is on a first-come, first-served basis so if you're thinking about attending this often sold-out event, this year it's more important than ever to sign up as early as possible. There is an enrollment form on the website at slot-techs.com. This will be a certified class, meaning that upon completion, you will receive a certificate that you can hang on your "I love me" wall if you're so inclined.

See you at The Casino.

Randy Fromm

TechFest 13 will be held at Mystic Lake Casino in Minneapolis, MN May 16-18 2006

Randy Fromm's Slot Tech Magazine

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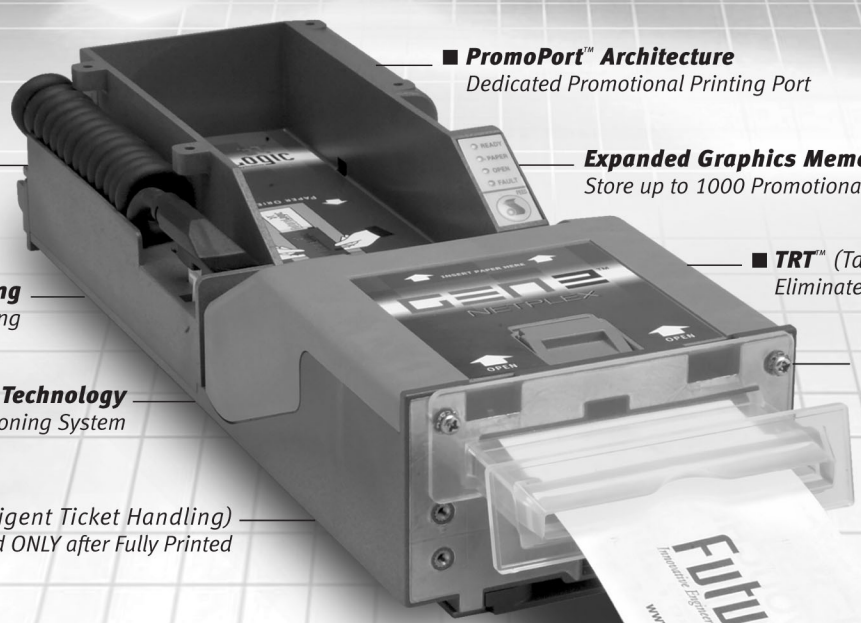

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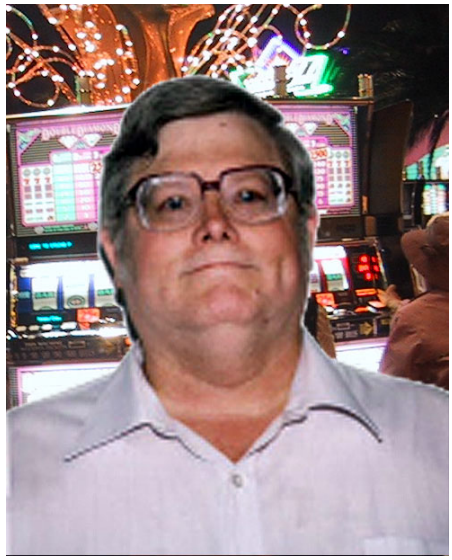

Circuit Board Design

By Herschel Peeler

After you can draw a suitable schematic the next step in your career talents development is taking that design and making a board out of it. Your first few attempts might be a little taxing on your patience, but stay with it. It gets easier as you gather experience.

Cost? FREE!

Note: To keep up with most of this article you may want to download the free software mentioned from www.expresspcb.com

There are a number of circuit board manufacturers out there who will take your board design and make a small run of circuit boards for you at an acceptable price. Express PCB, for instance, will make a batch of 3 boards (of a limited size) for $51.00. At your option, there are other possibilities. A standard batch of ten boards would run about the same, $17.00 each. That was the last quote I got back for a board 2.5" x 3.8", two-sided. Cost depends on board size, two or four layer (2-layer is just top and bottom, 4-layer is top and bottom with two power planes running through the center of the board) and a number of other factors. The default design is a fiberglass board with two layers with plated through holes.

You can download the software for free from their web site. They have a schematic drawing package that comes with it (www.expresspcb.com). I like the Express PCB circuit board design software better than OrCAD but I like OrCAD's Schematic software better. OrCAD just has more components in their libraries and it is easier to make changes to the symbols. ExpressPCB's board maker is, I think, easier to use. I was making circuit boards within an hour without using the tutorial examples. But then this isn't my first time using a PCB design program. The more experienced you are, the easier it will be for you. Be patient and consider your first few designs a learning experience.

Laying Out the Board

Start by setting the size of the board (I used the default 2.5" x 3.8") then put down items that must be put in a specific place like mounting holes, parts that will fit directly into a panel, things like that. To get a symbol to place, left click on "Component" then "Component Manager." This will give you a list of component layouts to draw from; it is a library. Select the component you want and click on "Insert component on the PCB." Keep in mind you are dealing here with the component body, not the electronic characteristics.

At the bottom of the screen is a small window that says Snap 0.050." This is a menu you may use to select how precisely you want to lay down the components. With most ICs with leads on 0.100" pin spacing a Snap of 0.050" will pop the component symbol to the closest 0.050" point on the layout once you Place the part. Snap of 0.050" lets you place a trace between the leads on an IC with a 0.100" pin spacing with ease.

When you call up a symbol, it will appear in the center of your design in white. Click and drag on any of the pins to place the part where you want it on the board. Copy and paste it to place more than one of them.

Right clicking on a component while you have it selected gives you a menu of options to rotate the part into position, or Copy and Paste. Currently selected parts

come up in white. Traces on the bottom of the board are in green. Traces on the top of the board are in red. Things that pass through the board also show up on red.

Get an idea of how you want the board laid out, where incoming signals are going to come from, where outputs are going to go and how the layout will flow over the board. This sets where you are going to put connectors and such. If you are working with two layers, it is a good idea to put most of the traces on the bottom of the board and use the top of the board only when you have to. Since traces cannot cross one another on the same side you may have to use a jumper on the top side of the board to cross over another trace.

Place the major components (ICs, Power Transistors and such) in approximate areas you want them. Don't worry too much about precision at this point. You can always move a part even after you have connected traces to the leads. It will drag the trace with the component as you move it.

Once you have all the parts in place, you place traces where you want them. Left click on the Trace button. Select top or bottom layer at the top of the screen. Move over to where you want to start the trace. Left click to start laying down the trace. Left click again to anchor the trace if you want to make a turn, or left click again to end the trace. Right click to stop laying down that trace. Once the trace is in place you can select it, right click on it, and set the trace width "Set Trace Properties" on the menu.

Computing Cost of the Board

Once you have all the problems out of the board design, click on the "Layout" button at the top of the screen and select "Test ordering the boards via the Internet." The program will go out to the ExpressPCB web site and get the necessary information. Once it tells you it is done, click on "Compute Board Cost" at the top of the menu, select the details of your choice (three for $51 or one of the more standard pricing options) and it will give you the cost of having that board made for you. Other options break down the cost into details for you to get a better idea of what costs how much. Three boards for $51 is about the same price as a batch of ten. A goodly portion of cost is setting up to do the first board. Once one is set up, doing more becomes cheaper per board.

Making the Board Yourself

If you should choose to make your own, this is possible also. You "simply" print the board layout on transparent film. You can buy printed circuit board material that is sensitive to UV light. Two methods are available here.

In the positive method, the areas exposed to UV light harden the sensitive coating on the board and when the board is etched, the area not exposed to UV light is etched away. There is also a Negative method where the areas exposed to UV light are washed away. In either case, the transparency you made is used as an overlay when the board is exposed to UV light. After exposure, the sensitive coating is washed away and the board is etched in acid. You then have the option of drilling holes, laying down another layer of copper to plate through holes. All this only costs you a few hundred to get it started. This material is available from a number of different vendors.

Or you can put out the bucks and just pay a professional to do it for you. From personal experience, I find it easier to have it done. I have done the DIY method in various ways. I have taken a rough draft, hand drawing, of a circuit from an engineer on late Friday and deliver a finished prototype, stuffed with parts, delivered to his door on Monday morning. See my resume under "unsuccessful self employment history."

Following articles will show some of the hints, tips and tricks of laying out a board.

Just to name a few sources you can find without searching too hard, the following companies advertise making circuit boards. Each has a different deal for you:

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www.pcb4less.com
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print, know what you need and what you are asking for. This is certainly a Buyer Beware world. You get exactly what you ask for even if it isn't what you thought it would be. The back of most electronics magazines has advertisers of these services. I found them in the pages of Electronic Design magazine (www.elecdesign.com) or Google on "PCB manufacturer."

- Herschel Peeler
- hpeeler@slot-techs.com

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SiP System Soon to Manage Macau's Only Wide Area Jackpot Link

Since October 6 of this year, the jackpot system and online casino management solution from Systems in Progress (SiP) has been managing a 3-level wide area jackpot in the Lisboa and Golden Dragon casinos in Macau. A total of 94 slot machines are connected in the venues operated by Sociedade de Jogos de Macau S.A. (SJM). The smallest jackpot has already been hit more than 6400 times, as planned.

The installation of the SiP hardware in the Aruze slots as well as the system setup and configuration of local jackpots had already been completed by the Macau staff when SiP's Senior Project Manager Max Pessnegger arrived. "Due to the superb preparation work performed at the two venues, my part of the implementation went like clockwork," Max reports.

After completing the few remaining configuration steps, such as making the local jackpots wide area ready, Max delivered short training sessions to the casino staff and provided go-live assistance. Maintenance Manager Sunny Mok is "extremely pleased about the easy, convenient browser-based configuration and monitoring" and about the low-maintenance and hassle-free operation of the network and software.

As the only operator in Macau to be currently featuring a wide area link and the only one in the world to be using this set of games, SJM is proud to be introducing another multi-site link. "The SiP system combined with the SJM-exclusive games will greatly benefit both players and SJM as the operator," said Assistant Slot Manager Tammy Ng. "I commend the professional way in which SiP has helped us bring this wide area progressive on-line and am looking forward to implementing the other project phases together with SiP."

The next phase of the project has already started. The existing link is gradually being replaced with the new solution powered by SiP. By the end of 2005, close to 200 slots in all SJM-operated gaming sites around Macau will be equipped with SiP's jackpot system, with another 200 machines following in 2006.

About SiP

SiP is a member of Unicum Group of Companies, developing, marketing and maintaining on-line casino management and monitoring solutions for the global gaming industry. SiP is based in Graz, Austria.

For more information on SiP please contact
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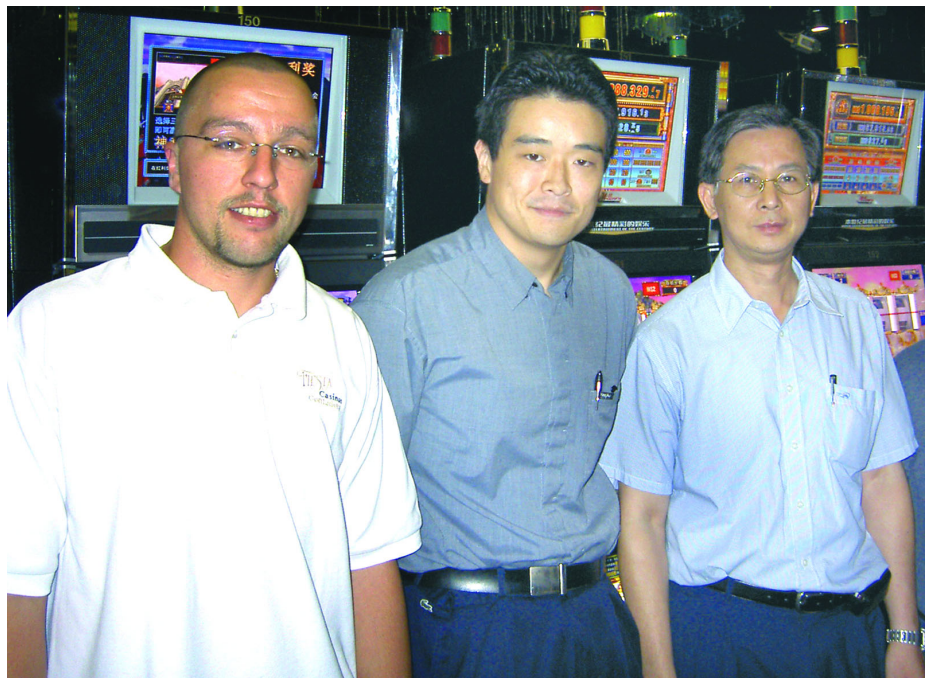
hsteffenini@sip.co.at.



With SiP Senior Project Manager Max Pessnegger, Assistant Slot Manager Tammy Ng and Maintenance Manager Sunny Mok are implementing SJM's unique wide area link

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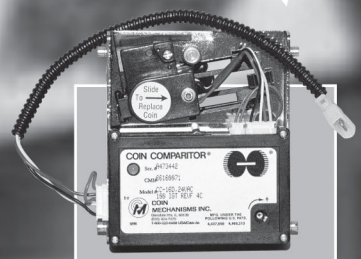

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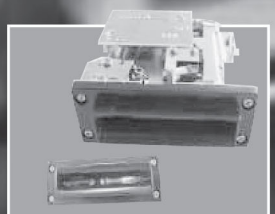
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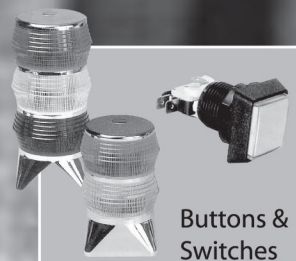
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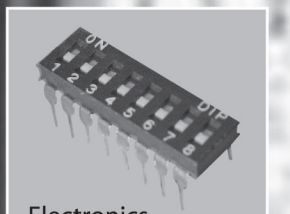
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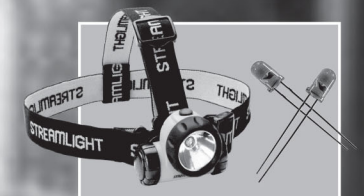

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Understanding Video Reels - Part 4

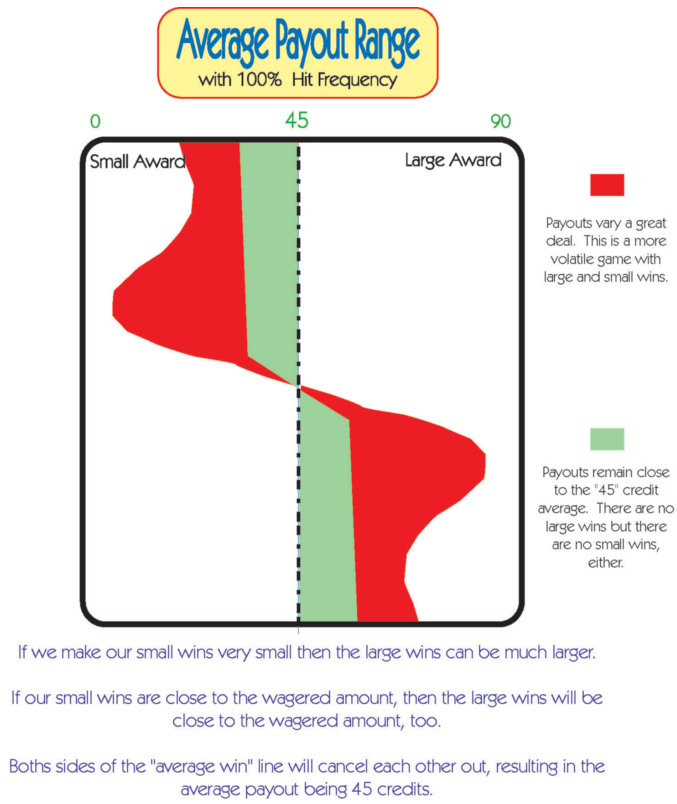
By John Wilson

This month we move deeper into the twisting and difficult labyrinth of video slot math. Let's jump in with both feet and start right away. The first mathematical function that we're going to study is the hit frequency. The higher the hit frequency, the more frequently that the player will win and the more potential enjoyment that can get from the slot machine. We use the term potential, because like everything else, there is always a trade-off involved. Suppose that we develop a video slot with a hit frequency of 100%. That means that every game will win something. While this might be enjoyable for the short-term, in the long-term it will not result in great satisfaction. The reason is that there is no opportunity for the machine to "save up" a large win. In order to create some reserve for larger wins, most games will result in a very small winning amount. If you bet 45 credits, you may win 5. It also means that the average win will not be very large.

Average Win

Consider a game where the maximum wager is 45 credits. Perhaps it's a nine-line, five credit game. The most that can be wagered at any particular time is 45 credits. If every game were to pay 45 credits, we'd end up with a 100% hit frequency and a 100% payout. We obviously want the theoretical payout to be less than 100%. We can do this in one of two ways. We can decrease the hit frequency, so that there are some games where no payin order to keep the hold frequency or to budget for a "big win."

Considering our game with the 100% hit frequency, we know that we must pay something every game. If we pay out close to 45 credits then our maximum payout won't be far away from 45 credits either. This is because our average payout would have to be 45. The average is sum of all the payouts divided by the number of games. For a 100% hit frequency and a 100% payout, the average would have to be the amount wagered, in this case, 45 credits. The more that the



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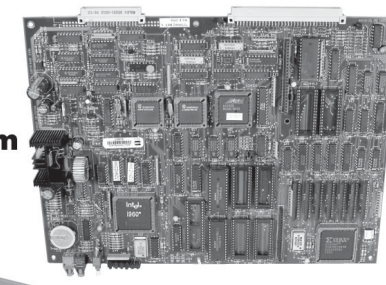

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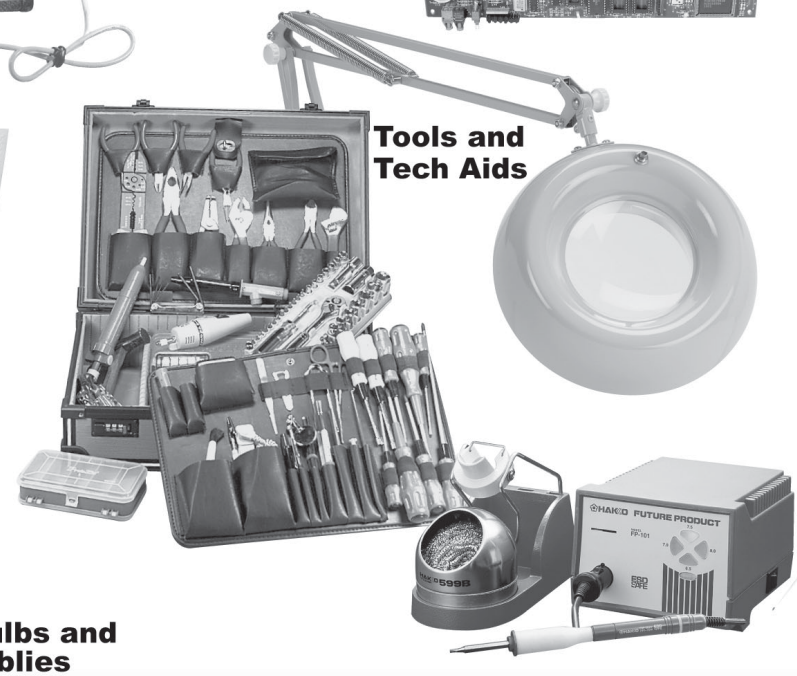

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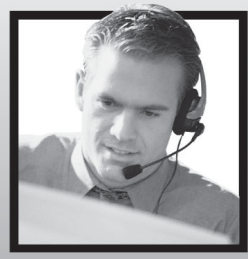

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payouts vary from the average, the more they vary on each side of the average. In other words, if we pay a minimum of 40 credits, we will probably pay out a maximum of 50 credits. We've dropped 5 credits below the average, so we'll only go up 5 credits on the other side, too. While this is a slight oversimplification, it does illustrate our point. Figure 1 illustrates the average payout values.

The more that we vary from the average, the more "volatile" the game is. That means that there will be smaller wins as well as larger wins. If we pay out 5 credits (40 below the average), we can also pay out 85 credits (40 above the average). Next we have to factor in other considerations such as how many of the payouts fall below (or above) the average. This gives us increased flexibility to move further away from the average, making larger winning payouts possible.

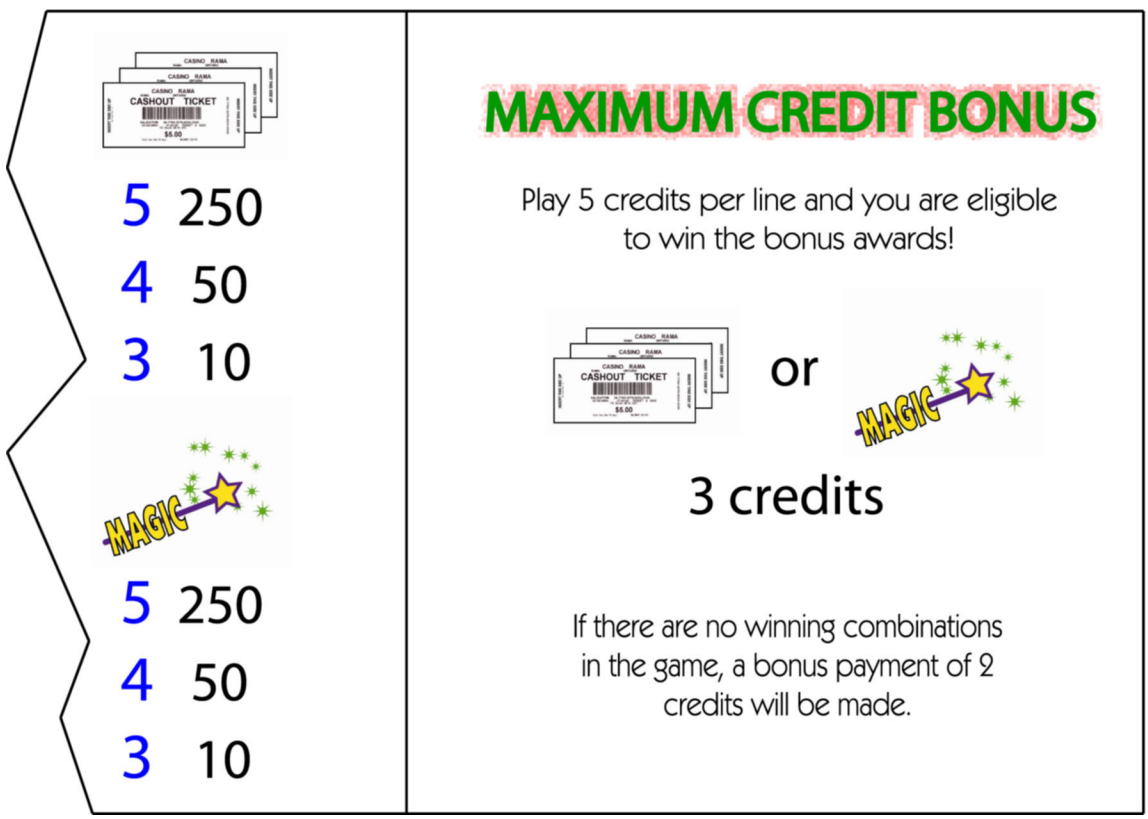
If we have a minimum payout of five credits then we have to do some creative math design as well. We have a nine-line game with up to five credits wagered per line so a five credit award is easy to do. We simply pay one credit for each credit wagered. If we want to pay out only three credits, however, then we run into a small problem. How do we pay three credits with a wager of five credits? If the player plays nine lines with one credit wagered per line then we pay out 3/5 of credit, or 0.6 credits. That's hard to do!

Perhaps we could make the game into a buy-a-pay game. If the player wagers five credits per line then they are eligible for special awards. If you bet the maximum amount per line, you don't always win. This could take care of the problem but we don't want to make it too confusing for the player. Figure 2 shows how our paytable might look.

Is There a Better Way?

The next solution is to make our hit frequency less than 100%. Does the player need to win EVERY game? No, especially if it means they can't win anything substantial. They would likely agree with this, too. Would you be happy playing a slot game where every time you bet 45 credits you win 35 back? All that happens is that you watch the credit meter shrink: 200 credits, 190 credits, 180 credits. Yawn! With the small wins the players never "get ahead" of their entertainment investment. As a result, the machine doesn't get played. Players would be happy to forfeit the insignificant wins for an opportunity to win something larger - even 90 credits would be better.

By reducing the hit frequency you give the machine an op-



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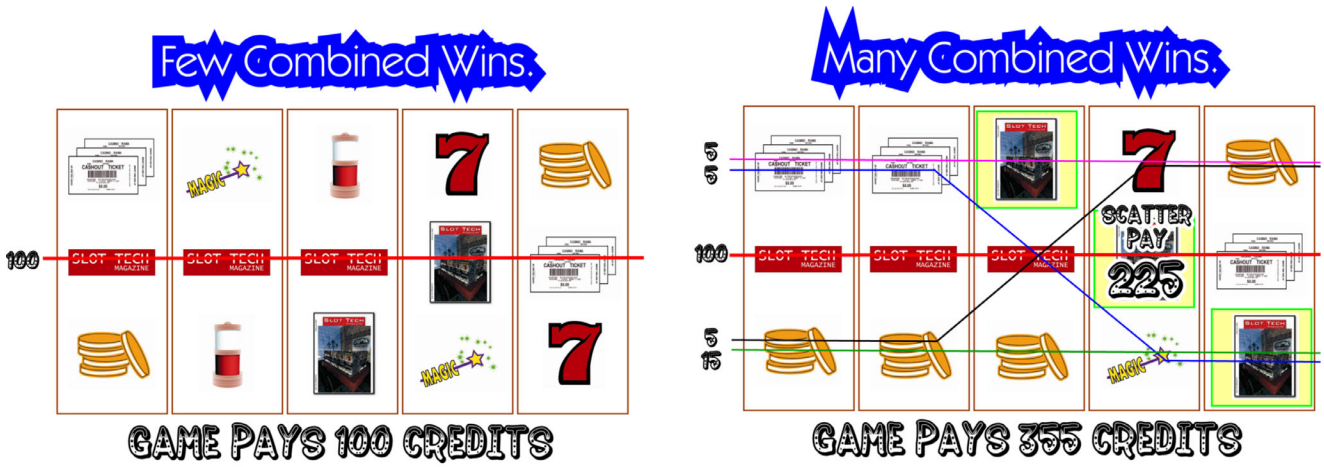


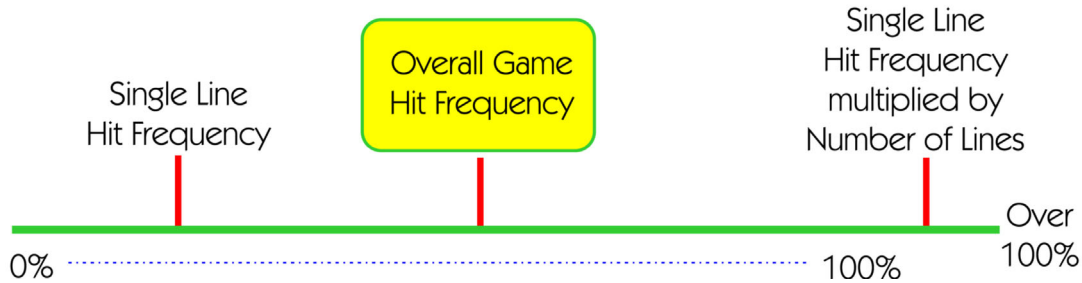
portunity to "catch up" on the payouts and create a reserve for larger awards. If the hit frequency drops to 75% then the player wins three out of four games on average. This is still pretty frequent. The games that pay nothing make the games that pay more exciting.

On the old TV series "The Twilight Zone" there was a gambler that died and went to … well, let's say he didn't make it to heaven. He had to spend eternity in a casino surrounded by pretty women and lots of money. He plays a slot machine and hits the jackpot. He plays blackjack and always gets 21. He tries roulette and his number always comes up. He soon realizes his penance - he can't lose. The wins become insignificant. There are no losses to make the wins seem better. There is no longer an element of skill or luck. In many regards, our 100% hit frequency places the player into that casino purgatory. Certainly the players don't want to loose all of the time, but they understand that they can't win all of the time, either.

The secret lies in having the perfect mix - enough wins to make it exciting, smaller wins to keep the players playing and give them some rewards to allow them to "stay in the game." Every now and then they want a win large enough to give them the opportunity to take it and go home or continue playing with more credits. Of course, sometimes they want a large jackpot that gives them extra money to buy their editor a new plasma TV.

Getting back to our video slot, let us suppose we've come up with a configuration that we think will work. Calculating our single line payout and hit frequency, we determine that we're going to pay out 90% and have a hit frequency of 4.75%. The payout percentage is fine but for a slot game, this hit frequency is pretty low. Winning 5 out of 100 games (or losing 95 out of 100 games) won't keep our players happy. However, with multiple paylines, we can have single paylines with a low hit frequency. By combining more lines we multiply the frequency of winning, creating a satisfactory level. This isn't

The overall game hit frequency will fall somewhere between the hit frequency of a single line and the hit frequency of a single line multiplied by the total number of lines available due to overlapping winning combinations.



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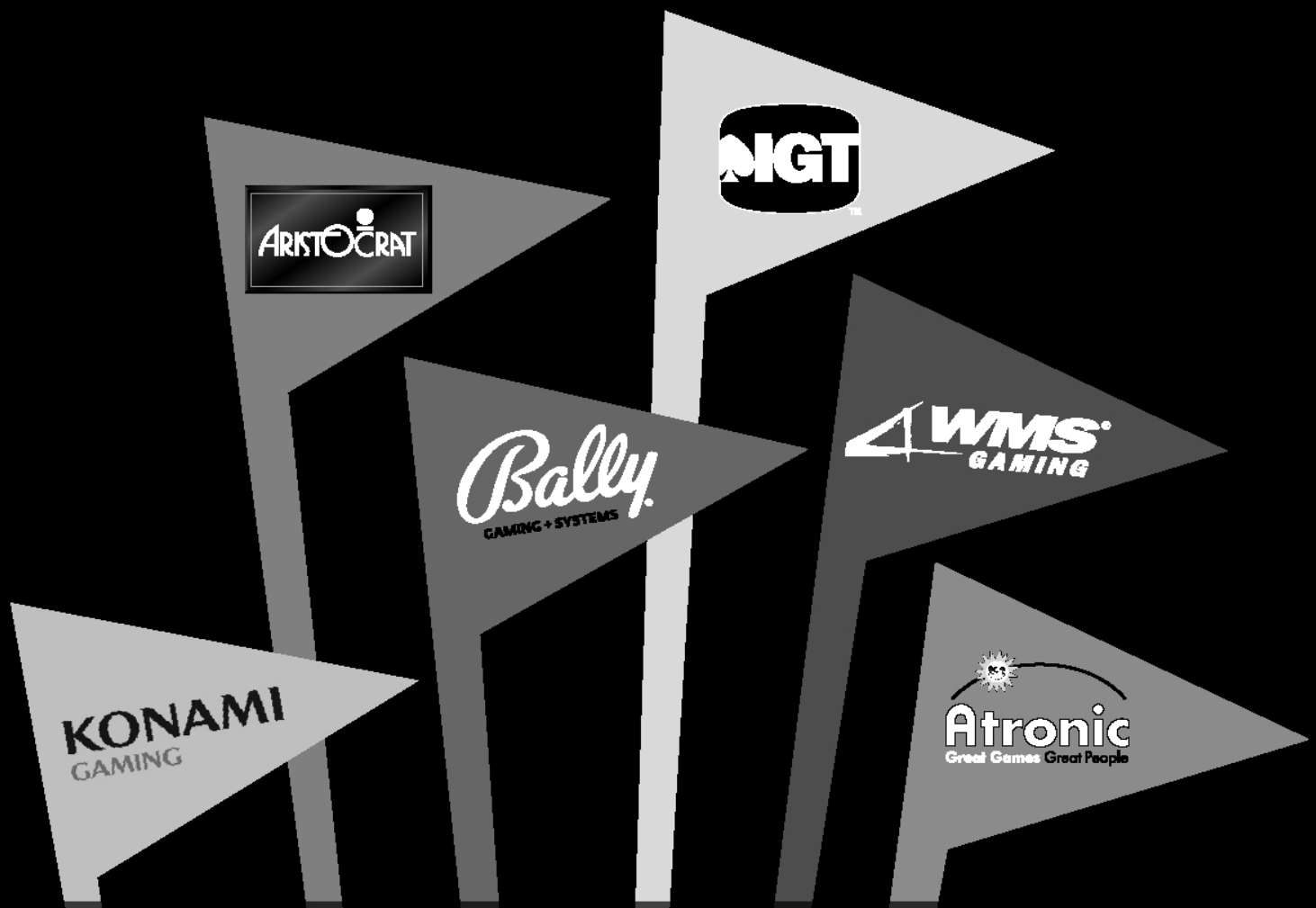

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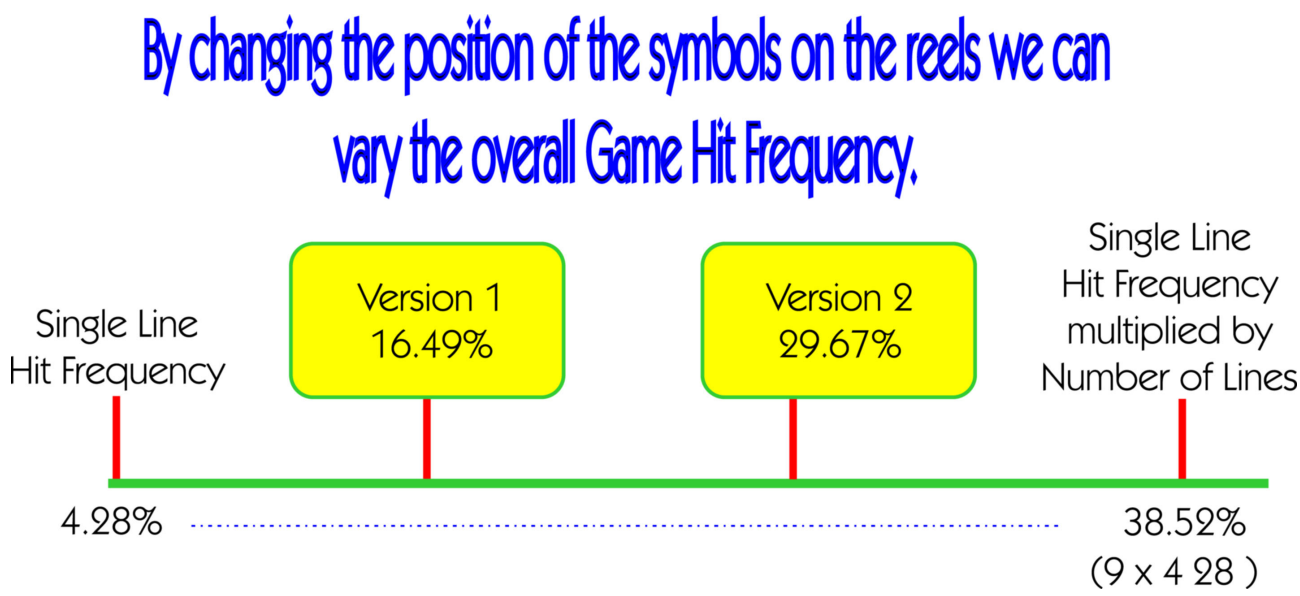

as easy as it sounds, though. And this is one area where game designers can shine and where they earn their money!

If we take our phantom game and play only one line, we will win (on average) 4.75% of the time. If we play two lines, we have twice the chance of winning. We will win 9.5% of the time. Add in another line and we triple our hit frequency, resulting in 3 x 4.75% or 14.25%. That's certainly much better, winning 15 out of 100 games, or one game out of six. Of course there may be times when we win on more than one line at a time. This affects our hit frequency slightly, as we'll explore in just a few moments.

The plot thickens ...
Eerie organ music plays...

Here the math takes a sinister twist. The three paylines on a slot machine are parallel to each other. There are no symbols that are shared between the three paylines. This is a significant factor! When we move beyond three paylines, the symbols on different paylines start to intersect. Things get messy in a hurry.

You would expect that a 4.75% hit frequency on one line would result in 9 x 4.75% for a nine-line game, or 42.75%. What if we have a hit frequency of 17.28%? Multiply by 9 and you get a

hit frequency of 155.52%. How can this be? You win on more games than you play? No, but you can win on several lines at once! That hit frequency means that you will win, on average, on 1.5552 lines per game. It's possible to win on all lines at once, or you may not win at all. The hit frequency that we determine by taking the single line hit frequency and multiplying by the number of lines isn't too meaningful to us, though. What we really would like to know is the hit frequency for the game. How do we determine that? That is certainly more difficult to determine. We can have two games with the same number of symbols on each reel using the same pay table and come up with different game frequencies. The reason is that the symbol positioning on the reel dictates how the payouts occur. We may place the symbols so that you have multiple line wins at any given time. Perhaps we will have a "cherry"-type symbol on the first reel in two places. This causes you to have frequent multiple payline wins. We may create our reels so that there aren't a lot of overlapping pays on multiple lines.

The results of these changes can be determined empirically, that is by creating the game and then going through every reel combination and determining the pays. This is often done using the "brute force" method. In this method, a simulator will step through each of the combinations and record the payouts for each one. By doing this you determine the overall game play. You can easily change how the game

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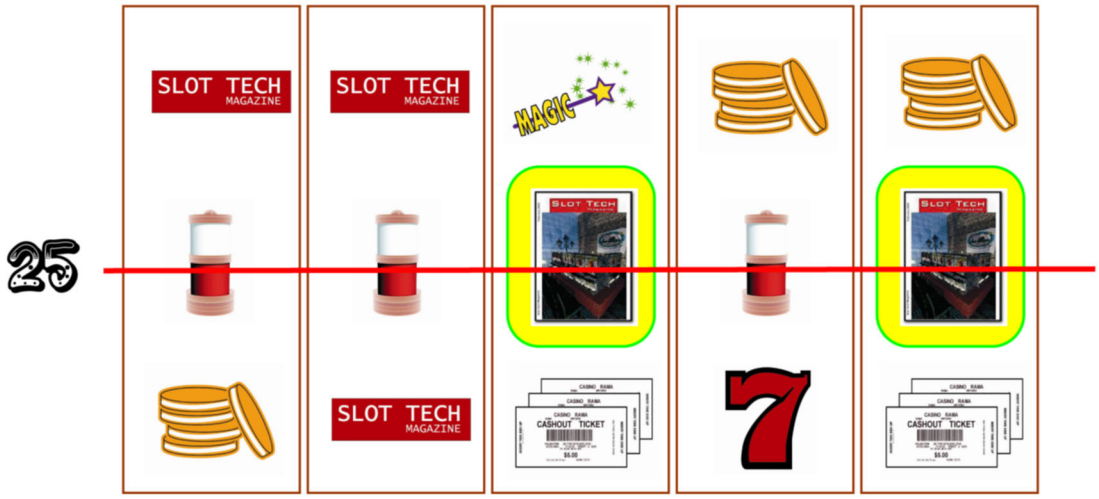
"Any Position" Payout for Magazine Covers and Candle



GAME PAYS 25 CREDITS

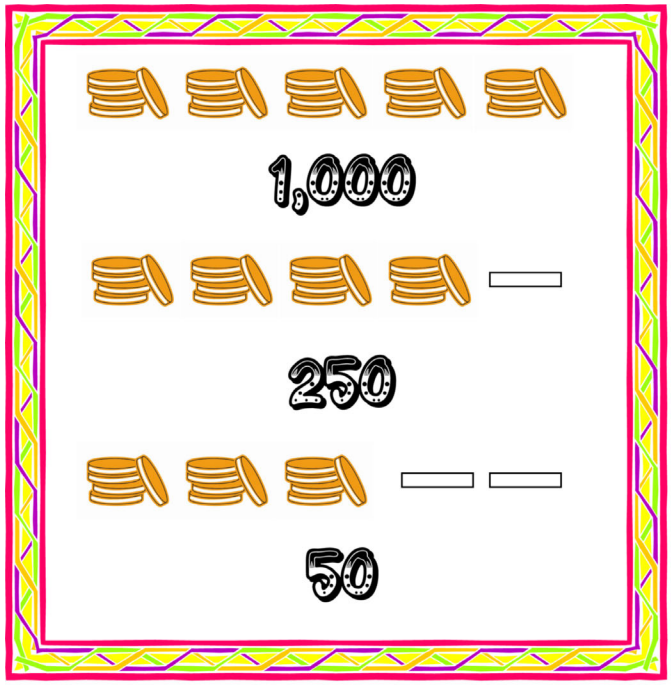
We forfeit the 3-Candles payment of 10 credits in order to get the 2-Magazine payment of 25 credits!

plays and pays just by moving the symbols around. In one recent test I did, the game came up with a 4.28% hit frequency on one line. By changing the symbols, the line hit frequency remained the same (since we had the same number of symbols on each reel, but in different order) but the overall game hit frequency was 16.49% In the second trial, after changing the symbol order again, the line frequency was still 4.28% The overall game frequency was 29.67%. What does this mean? In the first case, the player would win approximately three games out of 20. In the second example, the player would win almost one game out of three (six out of 20). In the end, the player will win the same amount of games and receive the same payout percentage level. However, in the first example, the player won't win as frequently but will win more when they do win. In the second example, they will win more frequently, but will receive smaller wins. Let's show an example of how this happens. Figure 3 illustrates sample reel combinations and the wining awards for them.

When we speak of line hit frequency, we mean the hit frequency that will occur on only one payline. This would happen if you wager one credit per game. The game hit frequency refers to how frequently any particular game will win. A win may result from only one payline or multiple paylines. A general rule of thumb is that the game payout will fall into a predictable pattern as show in Figure 4. In the previous game examples, the actual payouts are shown in Figure 5.

The overlapping symbols cause concern for calculating the total payout and hit frequency. You must pay close attention to the overall game play operating on all lines and having them work together. There are many instances where the actual hits and payouts may vary slightly from what you would expect. Consider Figure 6.

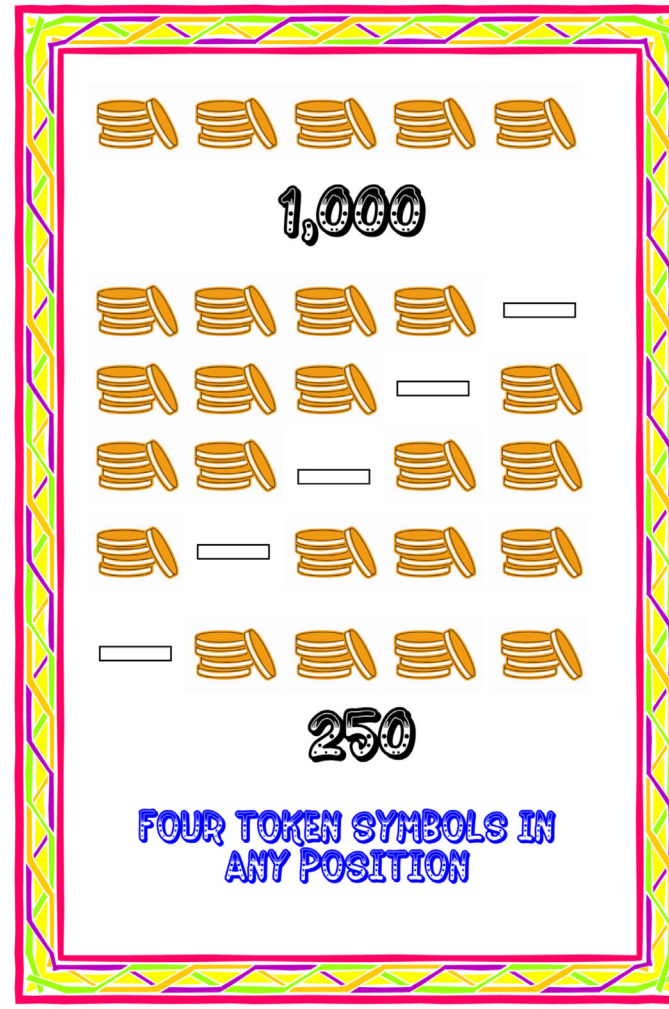
In Figure 6, we see that we are paid 25 credits for two Slot Tech Magazine covers and 10 credits for three Slot Candles. When the payline contains two magazine covers and three slot covers, what do we get awarded? Do we get paid for the three slot candles, the two magazines or both? Traditionally, games are designed so that



The "any position" symbols really complicate our math model.

For this reason they are treated specially and usually are done as a "Scatter Symbol".

You generally see symbols being paid "Left to Right" or "Right to Left" only.



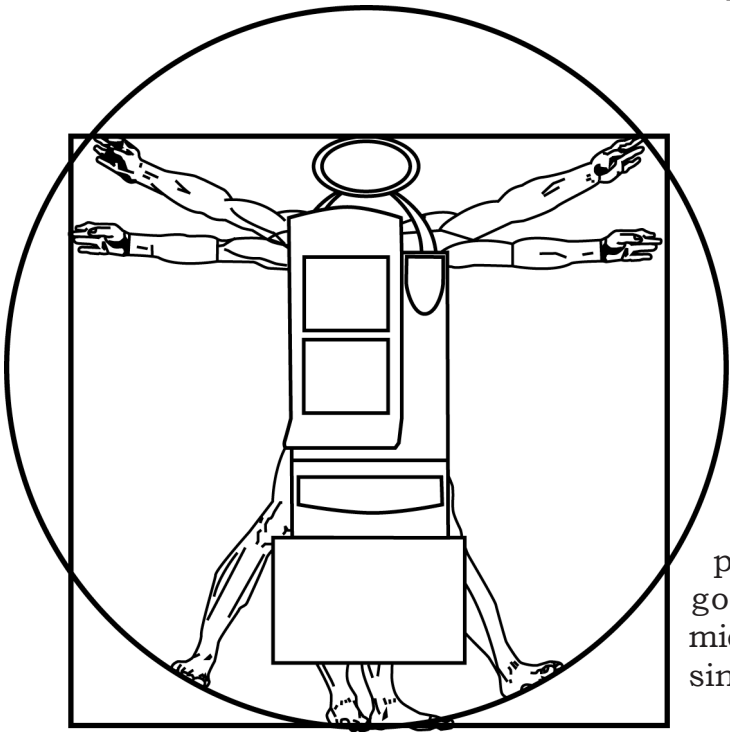
"Only the highest winning combination is paid on any payline." In this case, we would get 25 for the two magazine symbols and forfeit the three slot candle symbols.

The player is generally happy with this but mathematically we need to take this into account. Here we have two winning combinations but only 1 is going to be awarded. For this reason, many machines don't pay for "any position" symbols. Take a look at the illustrations in Figure 7.

Using the "mixed position symbols", the game design becomes more difficult and we need to rely on the "brute force" method of math. By keeping it relatively simple, we can use arithmetic formula to calculate everything. What's the difference? Using straight arithmetic formulas, a 10,000,000 cycle game can be fully calculated in seconds. Using the "brute force" method, it may take 10 minutes to work through every combination for all lines. However, the "brute force" method works extremely well. It will illustrate any problems with the formula that might not have been noticed. Although there are various mathematical formula that can be used for different calculations (for example, there are several that can be used to determine the volatility index), there is no one right way to determine it. Various methods have their own strengths and weaknesses. In essence, sometimes the overall mathematical calculations are just too complicated to do ourselves. That's where we have to rely on the information contained in the PAR sheets.

Although we still haven't designed our nifty video slot game, we have covered a lot of ground in order to get to the point where we can design it. Soon we'll start working on some actual game design and start putting it all together. Something tells me we're in for a few twists and turns, perhaps coming up with some configurations that won't work at all. But in the end, I think we'll have a winner!

- John Wilson
jwilson@slot-techs.com



The Atronic Slot Doctor Is In

By Michael Brennan

Many people don't go to the doctor for regular check-ups and physicals as often as they should, even though it is the best way to avoid a future health problem. By the same copper hopper token, many slot machines probably don't receive enough preventative maintenance, even though it is the best way to help avert future mechanical catastrophes.

Seeing a doctor and occasionally getting a flashlight shoved in your ears is a lot less damaging in the long run than avoiding a doctor's office for years, while that small bump in your head grows into a grapefruit-sized tumor. To continue the analogy, cleaning, calibrating and checking a bank of slot machines regularly is a lot less painful than neglecting them and having a ticket printer or monitor go down in the middle of a busy casino weekend.

We at Atronic believe in the concept of preventative maintenance. We would like our slot machines to receive regular check-ups, but since we haven't developed machines with legs yet, house calls are a necessity. Early slot issue detection is the best prevention, and we recommend slot check-ups every 30 days. This will help keep the slot machine and its vital organs in tip-top shape.

What follows is a list and explanation of our e-motion™ preventative maintenance procedures. These can be performed by any technician who wants to become an Atronic Slot Doctor for an hour or so.

Sponge Baths

Nobody likes to spend too much time with a foul and malodorous co-worker, and nobody likes to sit at a dirty, neglected game. The shinier and cleaner a machine looks, the more likely it is to attract players. This means more coin-in and more money for your company, which means you keep your job. And that job may entail a slot machine sponge bath, which we administer with a non-alcohol (and non-ammonia) cleaner and a soft cloth. Focus on touch screens, which can become loaded with "$4.99 buffet residue."

Turn Your Head And...

There is another benefit of intensely cleaning each machine. Thorough cleaning becomes inspection. Getting up close and personal with the games makes it easy to quickly see any cracks or damaged parts. You can identify cracked plastic, burned-out lights, and bet buttons that have felt the wrath of an angry fist.

Open Up & Say Ah

We recommend performing a lot of diagnostic tests during

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the preventative maintenance procedure. All of these tests are accessed from the e-motion™ service menu, which appears on-screen when you press the service button located on the interior logic box's front right side.

Select "Other Tests" from the Diagnostics tab in order to test the lamps, switches and buttons. Access each category by using the touch screen. The "Lamp" test is self-explanatory, while the "Switch" test shows the status of the many e-motion™ doors. Open each door and check that the screen reflects either "open" or "closed." You will not be able to check the main door. Perform the "Button" test next. Each time you press a button, its light will illuminate. This is a good time to verify that none of the buttons remain stuck when you press them into the down position.

Vision and Hearing Test

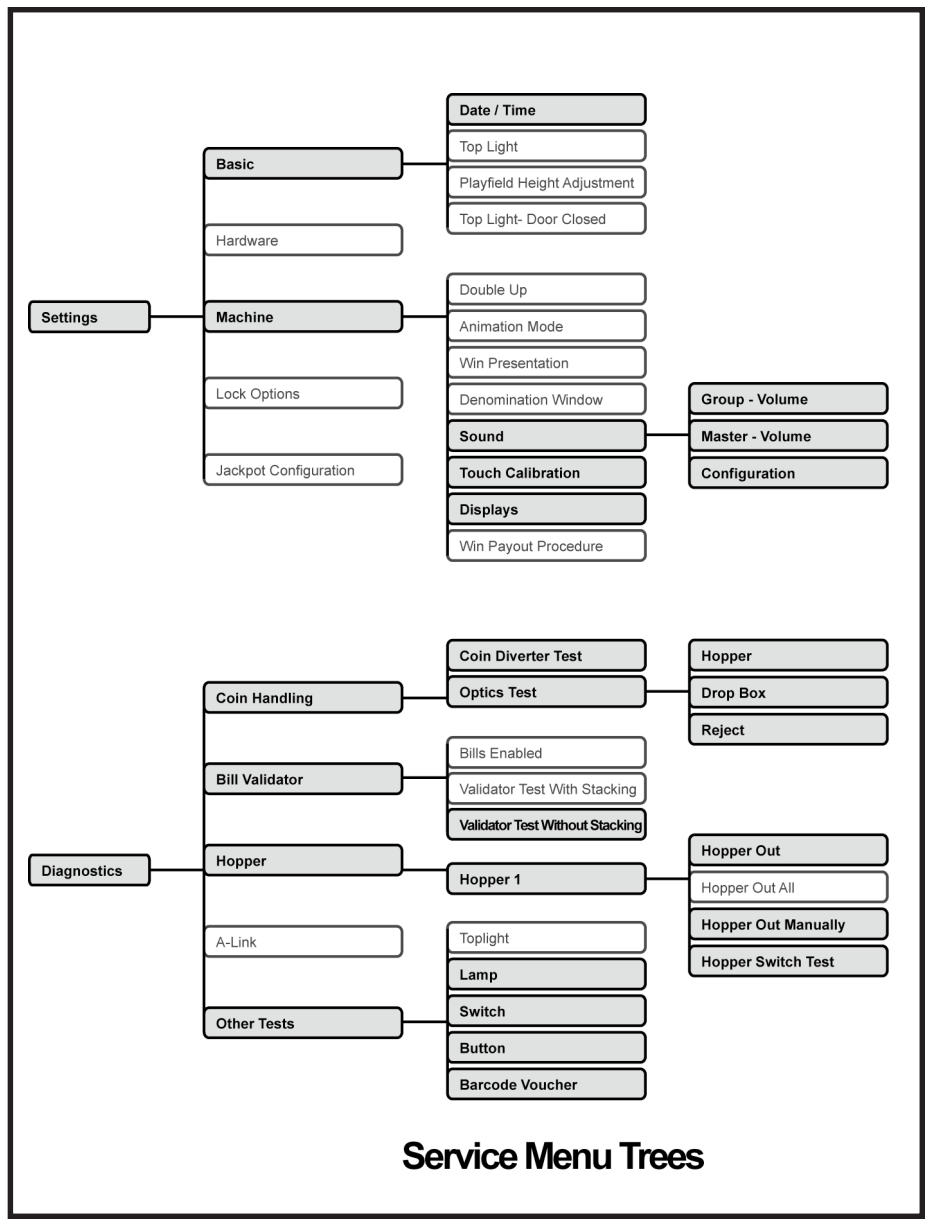
Since certain casino patrons of advanced age may have trouble seeing the large "E" on an eye chart, they may have trouble accurately viewing a dark or faded monitor. Plus, lighting intensity varies throughout the casino floor, so it is important to set the brightness and contrast of each game and check this as a regular part of preventative maintenance.

Your first step as a "sloptomologist" is to calibrate the touch-screen. Press the service button, select "Machine" and then "Touch Calibration" from the Settings tab. Then follow the prompts. After exiting the screen, select "Displays." Here you can adjust the brightness and contrast of each screen to make sure the nifty Atronic graphics are clear and visible in the ambient light.

Slot machines are meant to be seen and heard, so don't forget about the volume. From the Settings tab, select "Machine" and then "Sound." Slide the volume bar as you desire. You can also check the machine's date and time. Back at the Settings tab, choose "Basic" and "Date/Time." Note that the date and time may be set by the game's player tracking system.

Testing Peripheral Reflexes (The Electronic Colonic)

Bill validators, card readers, hoppers, coin comparitors and ticket printers experi-



Service Menu Trees

ence an extensive amount of wear and tear. Since slot machines are equipped with any combination of these from a wide range of manufacturers, it's tough to come up with universal maintenance rules for each. In general, a critical part of our preventative maintenance schedule involves cleaning, calibrating and testing most of these peripherals.

Order is important when servicing peripherals. The first step is to clean the peripheral, which usually involves inserting a special cleaning card into the acceptor. For the ticket printer, we recommend using a cleaning pen to wipe the thermal print head clean.

Atronic offers a free preventative maintenance kit sample pack, which contains a jumbo thermal printer cleaning pen and three cleaning cards: Waffletechnology™ for the bill validator, and cards for the ticket printer and card reader. Contact Atronic at 1-800-864-7670 and request the part number 65038349 for a complimentary kit. Mention Slot Tech Magazine and we'll send you two!

The cleanest bill validator on the block may still malfunction, so that's why we calibrate our peripherals on a regular basis. Calibration procedures are specific to that brand of peripheral and will vary. Take the bill validator, for example. For a JCM WBA bill acceptor, you need to remove it, alter dipswitch settings, reinstall it, insert a calibration card, take out the card, and then return the dipswitches to their original state. Frequent bill validator calibration improves the acceptance rate of good bills.

After these peripherals have gotten the most out of their electronic colonic, it's time to see if they still work. To test a bill validator, select "Bill Validator" from the Diagnostics tab in the service menu. Then choose the "Validator Test Without Stacking" option. This will let you retrieve the bills you insert into the acceptor.

To test a hopper, select "Hopper" from the Diagnostics tab. Choose "Hopper 1" and then perform various tests. Select "Hopper Out" (not "All") to release coins, and touch "Hopper Switch Test" to verify the timing of the coin out sensor. To test a ticket printer, select "Other Tests" from the Diagnostics tab, and choose "Barcode Voucher." This will print out a test ticket. Access coin comparitor and optic testing from the "Coin Handling" menu on the Diagnostics tab.

Eye Drops

Many of our local area and wide area progressive games now use a sign package that includes a set of rotating plasma displays. These rotators can lose lubrication and shriek like banshees if they are not re-greased in about 6 months. Instead of waiting for the screeching, we re-grease the sign rotator every 30 days. Apply the lubrication by using a grease gun on the zerk fitting in the post, just below the rotator.

Ok, you can now put your ratchet wrench and tongue depressor away, because that concludes the e-motion™ machine's monthly checkup. A healthy game is a happy game, and performing these procedures regularly should keep the games feeling fit for a long time.

In 2006 we will continue writing articles about Atronic, contributing more detailed and technical information. We aim to produce a string of "how-to" commentaries that will focus primarily on our e-motion™ platform. If you have any suggestions for an upcoming article, don't hesitate to send an email.

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Michael Brennan
Technical Documentation Specialist
Phone: 480-609-5968
Email: mbrennan@atronic.com
Web: www.atronic.com

Monitor Troubleshooting - Ceronix Style

Color Problems

A helpful hint when working with color problems is to first identify the color of the three grid lines at the top of the screen. When there is a missing color and the lines are white, the problem lies in the video interface section. This means it can be found in between the video source and pin #8 of the Video Amplifiers (K-PRA). If the lines were not white it would be an output problem, which is anything after pin 8 to the picture tube.

Use the following steps when troubleshooting a missing color.

1. First determine if it is an input or output problem.
2. If it is an input problem check pins 16, 13, and 9 on IC 241(Video Interface IC). If the color you are missing has a DC voltage higher or lower than the other two colors by .3V replace IC 241.
3. If the voltages are all the same check for an open between the output pins of IC 241 and pin 8 of Video Amplifiers (K-PRA).
4. If you determine it to be an output problem check pin 20 of the Video

K-PRA: VIDEO AMPLIFIER CIRCUIT.

TABLE DISPLAYS CORRECT DC VOLTAGES

PIN 1	VIDEO INPUT	9.5
PIN 2	+12 V LINE	11.9
PIN 3	+ 16 V LINE	17.17
PIN 4	NPN B	10
PIN 5	GND	0
PIN 6	NPN E	9.4
PIN 7	9.25 V LINE	9.4
PIN 8	NE592 OUTPUT	9.4
PIN 9	GND	0
PIN 10	+12 V LINE	11.99
PIN 11	AUTO BIAS	4.3
PIN 12	GND	0
PIN 13	127V LINE	129
PIN 14	PNP E. CAP	128
PIN 15	PNP E.	128
PIN 16	PNP B	127
PIN 17	PNP B DIODE	127
PIN 18	120V LINE	123
PIN 19	PNP C	78
PIN 20	AMP OUTPUT	77

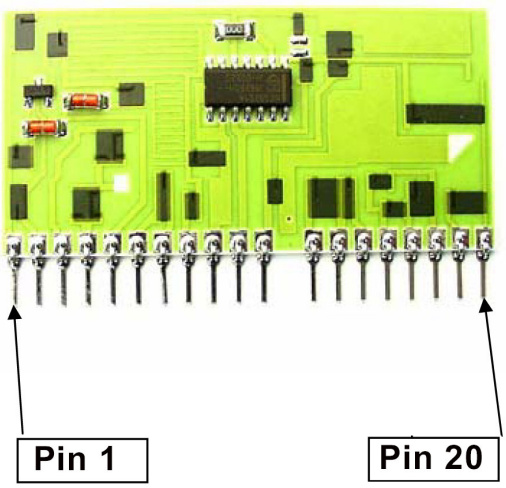
C5346A: VIDEO INTERFACE IC (Location 241).

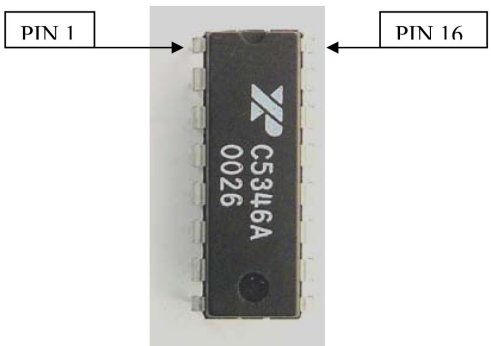
TABLE DISPLAYS CORRECT DC VOLTAGES FOR VGA BOARDS

PIN 1	RED REFERENCE	.630
PIN 2	RED IN	.756
PIN 3	BLACK LEVEL	5.7
PIN 4	GND	0
PIN 5	TTL	0
PIN 6	BLACK LEVEL	6.3
PIN 7	BLUE IN	.755
PIN 8	BLUE REFERENCE	.630
PIN 9	BLUE OUT	9.4
PIN 10	Vcc	11.97
PIN 11	+ ENABLE	10
PIN 12	MASTER GAIN	5.9
PIN 13	GREEN OUT	9.4
PIN 14	GREEN IN	.755
PIN 15	GREEN REFERENCE	.640
PIN 16	RED OUT	9.30

Amplifiers (K-PRA). If the voltage at pin 20 for the color that is missing is a minimum of 20 volts higher than the other two colors.

Replace the Video Amplifier (K-PRA) and Transistor at 945, 812 or 822, depending on which Video amplifier is being changed.





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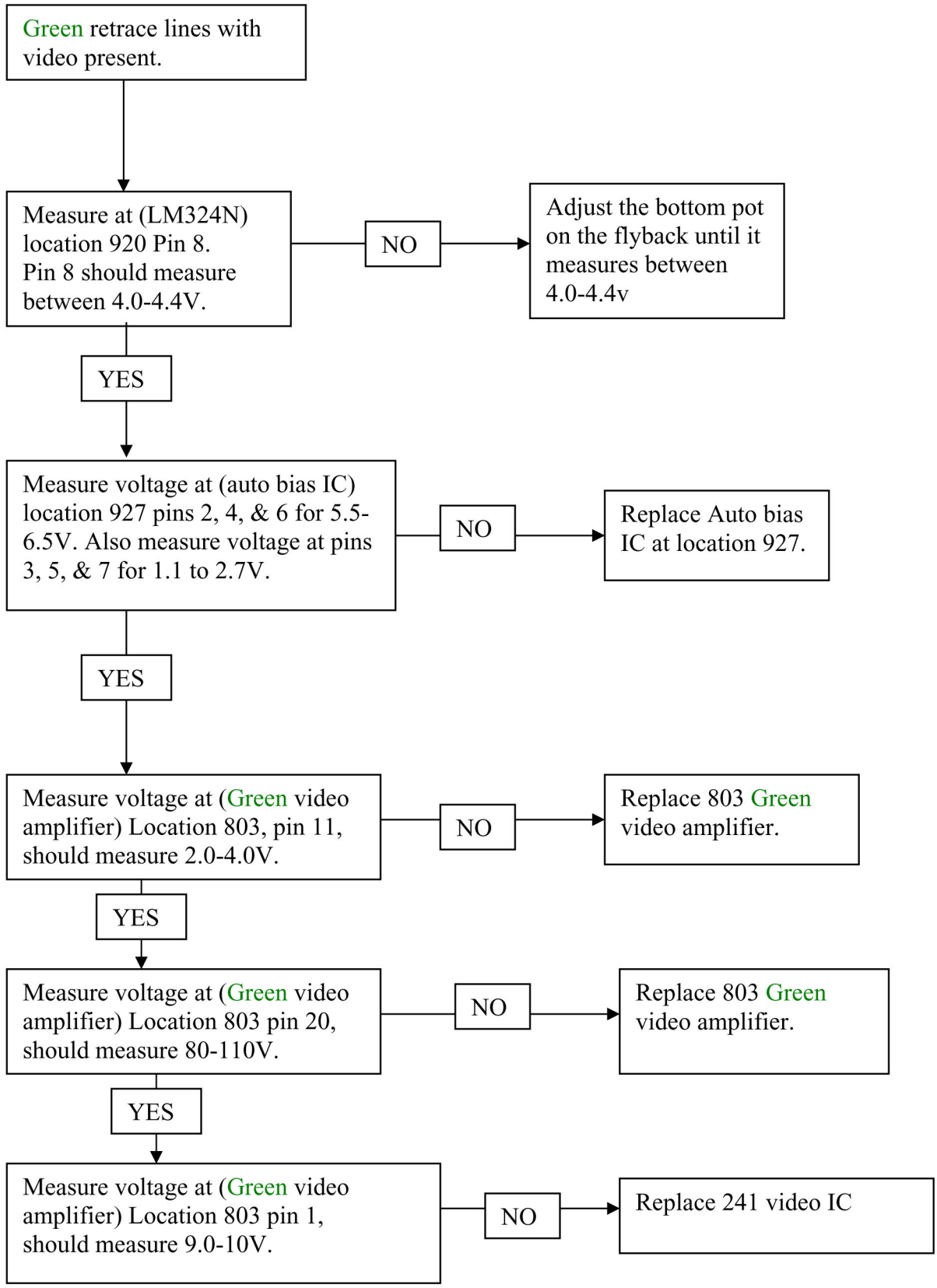
Troubleshooting flow charts: Symptom – Green Retrace with Video.

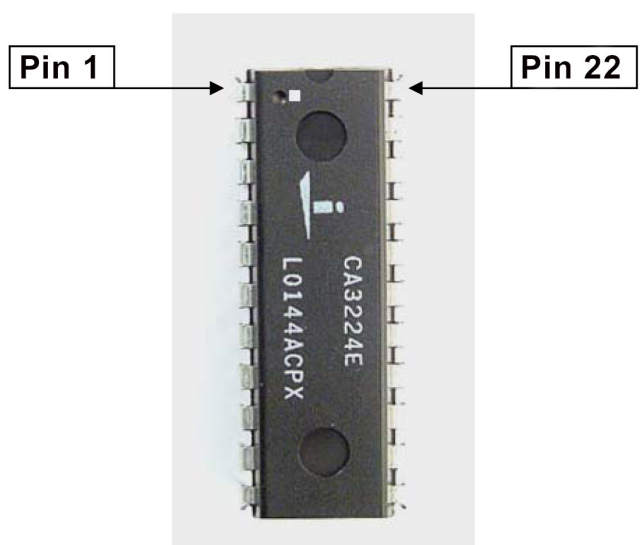
Note: Test generator needs to be set-up with color bar pattern.



CA3224E: AUTOMATIC BIAS CONTROL CIRCUIT.

TABLE DISPLAYS CORRECT DC VOLTAGES FOR VGA BOARDS

PIN 1	GND	0
PIN 2	BLUE INPUT	5.25
PIN 3	COMPARATOR	1.6
PIN 4	GREEN INPUT	5.3
PIN 5	COMPARATOR	1.8
PIN 6	RED INPUT	5.1
PIN 7	COMPARATOR	1.8
PIN 8	VERTICAL INPUT	.053
PIN 9	GND	0
PIN 10	HORIZONTAL INPUT	1.6
PIN 11	GRID PULSE OUTPUT	9.7
PIN 12	PROGRAM PULSE OUTPUT	8.4
PIN 13	AUTO BIAS ACTIVE PULSE OUTPUT	2.5
PIN 14	5V REFERENCE	4.9
PIN 15	VERTICAL REFERENCE BIAS	4.9
PIN 16	RED OUTPUT	3.5
PIN 17	RED HOLD CAP	3.4
PIN 18	GREEN OUTPUT	4.2
PIN 19	GREEN HOLD CAP	4.2
PIN 20	BLUE OUTPUT	4.2
PIN 21	BLUE HOLD CAP	4.2
PIN 22	Vcc	9.8



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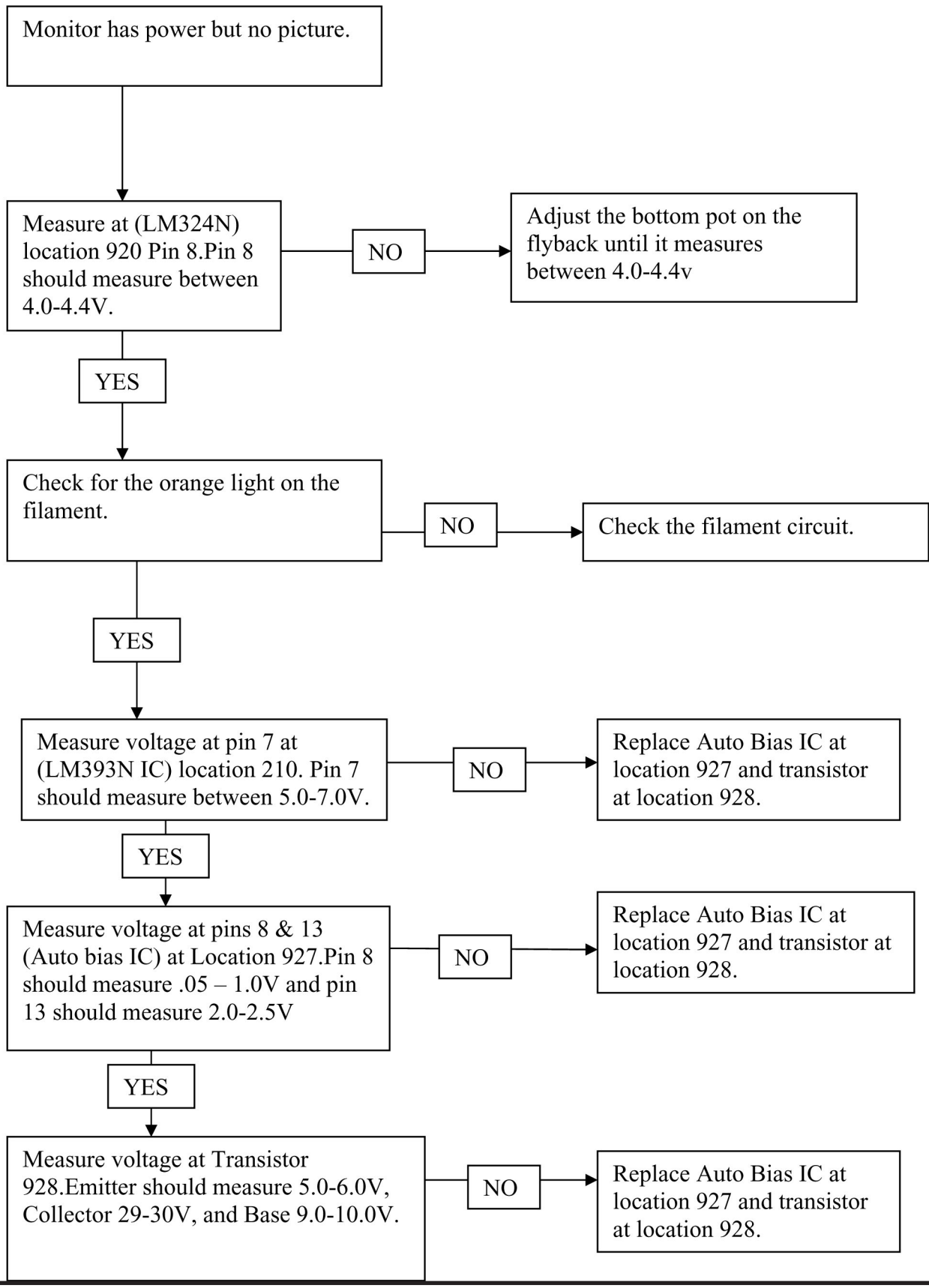
Troubleshooting flow charts: Symptom – No picture, monitor powers up.

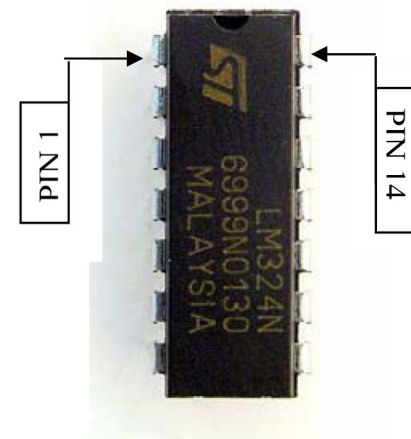
Note: Test generator needs to be set-up with color bar pattern.



LM324N: AUTO BRIGHT CONTROL CIRCUIT.

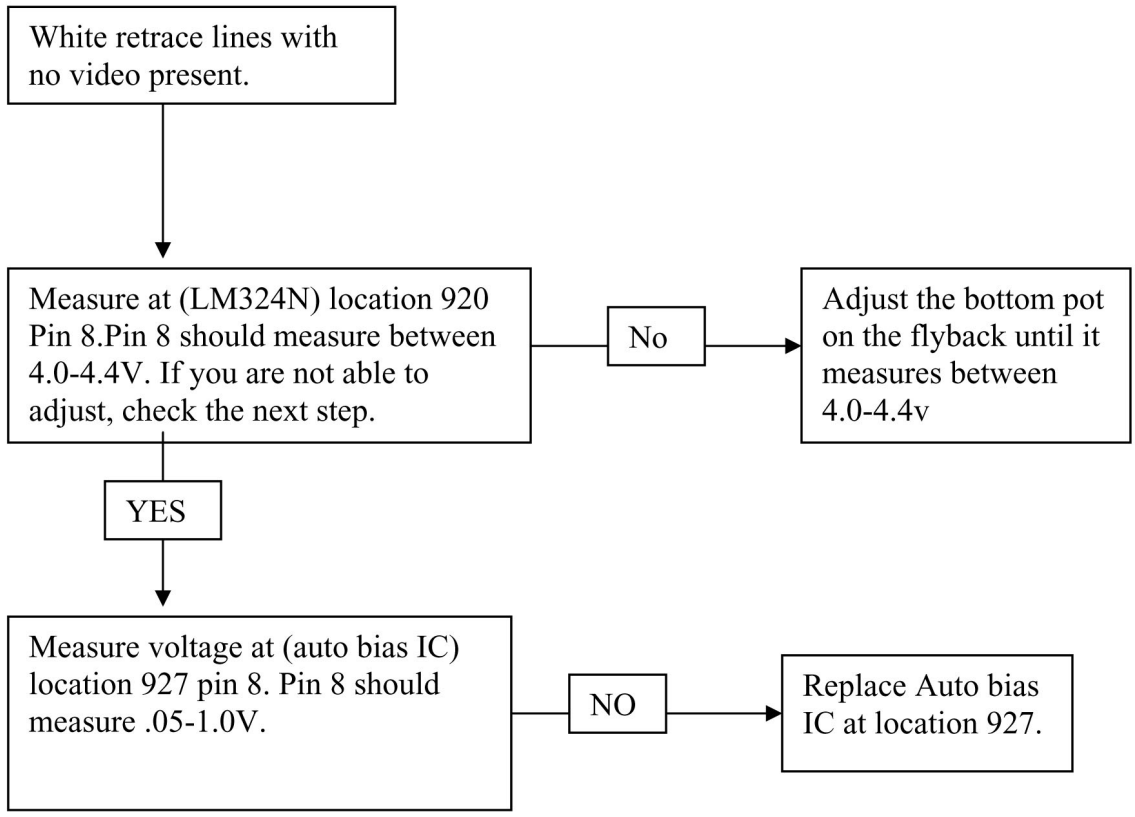
TABLE DISPLAYS CORRECT DC VOLTAGES

PIN 1	GREEN CHANNEL OUTPUT	3.4
PIN 2	INVERTING INPUT	4.0
PIN 3	NON- INVERTING INPUT	4.0
PIN 4	Vcc	11.95
PIN 5	NON- INVERTING INPUT	4.0
PIN 6	INVERTING INPUT	4.0
PIN 7	BLUE CHANNEL OUTPUT	3.3
PIN 8	SCREEN VOLTAGE ADJUSTMENT	4.0
PIN 9	INVERTING INPUT	4.0
PIN 10	NON- INVERTING INPUT	4.0
PIN 11	GND	0
PIN 12	NON- INVERTING INPUT	4.0
PIN 13	INVERTING INPUT	4.0
PIN 14	RED CHANNEL OUTPUT	3.1



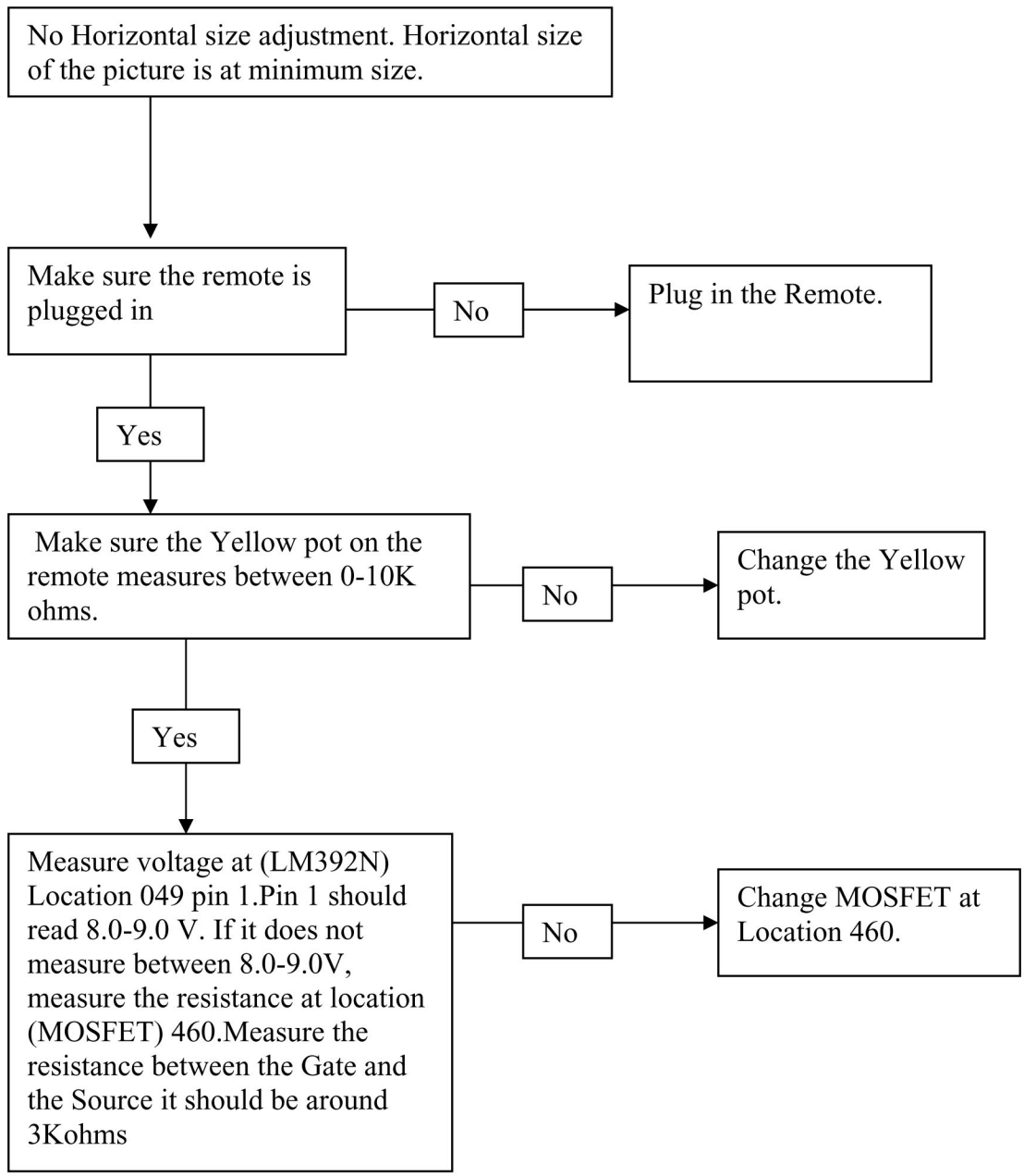
Troubleshooting flow charts: Symptom – White Retrace Lines and no video.

Note: Test generator needs to be set-up with color bar pattern.



Troubleshooting flow charts: Symptom – No H-Size adjust.

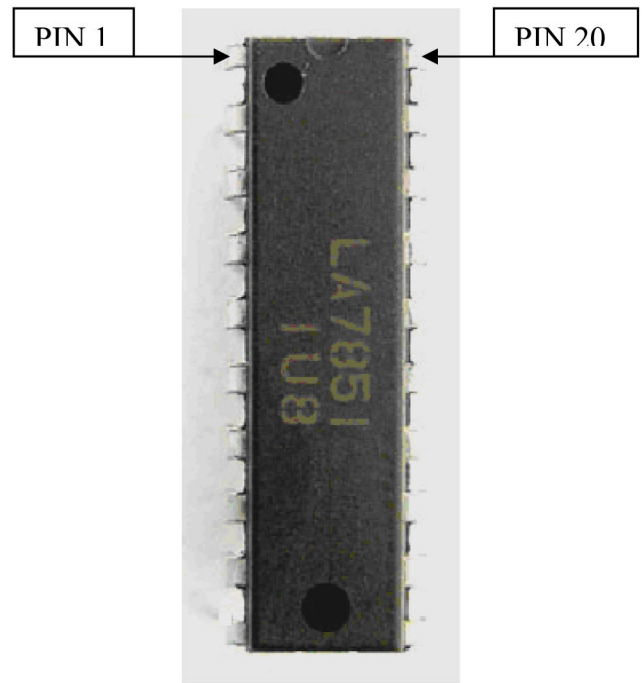
Note: Test generator need to be set-up with color bar pattern.



LA7851: VERTICAL AND HORIZONTAL DEFLECTION CONTROL CIRCUIT.

TABLE DISPLAYS CORRECT DC VOLTAGES

PIN 1	H-SYNC INPUT	3.8
PIN 2	PICTURE POS. O/S	8.2
PIN 3	DELAYED SYNC O/S	8.3
PIN 4	TRIGGER	.1
PIN 5	SAW TOOTH GEN.	3.5
PIN 6	BIAS	2.9
PIN 7	MULTIPLIER	5.8
PIN 8	HORZ. OSCILLATOR	5.8
PIN 9	DISCHARGE	5.4
PIN 10	H. V+	11.25
PIN 11	FIXED VOLTAGE FOR COMP.	5.6
PIN 12	OUTPUT COMP.	.396
PIN 13	GND	0
PIN 14	GND	0
PIN 15	OUTPUT OF OP AMP.	2.4
PIN 16	V. REF	5.0
PIN 17	VERTICAL OSC. O/S	.137
PIN 18	VERTICAL OSCILLATOR	5.8
PIN 19	VERTICAL +/- SYNC INPUT	5.9
PIN 20	VERTICAL V+	11.25



Power Supply Troubleshooting Technique

NOTE: All voltage measurements are DC with –lead to GND unless otherwise noted.

Monitors with zero voltage at V+

• Ohm out the zener diode at location 181.
• Replace the zener if it is shorted, check the FET to make sure it is not shorted.
• Replace the FET if it is shorted and the switching mode transformer at location 136.
• Apply power to the monitor.
• If the V+ reads between 10-35V DC, turn your power off and apply external power to the Power supply IC (See illustration 101).
• Once the external power supply has been properly hooked up measure the voltage at pins 16,15,10 and 8 on IC (C5184) at location 115. If any of the readings are in correct replace IC 115 and Transistor (MPSA64) 127. After the IC has been replaced repeat the step above. If the readings are correct remove the external power supply and power up the monitor.

Monitors with 10–35 volts at V+

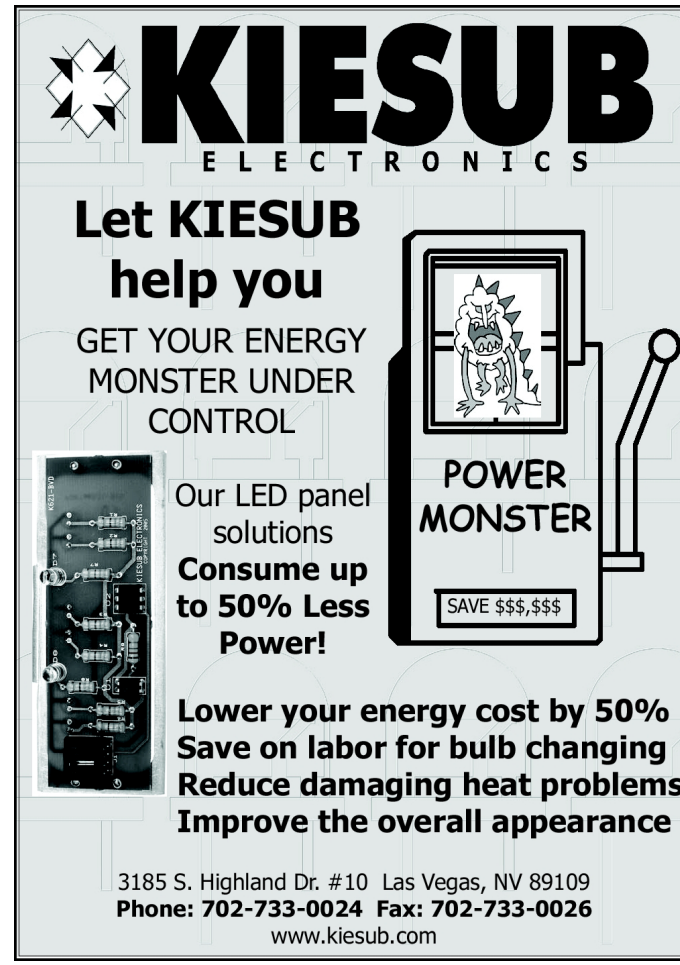
• If the V+ reads between 10-35V DC, turn your power off and apply external power to the Power supply IC (See illustration 101).
• Once the external power supply has been properly hooked up measure the voltage at pins 16,15,10 and 8 on IC (C5184) at location 115. If any of the readings are in correct replace IC 115 and Transistor (MPSA64) 127. After the IC has been replaced repeat the step above. If the readings are correct remove the external power supply and power up the monitor.

Monitors with a fluctuating V+

• Check the 16V line at diode 170 (See illustration 102).
• Measure the 12V-regulator input and output.
• Measure pins 8,11 and 12 on IC (LA7851) at location 415.

Monitors with a fluctuating V+

• Check the 24V line at diode 168. (See illustration 103)
• Check the vertical IC (LA7838) and relay (location 468) for degaussing circuit that requires 24V.



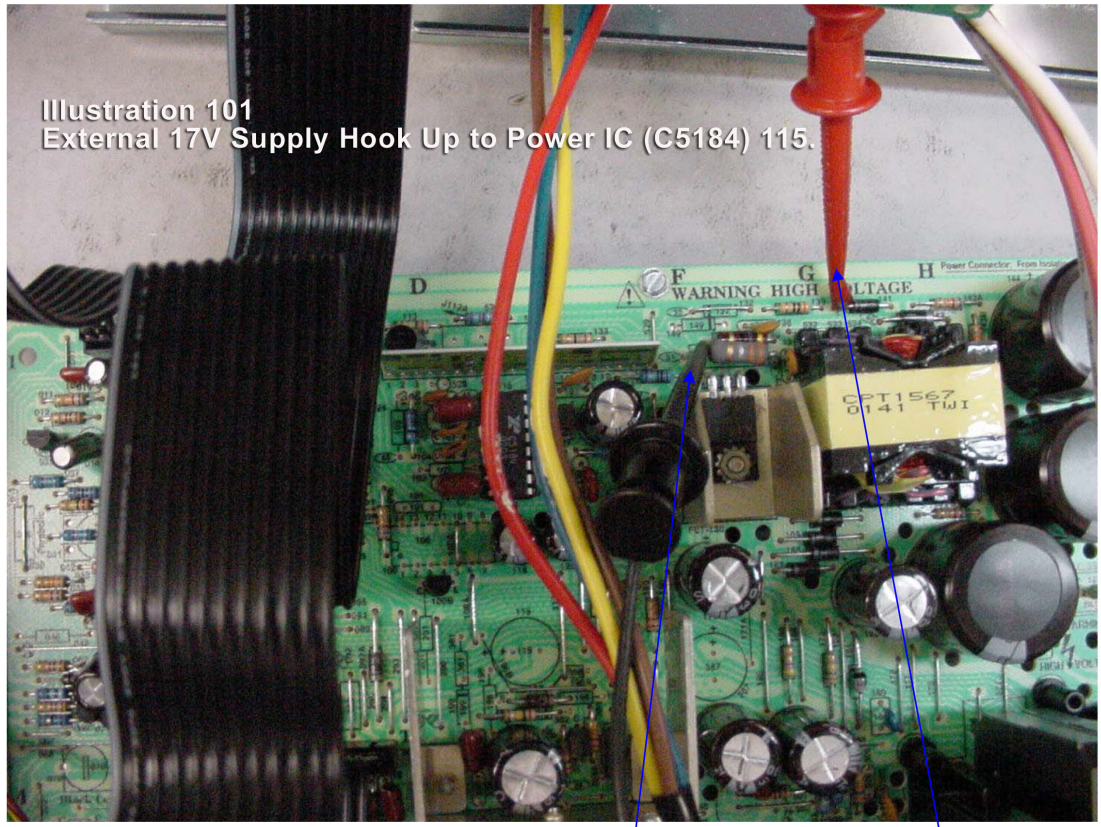


Illustration 101
External 17V Supply Hook Up to Power IC (C5184) 115.
-LEAD TO V-
+LEAD TO THE CATHODE OF DIODE 141

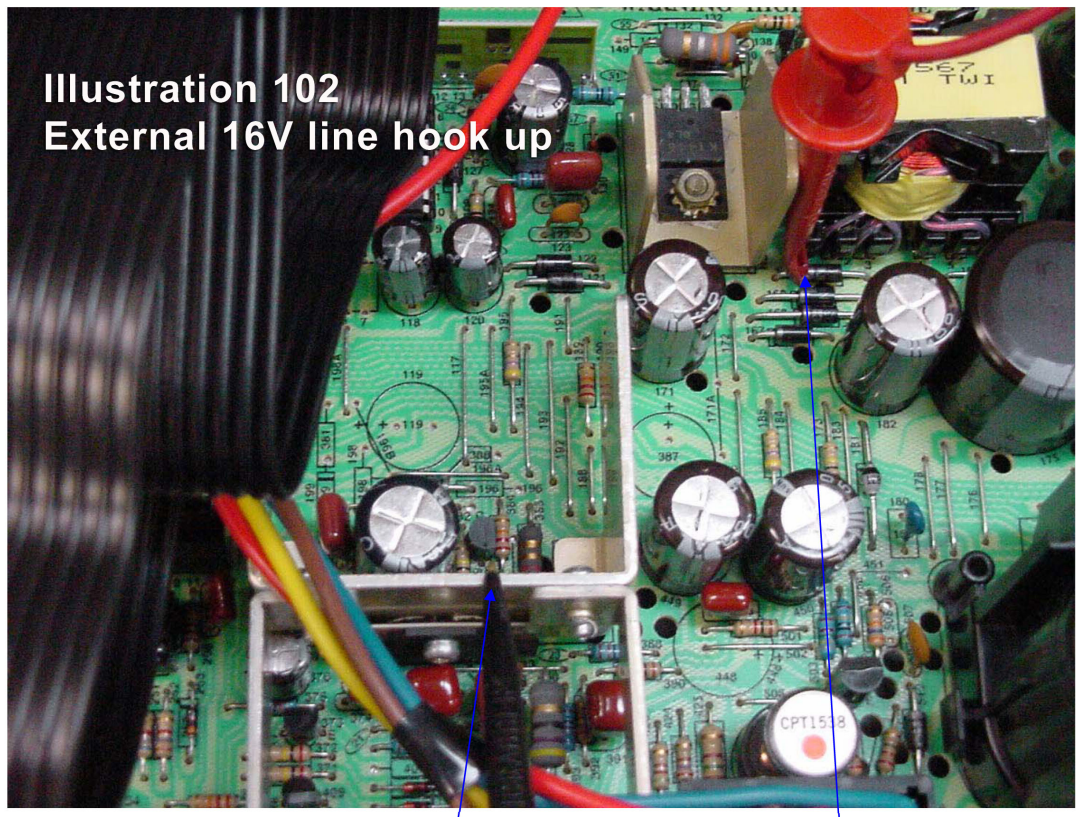
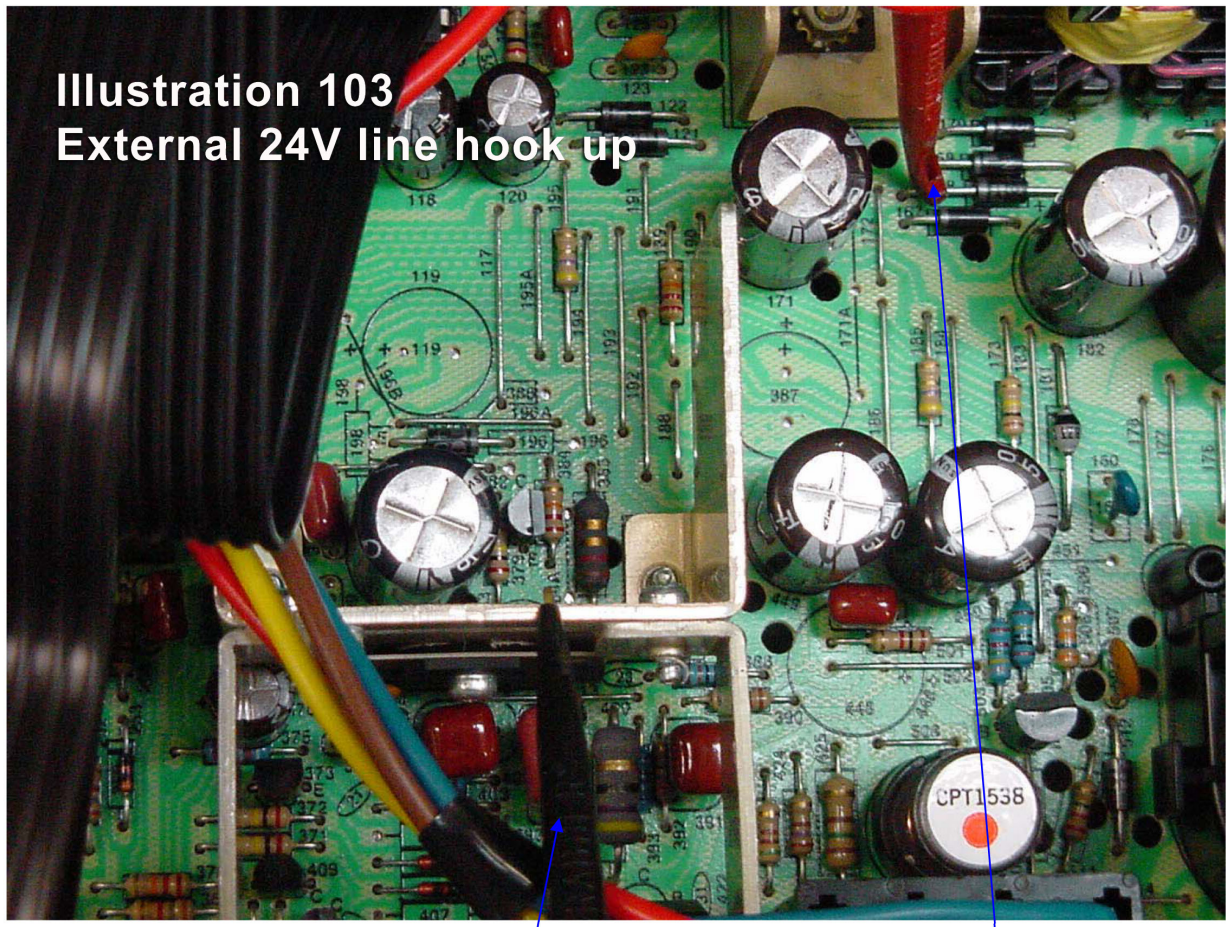


Illustration 102
External 16V line hook up
-LEAD TO GND
+ LEAD TO THE CATHODE OF DIODE 170



C5184: POWER SUPPLY CONTROL CIRCUIT

TABLE DISPLAYS CORRECT DC VOLTAGES WITH REFERENCE TO V-

PIN 1	+ INPUT ERROR AMP	5.7
PIN 2	- INPUT ERROR AMP	5.7
PIN 3	COMPARATOR	0.5
PIN 4	OUTPUT	4.23
PIN 5	CONTROL & FAULT SENSE 4Us delay	0.1
PIN 6	Rx OSCILLATOR	6.0
PIN 7	Cx OSCILLATOR	3.7
PIN 8	+7.5 REFERENCE	7.7
PIN 9	GND	0
PIN 10	DRIVE	1.4
PIN 11	CURRENT SENSE	0.06
PIN 12	CONTROL & FAULT SENSE – COMP.	3.6
PIN 13	CONTROL & FAULT SENSE + COMP.	4.4
PIN 14	OVER VOLTAGE PROTECT INPUT	6.5
PIN 15	+17V INPUT	19
PIN 16	15V	17

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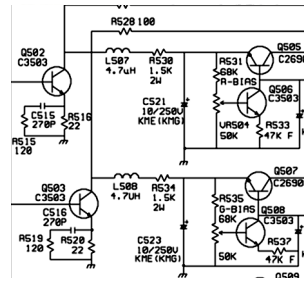
The individual components used in games are introduced. Parts such as resistors, capacitors, diodes, potentiometers and transistors are covered individually. Students learn how the components work and how to test them using the meter.

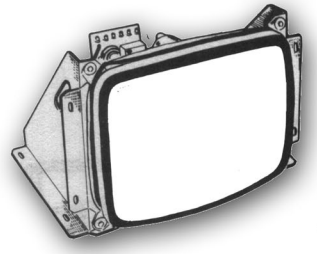
SCHEMATIC DIAGRAMS

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.



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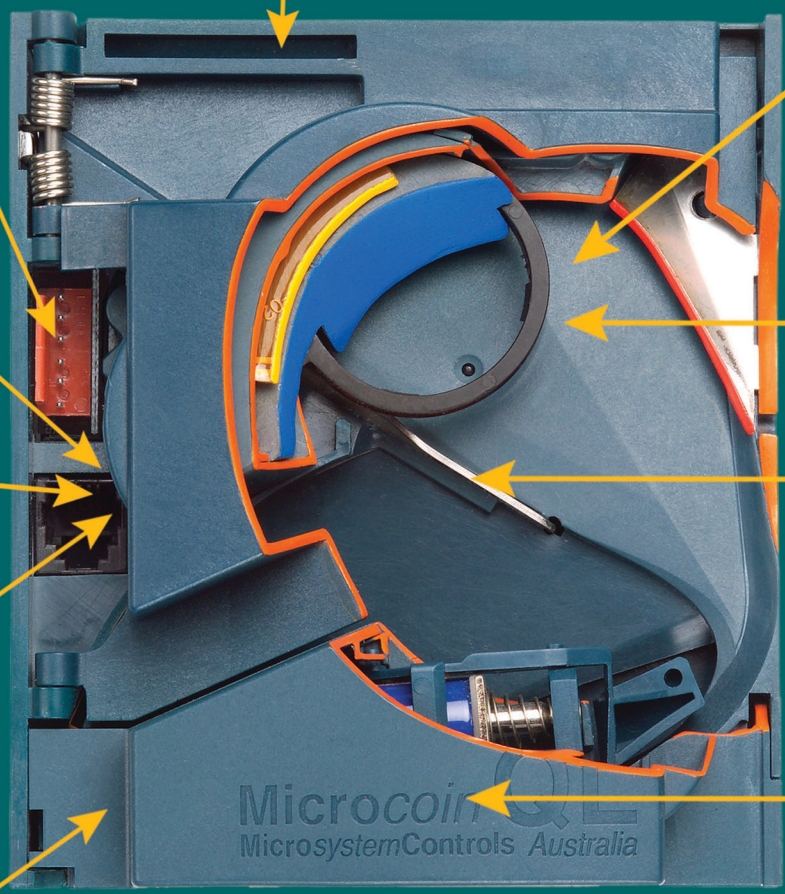

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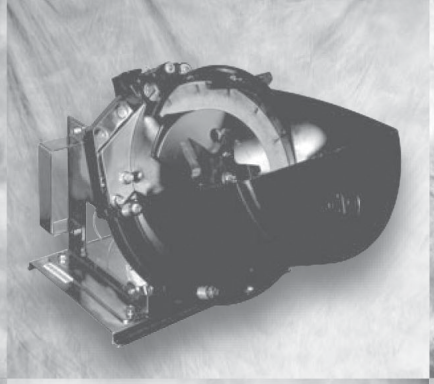

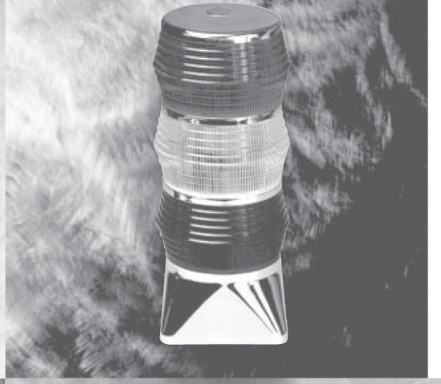

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