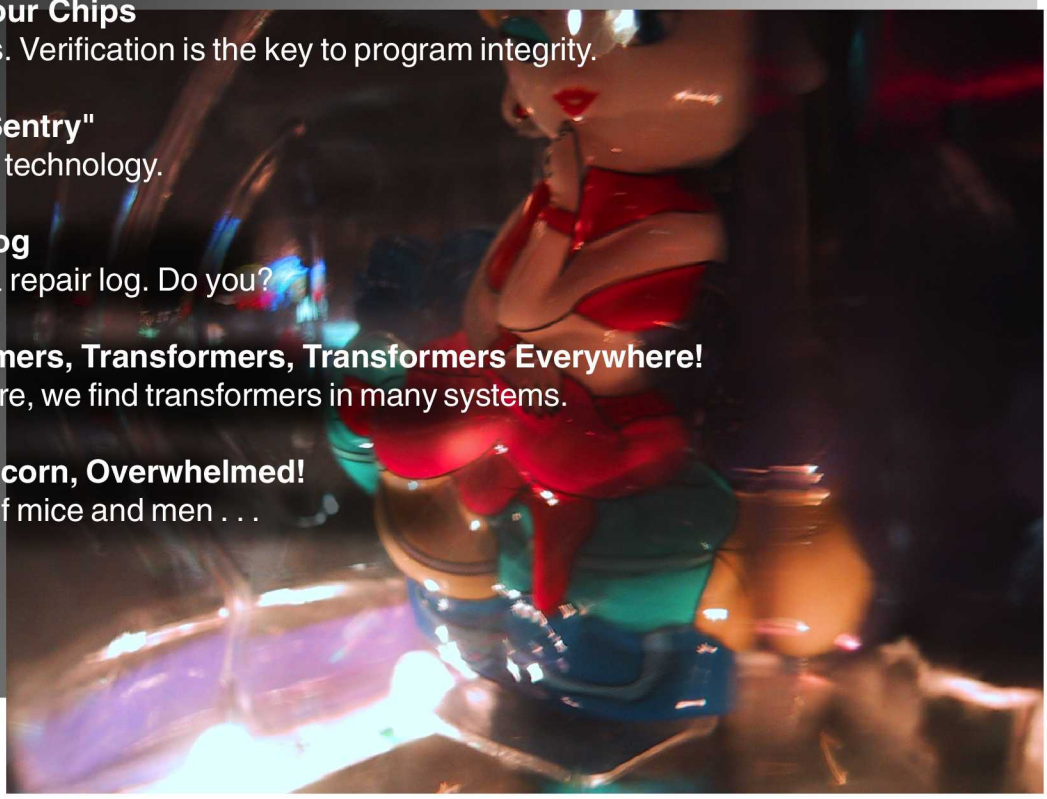
Inside Slot Tech Magazine

October, 2001



Dear Friends,

Everyone knows the situation in America and the world at this time. I was teaching a group of technicians in Charlotte, North Carolina when it happened. We watched the events unfold, all of us heartbroken at the loss of our fellow human beings by this insane action. Some of us were numbed by the event, most of us were angry as hell. We all agreed however that we were there for a reason and that we needed to carry on, not as if nothing had happened but because to succumb to the psychological shock was to allow the enemy to win another battle - the battle for our souls. My friends, this is one battle that will never be lost. The American spirit, indeed, the spirit of the entire Free World (there's a cold war expression for you) will never be affected by such evil except to strengthen our resolve and ensure our unity in mind, spirit and intent. We intend to persevere. We intend to root out this evil creature and grant him the martyrdom he desires. But most of all, we intend to move ahead and continue loving our families and doing our jobs.

With that in mind and with sorrow in our hearts, the staff and writers at Slot Tech Magazine extend our deepest sympathies to those who have lost friends and loved ones.

Randy Fromm's
Slot Tech Magazine

Editor
Randy Fromm
Technical Writers
Pete Bachran
John Green
Peter Hand
Bart Holden
Ken Locke
Kevin Noble
Herschel W. Peeler
Scott Reynolds
Brad Smith
Frank Sutter
Michael Thomas
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
slot-techs.com

SUBSCRIPTIONS
Domestic (USA)
1 year - $60.00
2 years - $120.00
International
1 year - $120.00
2 years - $240.00

Dear Randy,

I read the article in the July issue about Paul Trombetta, of Pacific Amusements. In reference to his problem of micro switches deteriorating in the IGT PE+ games, I have a recommendation. We have an abundance of the PE+ 13" (B10 model) and had the same problem years ago. I have found a switch that lasts much longer than the "Cherry E61" or "Micro UM50 series" switches. Nine years ago, I purchased a switch made by "Zippy", from the "old" WICO company. I have recently been able to obtain this switch from HAPP Controls. HAPP's p/n: 95-2502-00.

Randy Fromm

My switch usage has drastically dropped since using this "Zippy" switch (Now that I can buy 'em again.) Many (hundreds) of the old Zippys we installed 8 to 9 years ago are still in service today! I recommend he try them if he can.

Kelly Rusch - Slot Tech Dept. Treasure Island Resort & Casino

Paul will read your suggestion when he gets the October issue of Slot Tech Magazine. I wonder how long the magazine takes to get to his casino in Saipan. Thanks for the feedback. It was nice to meet your slot techs at the TechFest, last month.

CORRECTION: Last month's Slot Tech Magazine carried an article about Asahi Seiko's new escalator retrofit for WMS Gaming products. The unit was incorrectly identified as being for Bally games. Slot Tech Magazine regrets the error.

Randy Fromm

Randy Fromm

ICE 2002 will be bigger than ever before. It will also include totally new areas that are vital to the future of your business. Visit **www.ice-london.co.uk** and you'll find everything you need – the new *i-gaming zone*, the new *Components Zone*, the new *Recruitment Village*, exhibitor list, special rate hotels, travel guides and the fastest way to pre-register. Or telephone:+44 (0)870 429 4620 fax:+44 (0)870 429 4621.

THE INTERNATIONAL CASINO EXHIBITION
EARLS COURT, LONDON
22-24 JAN 2002

ATE
An ATE **Exhibition**

Sponsored by
EGO
european gaming organisation

It's All Your Fault!

By Ken Locke

It's all your fault. You heard me. You think I didn't see it or feel it? You didn't hear it or smell it, but you did it. If you weren't so damned irresponsible, this never would have happened. I blame those friends you hang out with. Why can't you be like your brother? He doesn't smoke EPROMS. Can't you just say NO to ESD?

Electrostatic Discharge or ESD is quite possibly the most insidious enemy you have on the casino floor today. What's more, you are its greatest ally; you and all your hooligan friends scuffing around on the carpet.

Sit down young man. We're going to have a little talk about your behavior.

Electrostatic Discharge is defined as the sudden transfer of electricity due to a build up of a potential charge. You experience this almost every day in one form or another. Clingy laundry, getting zapped while getting out of your car or putting on a sweater are normal occurrences of ESD. While annoying, these events are not what you might have considered dangerous.

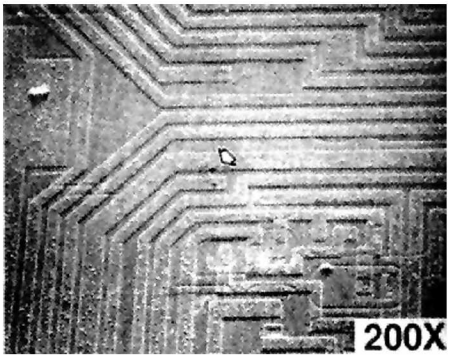
What is the deal with ESD? We asked John Ollson, Manufacturing Engineer and resident ESD Yoda at International Game Technology for the 411. "We're creating machines with more processing power... higher densities in the memories, the substrates get smaller, the propensity for ESD damage becomes a larger concern."

So much so that Mr. Ollson has launched a full-scale education ESD education program at the manufacturing facility in Reno. His goal is to change the culture of ESD awareness by getting every employee to buy into the existence of this phenomenon.

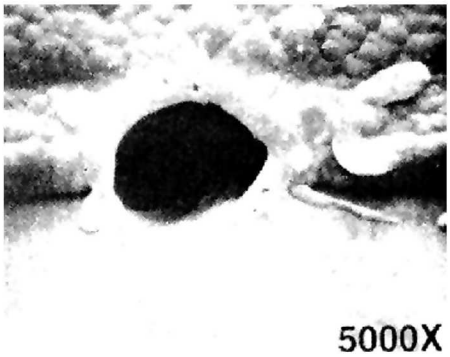
Not an easy task with nearly four thousand employees worldwide and an even harder feat convincing seasoned techs as to the impact ESD has on their floor. He doesn't stop there. ESD Awareness Training even reaches passed the corporate doors into the hallways of their suppliers.

The common belief among many long-time technicians is that "if it doesn't leave a smoking hole it must not be a problem." If this sounds like you, you had better check your calendar. It's the 21st century, dude. CMOS devices have conductive paths less than a 1/100 the thickness of a human hair. As we discharge electricity into a leg of a common PROM there is a degree of associated heat and impact. Deep inside the chip is a tiny Pearl Harbor. The bomb reference applies to both the events of December 1941 and the recent Ben Affleck release (uh . . . You would be the Japanese).

Luckily I found a great deal on an electron microscope at a garage sale to provide you with these stunning real-life ESD shots.



At two hundred times magnification this doesn't look like much.



But at 5000 times, what we see is quite literally a crater. Impact of current and its accompanied heat have caused this material to splatter throughout the interior of the chip.

Here we see a lightning bolt effect where the detonation

took place. It further affects the neighboring substrate. Careful examination shows particles nearly spanning the nonconductive channel to create a potential short.

Now you have really done it. Large chunks of substrate have now disseminated to the point where a short has occurred. This is what is known as "pot-holing". Aptly named since its effects are much the same as their namesakes on the highway. Sometimes you hit 'em, sometimes you don't. But eventually its going to be a problem.

Mr. Ollson goes on to explain. "The outcome of improper ESD procedures is not always readily apparent. Potholes occur to create a latent failure. That is, we may not see problems until later on down the line. Over time we could erratic behavior in the machines performance or worse problems with the paytables

and false jackpots."

Still not a believer? Maybe you're just insensitive. Human nerve endings rarely detect static charges below 3000-4000 volts. Even PROMs of the last decade can sustain damage from 0-100 volts. Soon we'll see devices susceptible to 35V and below.

In case you were questioning whether you able to detect below 4000 volts, consider there is next nothing in way of current in these instances. Low current, low impact. A little fuzzy? Take a look:

Walking across a carpet
1500 to 35,000 Volts

Walking over an untreated vinyl floor
250 to 12,000 Volts

Worker at bench
700 to 6,000 Volts

Handling a Styrofoam cup
600 to 7,000 Volts

Picking up a common plastic bag
1,200 to 20,000 Volts

An interesting side-note: The human body cannot even detect the sensation of ESD until about the 3000-4000 volt range. Now I know what you're thinking. Thirty-five thousand volts! Isn't that enough to push a train?

But as any first year EE student can tell you; it ain't the volts, it's the amps. Very little current flow is associated with a typical ESD event. This is why you don't smell charred flesh when you zap your wife with a peck on the cheek on a cold, dry winter's day.

Static Shielding Bag

What are the symptoms of electro-static discharge damage? This is where its gets a little murky. Truth is, you just never are certain. Anything from erratic machine behavior to false jackpots (yikes) are commonplace. John Ollsen continues, "Ghost bits and memory violations become a problem." (At this point in the interview I have no idea what he is saying, but it sounded really cool).

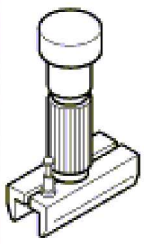
Corrupted firmware, as it has come to be called, comes in two distinct categories: Latent and Catastrophic. Catastrophic is easy to spot. Latent failures, on the other hand, can happen anywhere from the manufacturing floor to the Slot Tech Shop. The bugger is these are problems will happen 'eventually' and there is no way to tell they exist until the move into the catastrophic category.

So what's a poor mother to do? Training, prevention and the occasional threat wouldn't hurt. The Internet has tons of resources for ESD awareness to include sites, books, videos and formal instruction. The use of ESD straps, proper handling and outfitting your workstations to be ESD safe are also a big help.

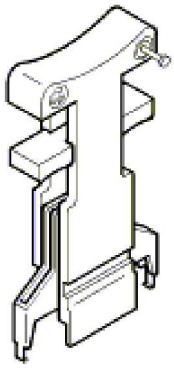
Okay, I am off my soapbox for this month. Kids, this is like wearing your seatbelt. No one can really make you do it, but when the time comes you will wish you had. ESD is real. I hope you've learned your lesson. Now go to your room and think about what you've done.

-Ken Locke
ken.locke@igt.com

ESD Strap



Insertion Tool



Extraction Tool

TechFest, 2001 a Hit!
TechFest II scheduled for January, 2002

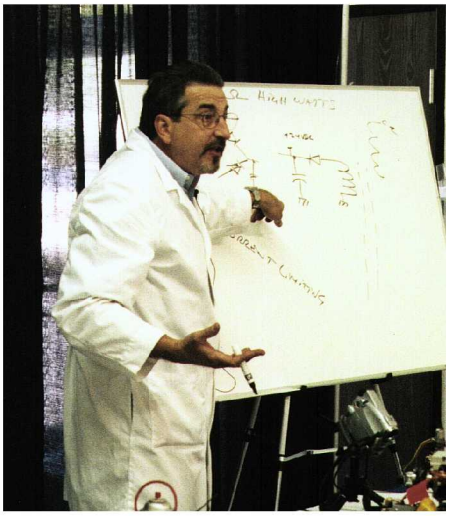
Don Seagle of Asahi Seiko showed the finer points of coin hopper conversion and repair.

Frank Happ generously provided the venue for TechFest, 2001 at his parts house in Las Vegas. Happ Controls also sponsored luncheon on the opening day of the TechFest.

IGT game design engineer Joe Kaminkow was a featured guest speaker at TechFest, 2001. He expressed his appreciation for what the gaming industry's slot machine technicians do every day "in the trenches."

TechFest, 2001 featured presentations from Asahi Seiko, Coin Mechanisms, Inc., JCM, Mars Electronics, Inc., 3M Touchsystems/MicroTouch and Sencore.

TechFest II is scheduled for January 9th - 12th, 2002.



Randy Fromm covered monitor theory and repair

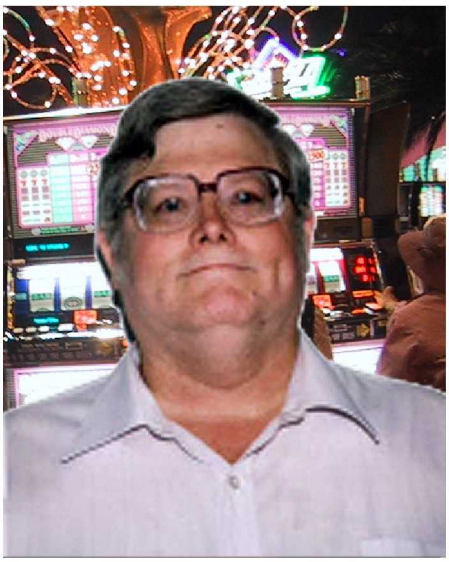
On the right, Medeco's Michael Kennedy and Nick Sollazo descuss their removable core locks that allow a lock to be replaced in just seconds. Medeco High Security Locks sponsored luncheon on the third and final day of the TechFest.

Slot techs from around the country and as far away as the island nation of St. Maarten enjoyed three days of technical presentations at TechFest, 2001.

Diverters and Bench Repairs

Two, totally unrelated subjects but since this is the big SHOW ISSUE . . .

By Herschel Peeler



Adjusting diverter coils properly to prevent pre mature failure

Coins accepted by a game have two paths to take. They can go to the hopper, or to the drop. The position of the diverter determines which path the coins will take. The diverter is usually just a solenoid with a mechanism to move a paddle between the two paths for the coin. The coins either go to the hopper, or, if the hopper is full, they go to the drop.

The diverter coil is a simple creature. It is a coil of wire wrapped around a hollow tube. Pulling current through the coil creates a magnetic field. A plunger is pulled into the hollow tube by the magnetic field. When power is removed, a spring pulls the plunger back out.

Properly adjusted, the diverter coil should last the life of the game, or maybe fail once in ten years. If not properly adjusted, it will certainly fail prematurely. Symptoms of a bad diverter coil could be intermittent operation resulting in the drop count being incorrect.

When installing a diverter coil it should be adjusted so that the plunger pulls fully into the coil. If the plunger does not pull fully in the resistance (impedance) of the coil is lower than it should be, resulting in higher current through the coil, higher heat, and premature failure.

A coil that is already progressed to a solid failure is easy to spot. The case shows signs of heating or is cracked and swelled, and may be the plunger may be stuck. Before the coil develops to this condition it will show signs of intermittent operation that show up in Fill Checks.

If you test the diverter during a fill check, it may seem to work properly. At the time you are there the coil may be cold and work properly. But once the game is in play, the coil energizes, heats up, and sticks in the incorrect position, causing the count in the drop to be incorrect.

If your supervisor send you to a game for a Fill Check the best advise is, "**don't just stand there, change something**". If the diverter has not been changed before you, change it. If it has already been changed, adjust it. Don't tell your supervisor the game works okay.

Before you throw that coil away, confirm your suspicions. A resistance check of the coil will support the suspicions. Compare the resistance of the coil with that of a known good coil. A change of only ten percent may be enough to cause intermittent operation, but hard failure may be happen until the coil drops to fifty percent of this value.

Bench repairs

Initial game repairs on the floor should be expedient. The objective at the time is to get the game back into a working condition with as little misery as possible. Proper respect should be given to accounting procedures and the customer's credits, of course. Once the defective assembly has been swapped out and returned to the shop, the troubleshooting begins.

Test fixtures

Most manufacturers of gaming machines also manufacture a test fixture for the game. This is usually nothing more than a game in a different case. The boards are made accessible for troubleshooting. Switches substitute for general inputs. Lamps substitute for general outputs. AC line voltage has a variac so AC may be brought up slowly. Peripheral devices (hoppers, coin comparators, bill validators, monitors, reel mechanisms, and such) may be tested as optional devices.

The test fixture itself has no unusual diagnostics built in. It just makes troubleshooting easier. Diagnostic routines are usually built into the game as a power-up self-test routine and diagnostics.

Usually when these routines find an error the program loops on the failing routine, when possible. Understanding what the diagnostic is doing, and where that circuit is at on the board, will narrow your troubleshooting down to a few components.

Other books I have read suggest cutting the circuit in half, logically, and troubleshoot the board one-

half at a time. This approach was appropriate when we were talking about radios, but I think it has very little application to embedded microprocessor circuits.

Start from what you know.

If you know a certain output is not working (only one output) put the game into a condition that should use that output, and start with the most obvious first.

Outputs that are not working limit the possibilities to only a few components. The output driver itself (a transistor or an IC), or the circuitry between the data bus and the driver (usually only a few components).

The same may be said for an input that is not working (only one input). Put the game into a condition where that input should be seen by the CPU and start from the input circuit of the board. This limits the possibilities to a few passive components and maybe an opto isolator. Single symptom failures stop at the data bus.

For multiple symptom troubleshooting find out what the symptoms have in common. Failures in multiple memory devices usually points to address decoding. Address decoding ICs themselves seldom fail, but PALs have a notable failure rate.

Shotgun

The shotgun approach was covered in last month's Slot Tech Magazine so I won't go into detail here other than to say that it's a quick and easy, no-brainer approach to troubleshooting embedded processor based equipment. It may be less than what you were told in school that should be done but if a quick repair is called for, a guess based on good experience is sometimes a satisfactory substitute.

If the problem can be narrowed down to a few components, as is often the case where you have one specific symptom, replace all the possibilities at one time. A transistor may only cost $1.00, an opto isolator $1.00, a driving IC maybe $1.00. Your time is worth $40 or more per hour. Troubleshooting takes time. Replace the parts, then think. If you see the same failures over and over again, this approach, guided by experience, can get many parts repaired quickly.

The bottom line is how quick the repair was and what it cost, not how smart you were to find the problem.

Easter Egging

Another less than honorable but useful approach is called Easter Egging. If many parts are suspect (which means you really have no clue as to specifics), narrow the possibilities down by swapping parts. If the board has a dozen ICs on sockets, swap out all socketed components with a known good set. This, of course, requires that you keep a known good set of ICs around for the boards you work on.

If the problem moves with the chip set, it is only a time consuming task to find out which IC is the problem. Don't be surprised if the problem goes away by magic. The problem may have just been a bad connection between the IC and its socket.

If the problem was not a socketed component, you have a decision. Send it back, or start troubleshooting. Most of the time, if the board has a catastrophic failure, some activity may be present on the microprocessor. If you have no other symptoms, other than it being simply brain dead, look for the obvious first.

Look for signs of physical damage.

Does it have power?

Is the microprocessor getting clock cycles?

"The bottom line is how quick the repair was and what it cost, not how smart you were to find the problem."

Is it being Reset?

If it is running, look for irregular Address and Data Line signals.

Is anything warmer than it should be?

Is there only one circuit malfunctioning?

Something to consider if it is just brain dead:

Manually pull the Reset line active. If it is active low, jumper it to ground. Address and Data Lines should go tri-state, making it easy to spot one that is hung high or low. Address Selection circuitry should be inactive. Nothing should be selected.

Cool test rigs to have if you actually do some troubleshooting:

If your microprocessor is on a socket, make a box with lights and switches that plugs in where the microprocessor would. This allows you to manually select an address and read or write data to check circuits.

If programming is within your ability, write a short RAM test and put it in an EPROM so you can know what the microprocessor should be doing. For some strange reason, OEMs in this industry seldom supply you with source code for their EPROMs, and you are at a loss to know for sure what the

microprocessor should be doing.

The same can be done for an I/O test. Write a program that reads input switches and lights player panel lamps. Create an EPROM that runs the reels. Many small tasks can be implemented in EPROMs to check specific circuits. These are handy to have and make an impression on certain people. Other people will be worried. In this industry, being able to alter a game by rewriting the EPROMs is a danger. Some will be impressed. Others may be scared. The wisdom is in knowing with whom you work.

Knowing when to send it back

Troubleshooting is a form of challenging entertainment. Finding the problem often makes one feel like a hero but know when to call it quits and send the board back to the manufacturer. This is a gray-area value judgement. What conditions are you working in? What does it cost to replace it versus what it costs to repair it?

If you are in Las Vegas, it isn't hard to just send it back to a local plant. If you are at a far outpost or the manufacturer no longer supports the part, you may not have that option.

What repair parts do you have available? Shop parts stock can wrap up a lot of revenue that just sits in bins until it is obsolete. "Bean counters" irk at the idea of keeping thousands of dollars in bins. Good purchasing practices seldom encourage buying in single quantities. The result is, if you buy something, you buy a bunch of them. In a prime strip casino, the games seldom stay in house long enough to use the repair parts you purchased to support them. When you sell off the games, seldom does the shop get cleaned up of those parts.

The repair parts problem is a known condition. Usually those who make the decisions concerning the shop are far removed from the needs of day-to-day operation.

Working with out a schematic.

We often find ourselves in this horrid circumstance. We have a board we know is defective. We can't send it to anyone for repair. We have no documentation. If you have sufficient experience, you realize that embedded microprocessor designs have more in common with one another than they have differences. Taking a look at the overall board, are you familiar with the microprocessor used? The circuit has a microprocessor, memory, inputs, and outputs. Memory is easy to identify. Output circuits have driver transistors or driver ICs. Inputs have no drivers, and simple inputs to data bus buffers.

Most of the time the symptoms can lead you to a general area on the board. Experienced troubleshooting tactics can usually get you through.

If this is a board you will be seeing more of, ask yourself if it is worth your time to de-engineer the board and make a schematic. I have done this on more occasions than I would like to have paid for. Good schematic generator software, complete with libraries of IC pinouts, can make this job less tedious. Lacking the computer solution, a good supply of data books will get you through.

After you have seen a thousand schematics, you can look at a board and almost see the schematic. If you have this ability, bless you, my son, you are indeed a board tech.

- Herschel Peeler
hpeeler@slot-techs.com

MEI

Bill Acceptor

ZTSeries 1000

ZT 1200

HIGH, FOUR-WAY ACCEPTANCE

Satisfy customers by accepting bills of all conditions. Bills can be fed in any direction, face up or down.

EASY TO USE

The Recognition and Transport Unit (RTU) and the Lockable Removable Cassette (LRC) can be removed from the front with one hand. The RTU fully opens for cleaning and electrically connects automatically when inserted.

An easily accessible toggle switch enables the operational mode to be changed to "test" or "set-up" mode.

BAR CODE CAPABILITY

Reliably accepts industry standard bar code coupons face up in both directions.

FUTURE FLEXIBILITY IN A FLASH

All US models accept $1, $2, $5, $10, $20, $50 and $100 bills. The ZT Series 1000 bill acceptor can be easily updated electronically to handle new currency designs.

RELIABLE / LOW MAINTENANCE

With the streamlined recognition system, sensors are embedded under the smooth plastic bill path and the magnetic head and pinch roller have been eliminated to dramatically reduce jams, debris buildup and the need for cleaning.

EXCEPTIONAL SECURITY

Through the use of multiple wavelength optical sensing and sophisticated data processing the ZT Series 1000 bill acceptor sets the standard for rejecting invalid bills. Optical cross-channel sensors examine the bill path for foreign objects such as clear tape or strings. The LRC triggers an automatic "lock out" when separated from the unit for added security.

MEI®

NEW MILLENIUM OF IGT DIAGNOSTICS

By Bart Holden

With the rapid introduction of the IGT S2000 into casinos around the world comes a new and improved diagnostic and history program to aid the slot technicians' mission. With the addition of a dot matrix, IGT successfully eliminated the need for the technician to carry along a diagnostic booklet to sort out all of those numbers. Instead each menu, submenu, and function is written out and also organized within a number system closely resembling an outline. Once you figure out the function of each of the door panel buttons, you are well on your way to understanding and perfecting IGT diagnostics.

BUTTON FUNCTIONS

To enter the diagnostics screen press the internal test switch located on the Central Processing Unit. The dot matrix will display [1 ACCOUNTING]. The function of the change button is to scroll you backward through menus and submenus. The cash out button scrolls you forward through the menus and submenus. The spin reels button accepts the menu or submenu that is currently displayed on the dot matrix. The play max credits button exits the current test. It will take you from submenus to the main menu and eventually out of diagnostic mode. Finally, the jackpot-reset switch initializes certain test such as the ten-coin hopper test.

MENUS

I will touch on some of the many functions of the diagnostics available on the S2000. Most of the functions are useful to the slot tech, however some deal with the accounting side of the slot machine and will be omitted.

The first of the main menus is the ***accounting*** menu. Here you can access your game meters. You can also see an error history in this menu. This tells you the number of coin jams and/or error, bill jams, coin out jams, extra coin outs, and a host of other errors. There is not much more of interest here to a slot technician.

The next main menu is the ***history*** menu. Here you will find the game history, which holds an advantage over the old S-Plus platform. The game history can now recall 25 games as opposed to 5. Furthermore if you input the proper date and time when you setup your S2000, you will also have a time stamp on the game recall. What a relief to have this information when involved in a dispute.

You will also find a 100-event history here. This will show you the sequence of events that occurred before arriving at the game including game starts and stops, doors opened, any errors, hopper payouts including the number of coins, and bills stacked including denomination. Again this is a priceless tool to posses during a dispute.

This menu also contains a bill history page that is date and time stamped. It has a voucher in history if you utilize E-Z pay and an Electronic Funds Transfer history. It has a hand pay and hopper payout history as well. By coupling these different time stamped histories one can easily determine if a patron has a legitimate complaint with a slot machine.

The third main menu is the ***options*** menu. This is where you will setup your game during your initial installation. Here you will find your machine options, communication options, sound options, and bill acceptor options. You can choose your player tracking protocols here as well as enabling or disabling your bill validator.

Under machine options you will find another set of submenus. The first is the machines credit mode setup. You can toggle between credit mode, non-credit mode, player-initiated credit, and player initiated non-credit depending on your casino's preference.

The time setup submenu is also located under machine options. The importance of

setting your time and date cannot be overstated. It will be your savior during a heated customer dispute. To set your time, press the spin button while time setup is displayed on the dot matrix. Next, press the change button to skip digits and the cash out button to change the numbers. Once you have the right time and date, exit out using the max bet button.

Under machine options you will find your submenu to setup your machine limits. You can setup your hopper limit, credit limit, jackpot limit, and bill limit here. Use the same steps as setting your time and date.

The fourth main menu is your ***input/output test*** (I/O test)**.** This is one of the most powerful tools a slot technician can utilize. This can save valuable time when troubleshooting a faulty slot machine. For instance, why open and close the main door over and over to see if a game accepts coins when you can use the coin lockout? Why use a multimeter to check continuity from your hopper probe to the hopper board when you can use the hopper probe test? Slot machines wouldn't have diagnostics if they weren't useful.

The first submenu is the input test. Under this menu you will find the door input test. Use this test to verify that your button switches are working properly. Scroll through each button and press the appropriate button to change the state from a zero to a one on the dot matrix display.

Next is your cabinet input test submenu. By scrolling through the cabinet input test menus, you can test your slot handle, coin out optics, hopper motion, hopper probe, auxiliary key, hopper level, as well as other less essential inputs.

You will also find the processor input test under the input submenu. This is the test used to verify your door signals. This includes the main door, bill validator door, and logic door. You can also check your reel optics and battery voltage here.

The output test is located under the main menu I/O test. Under the output test submenu, door output test is located. As you scroll through the door output test you will notice that the game buttons will appear one at a time on your dot matrix. As each button is displayed the status of its light emitting diode will change to verify the light is good.

You will also find the coin lockout as you continue to scroll. Press and hold the spin button to enable the coin lockout to test the operation of your comparitor. Continue to scroll through the submenu and you will find the diverter test. Press the spin button to actuate the diverter.

Also under the output test you will find the submenu cabinet output test. Here you can verify the hopper brake, candles, and meter operation. This is also the location of your handle solenoid test. Press the spin button to release your handle.

More submenus of the main menu I/O test are the sound test and sound file test. These are useful for checking your game volume.

Under the I/O main menu you can also access the 7-segment display test and dot matrix display test. The 7-segment display test runs a test pattern across the display to verify proper operation. Once initiated, the dot matrix test illuminates completely and then runs a vertical and horizontal sweep across the display.

Also under the I/O main menu you will find your hopper/printer test and bill acceptor test. This is your 10-coin test to verify proper hopper operation. The bill test allows you to insert a bill to verify that the machine is reading the bill properly.

The next main menu is the ***game test*** menu. Here you will find the reel strip test and the paytable test. The reel strip test automatically runs through each stop. Of more use is the paytable test, which requires the use of a PAR sheet. Here you can verify that the game is paying correctly by manually inputting the desired combination.

Finally the main menu machine out of service is displayed. Press the change or cash out buttons to scroll between in service and out of service.

When you have free time go out and sit at a S2000 and familiarize yourself with the diagnostics. IGT has all but perfected this great tool. From disputes to troubleshooting, a slot tech has the edge.

-Bart Holden
bholden@slot-techs.com

How Much Can You Learn in 3 Days?

Make plans today to join the gaming industry's top engineers, technicians, technical writers and instructors for 3 days of technical seminars and presentations that will enhance your performance as a technician and dramatically increase your value to your employer.

This is a technical presentation. The TechFest is geared for working slot techs and technical managers who are looking for a way to make a dramatic improvement in their understanding of video slot monitors, touchscreens, bill validators, hoppers and more with no-nonsense technical presentations from:

- **Asahi Seiko**
- **Coin Mechanisms, Inc.**
- **JCM**
- **Global Payment Technologies**
- **MicroTouch**
- **Sencore**

- PLUS - A special instructional series on video slot monitor repair presented by Randy Fromm

DON'T MISS GAMING'S BEST TECHNICAL PROGRAM OF THE YEAR

MAKE PLANS NOW FOR TECHFEST II

BE A BETTER SLOT TECH

Come and spend 3 days at TechFest II. With engineering and technical representatives on hand from the gaming industry's leading suppliers of touchscreens, bill validators, coin comparitors, hoppers and monitors, YOU have a chance to ask about YOUR problems. You have a chance to get REAL answers to your questions, face-to-face with some of the most qualified technical experts in the industry.

Visit the website at slot-techs.com for more information

TechFest is for slot techs of all skill levels, from novice techs who want to learn the basics of BV and hopper maintenance to advanced techs that need to brush up on monitor repair.

Space is limited - Register today!

SLOT TECH MAGAZINE'S

TECHFEST II

SCHEDULE OF EVENTS

Wednesday, January 9th, 2002

9:00 am - 12:00pm
How Monitors Work - Part 1
Theory of Operation - Beginning level

12:00pm - 1:00pm
Luncheon sponsored by:
Happ Controls

1:00pm - 3:00pm
JCM - BV troubleshooting and repair

3:00pm - 3:30pm
Afternoon Coffee Break

3:30pm - 5:30pm
3M Touchsystems / MicroTouch - Touchscreen Technology

Thursday, January 10th, 2002

9:00 am - 12:00pm
How Monitors Work - Part 2
Narrow Down the Problem - Intermediate Level

12:00pm - 1:00 pm
Luncheon - Sponsorship available

1:00pm - 3:00pm
Global Payment Technologies - BV troubleshooting and repair

3:00pm - 3:30pm
Afternoon Coffee Break

3:30pm - 5:30pm
Coin Mechanisms, Inc. - Coin Comparitor technology and repair

Friday, January 11th, 2002

9:00 am - 12:00pm
How Monitors Work - Part 3
Circuit Analysis and Component Level Troubleshooting - Advanced Level

12:00pm - 1:00 pm
Luncheon - Sponsorship available

1:00pm - 3:00pm
Sencore - Monitor Troubleshooting and Repair - Using sophisticated test equipment to speed through monitor repairs

3:00pm - 3:30pm
Afternoon Coffee Break

3:30pm - 5:30pm
JCM - BV troubleshooting and repair

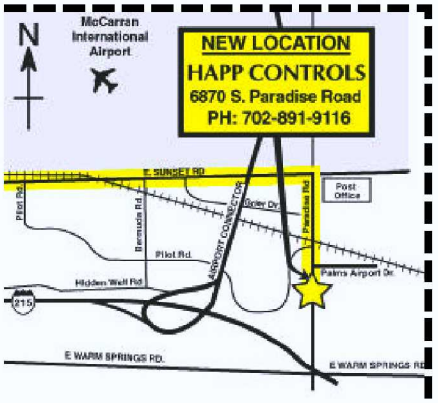
Enrollment Form

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

TechFest II will be held January 9-11, 2002 at:

Please complete this enrollment form and return it to Slot Tech Magazine by December 31, 2001. Enrollment is limited. Do not purchase airline tickets until you have received confirmation of acceptance.

Happ Controls
6870 S. Paradise Rd.
Las Vegas, NV 89119



Company Name _____

Name(s) of attendee(s) _____

Address _____

Address _____

City _____ **State/Prov.** _____

Country _____ **Zip/Postal Code** _____

Telephone _____ **Fax** _____

E-mail _____

Enrollment fee is $390.00 per person. Payment by credit card or check payable to Slot Tech Magazine. Purchase orders will be invoiced.

[ ] American Express
[ ] Discover
[ ] MasterCard
[ ] Visa

Account Number: _____

Expiration Date: _____

Troubleshooting Through Signal Injection

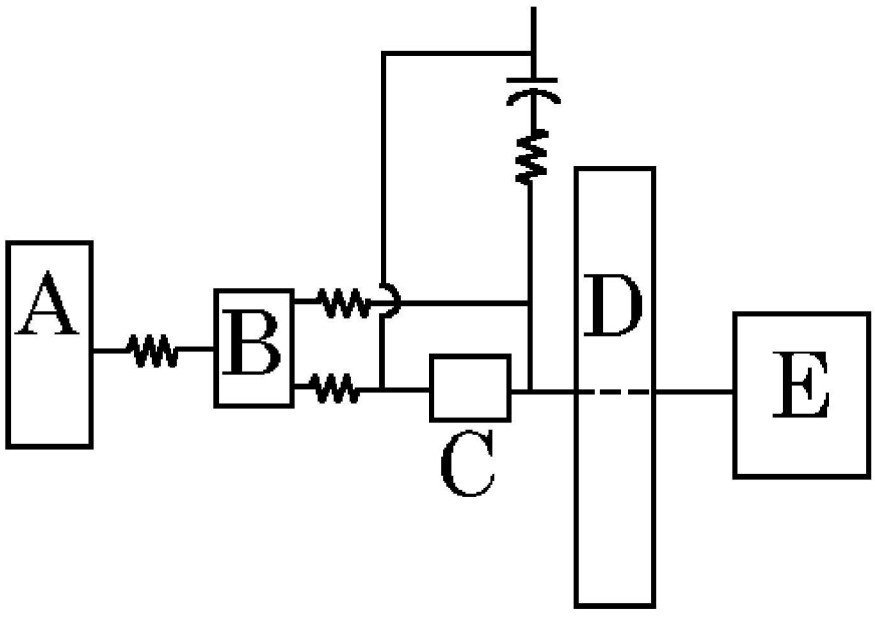
By Frank Sutter

Last month, I began an overview of the five main methods of electronic troubleshooting, and I then expanded upon the most low-tech of the methods, which I called "shotgunning." As a reminder, the five methods of component-level circuit board troubleshooting are: **experience**, meaning having seen the problem before, **comparison** with a known good board, **signal tracing, signal injection**, and **shotgunning**. I also promised that I would talk a bit about the most advanced of these five methods: signal injection.

Signal injection is the process of injecting a known good signal into the input of a circuit and then testing for the expected output of the circuit. Signal injection has been used for years in the electronic architecture known as analog. In that antiquated form of implementation, still in use today in TV's and VCR's, signal injection was both extremely effective and at the same time difficult to use. It required special equipment to generate the required signals and extensive knowledge of the inner workings of the circuitry to be tested in order to implement the complex setup required for running the tests. In short, for the most part it was used by the most knowledgeable technicians in the most well-equipped shops, on the most difficult tough-dog repair jobs, and only when all other methods have failed.

Digital electronics has changed all that, just like it has changed everything else related to electronics. The digital signal has two states, high and low. Both are available right on the board you are working on. In order to use them however, a technician first has to get over a very well-placed and reasonable mental block he or she may have about shorting one part of a board to another.

Let me start with a few words of assurance and of caution. On a printed circuit board that has been implemented using digital electronics, the current is supplied through very low voltage power supplies. For this reason, it will be hard to do significant damage to a board. However, I caution you to not misinterpret that statement. When I use the phrase significant damage, I mean smoke, flames and charred spots on the board. I don't want to convey the impression that you might not blow through a silicon junction or two, and zap a couple of chips or diodes because that will certainly be possible. Although the low voltages involved make this a relatively safe technique, I caution you to not

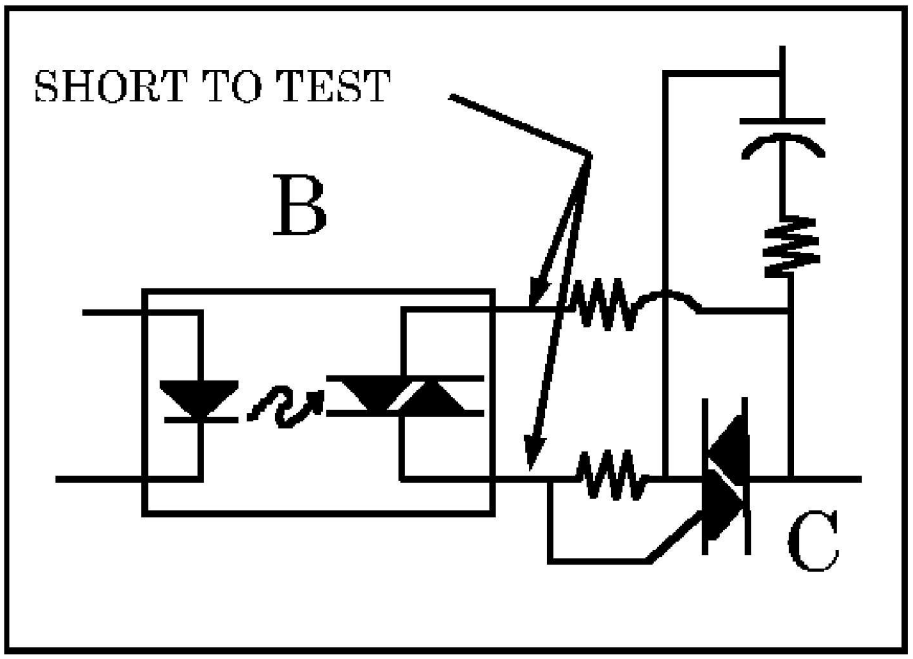


get too creative. Be sure that when you do actually power the board up and make the short, you know exactly what you are doing, where you are doing it and what you expect to see happen.

In order to demonstrate how this technique works, I'm going to consider a game that has a failed diverter. In this case, the problem has been isolated to the CPU. I have sketched out a quick generic block diagram of how the diverter circuit typically works. In the diagram, the first block (A) represents the decoder stage. This chip is known as a decoder because it takes a set of inputs from the processing section of the CPU, and interprets the "code" appearing at the input in order to create a specific action or output. It performs this miracle through a hardwired signal steering network contained within the chip.

This particular decoder chip has the capability of enabling any one of several slot machine functions depending on the specific combination of ones and zeros on the input lines. In normal operation, and in accordance with the game program, if the microprocessor receives the "hopper full" probe signal, it would respond by setting up the proper combination of signals on the four code lines feeding the specific decoder chip that has been wired to control the diverter. The decoder, by virtue of its internal steering network, would then sense the "code" appearing at the input lines and enable the diverter circuit. At that point, the pin that controls the diverter circuit would go active. Because there are many output functions in a slot machine, there are normally several decoder chips on this board. Each of these is connected to individual outputs. They are each designed to enable specific, predictable output lines in response to specific combinations of ones and zeros on the input code lines. This

is important to keep in mind because if one of the decoder input lines has gone haywire, it's very likely that there would be greater problems with the machine then simply one malfunctioning output. In this case, since there is only one malfunctioning output, we can almost positively assume, at least until proven wrong, that that the four input lines to the decoder are functioning properly.



The "high" signal (logic 1) on the diverter output line is passed through a resistor to an optocoupler (B), which has the function of passing the signal to the input/output section of the board. This step is necessary because the stages following the optocoupler are operating on a completely different power configuration and the two power supplies are incompatible. Specifically, the I/O section controls a high voltage AC current, while the decoder and everything before it runs on a DC 5 V system.

The input of the optocoupler responds to the high on the diverter pin of the decoder chip by lighting up an LED inside the chip. This light turns on the receiving or output section of the optocoupler. The output section "sees" the light from the LED, and responds by conducting current. The gate of the triac (C) is connected to this output. The gate senses the current, turning the triac on. The current conducted by the triac passes through the motherboard (D) and several other connectors to reach the diverter coil (E), which then changes its position. That's the entire process that the CPU uses to change the diverter coil's position. Lets see how to use signal injection techniques to find out why ours might be failing.

With the CPU in the shop, and mounted in the tester, the best first troubleshooting step is to divide the entire diverter signal path in half, and test right about in the middle somewhere. This will immediately eliminate half of the electronics and isolate our problem to the other half. The middle of the signal path is the optocoupler, so let's start there.

As I explained, after the optocoupler receives an actuating signal from the decoder, the receiving side conducts current. In the absence of an actuating signal, the receiving side of the optocoupler blocks the current. Therefore, to actuate the stages that follow the optocoupler, it would be convenient to short one leg of the receiving side to the other leg of the receiving side, conducting current around the blocking optocoupler and simulating a normal actuation. If everything beyond the optocoupler is working, this short should cause the triac to turn on just the way the optocoupler normally would. The triac should then send current to the diverter indicator on the tester. If the diverter indicator does not turn on when this short is made, you can suspect the triac or far less likely, one of the resistors or capacitors that bias it.

On the other hand, if this first signal injection turns the diverter indicator on, everything from the optocoupler to the output device is working properly. At that point, you must suspect either the optocoupler itself or the decoder chip that feeds it. The decoder chip would be a rare failure but in order to isolate the problem a little further, take a clip lead and tie one end to the DC 5 V supply. Apply this voltage through the clip lead to either end of the resistor in the signal path between the decoder and the input of the optocoupler. In this way, you are injecting the turn-on signal that normally would come from the decoder chip. If the diverter indicator comes on when this injection is made, the decoder chip is bad. If the indicator does not come on, the optocoupler is the villain.

Simply and yet in a straightforward, powerful way the signal injection method has isolated the bad component in two tests. Before you make an attempt at troubleshooting in this way, you should have a pretty thorough understanding of how digital electronics work and the ability to read and interpret a schematic. PLEASE don't just short the power supply or the ground to other components on the CPU on an experimental basis. There is the potential to do great harm to a board if you do.

Having said that, understand that in MOST cases, all this method is really doing is injecting a signal that is supposed to be there anyway and that the signal you inject should only trigger the normal operation of the circuit under test. As long as you are sure that this is what you are doing, these tests are perfectly safe.

Good luck with this test method, and until next time, keep 'em runnin'.

- Frank Sutter
fsutter@slot-techs.com

Interviewing Bliss

By John Green

Hiring new slot technicians can be worse than pulling teeth and at one point I would rather take a punch to the gut than go through the hiring process. Over time we have developed a more streamlined way and I would like to share it with you. We enjoy a very low turnover rate and most techs have been with us since day one. I attribute this to our training and hiring process. When our riverboat opened, most of use had never seen the inside of a slot machine and didn't know much about how they worked. We spent most of our time doing installation and prep work and this went on till the second we opened the doors to the public. I remember bloody knuckles and so much radio traffic that you couldn't answer a call. There were people lined up around the casino waiting to get in. What a mess. We now train our techs on all the different machine types and manufacturers, repair techniques and even do mock customer scenarios. They train with me for several weeks with hands on and then go to their respective shift where they shadow a seasoned tech until they are ready to make a go of it. Everything is documented and we do follow-up training and strengthening as needed. However, to make it to this point we must go through the interview process.

We use a unique interview process that you may find rather intimidating. A supervisor from each shift, myself and sometimes the manager or lead techs will sit in on the interviews. We have a small test we give while they wait for their turn to interview. The test contains basic electronic and mechanical questions and a few situational "what would you do if?" questions. This gives us a clue as to what they are weak in and where they may need more attention after they are hired but the test has no bearing on whether or not they get hired.

It is important to make the interview process the same for each prospect. We ask them a set list of questions and take notes as to what is said. They may expound on any answer but each is given an equal chance by our asking the same set of questions of everyone. We also designate one person to ask all the questions so there is one focal point for them. Once they give an answer, follow-up with an open ended question. If they tell you about an electronic school they attended, ask if they liked it and what they learned. This should put them more at ease and you learn more about them. Remember, once hired, they become part of YOUR technician family. You want to know as much about them as possible without getting into taboo questions that we will cover later. The more you can get them to talk, the more you can learn of their personality and demeanor. However, cut them a little slack as they are probably nervous and anxious and, to be honest, there are people out there that just can't interview. There is nothing wrong with them, they just have no interviewing skills and must be coaxed into giving up information. Put the interviewee at ease; ask them if they want some coffee or water. Most will accept as they can pretend to sip on a cup of water while they think over their answers.

State and Federal laws prohibit questions about race, religion, national origin, ancestry, medical condition, physical handicap, marital status and age. Personal questions like marital status, living with girlfriends, how many pets do you have, are you going to start a family may not be illegal but they are inappropriate.

Be tactful and make sure the questions deal with the job you are hiring for. Use questions to get information about their experience or background and their career goals. Ask them about hobbies or community involvement. Ask them to give a self-assessment, for instance, their weakness and strengths. This is a really tough question. If you don't think so, go to your boss today and tell him your weakness and strengths. It is easy to think about it in your head, but telling someone is tough. The look on their face when you ask them their weaknesses is actually kind of comical. You have to really think about what you want to tell someone that may hire you.

Make sure you cover what you will expect from them and what they will be hired for. Read them a job description and ask them if there is anything that would prevent them from performing any of these tasks. Remember, you can't ask if they are have a handicap but you can ask if they can perform the tasks you read to them. Be sure to cover what shift they may have to work and if there is any outside conflict that may prevent them from working a particular shift. This is an open question that could allow them to discuss childcare, college classes, transportation problems or an outside involvement they may have without outright asking them.

After all the interviewing is complete, we review our notes and each person picks a person they want and then write down why. Basically, we try to sell each other on which we want to hire. Once everyone is happy with a choice, the hiring paperwork is started. Remember, if you can't find anyone with enough technical skills, hire from personality and then teach them the technician side. If you hire a bad apple that is strong on technical skills, they will conflict with your other employees and most likely the guest.

- John Green
jgreen@slot-techs.com

Key Control

By Brad Smith

When talking about key control the first thing that comes to mind is unauthorized duplication. This can be done in a variety of ways, but typically amounts to someone making a copy of your keys.

The first step to solving this problem is to use locks with a patent on the key. When a key has a patent, it cannot be duplicated at just any outlet. In the case of Medeco, gaming keys can only be cut by Medeco gaming service centers, and only with your written permission. The patent on the key gives both the casino and Medeco a way of assuring that the key blank your key was made from and the key machine it was cut on is not out on the open market, thus preventing someone from copying it. If the key is not patented then that blank can be offered on the open market, similar to that of a house key that you can get copied just about anywhere.

Another way to maintain key control is to use a locking key ring. Locking key rings assure everyone involved that the keys given out at the beginning of the shift are the same keys returned at the end. If the keys cannot be removed, then it makes it nearly impossible to have them copied. Locking key rings help protect the employer by assuring keys were not removed, and it helps protect the technician by providing proof that a key was never lost or misplaced. Lockable key rings make it impossible to leave a key lying on a machine or to have one stolen. In order to lose a key, the entire ring would have to be taken and that is one process that would be hard to pull off.

A final issue concerning key control is how to secure your spare locks. It is common practice to carry spare locks in the case a lock needs to be replaced. While this is a smart practice, there must be as much attention placed on the spare locks as there is on the keys. If a spare lock is ever stolen, it can be used to make a blue print for a key. At all times spare locks should be locked away and the access to them should be limited.

In order to truly practice adequate key control, you must make sure your locks have a patent on the key. This combined with the other security precautions (such as using lockable key rings and physically securing locks), will help you protect the employees and the casinos.

Written by:
Brad Smith
Marketing Manager , Industrial Security
Medeco High Security Locks

Profile of Medeco:
Medeco is the leader in high security locks for the gaming industry. Located in Salem, Va. Medeco has been making high security locks for over 30 years. As an Assa-Abloy company, Medeco is committed to providing Global excellence throughout the gaming industry. 1-888-Medeco1.

ADVERTISEMENT

Randy Fromm's Casino School

On-Site Technician training

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

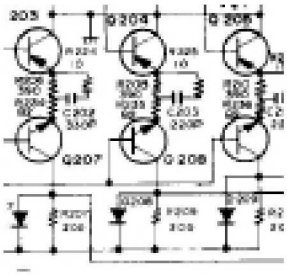
This relatively inexpensive piece of test equipment is easy to operate. Casino School students learn to use the digital multimeter to perform tests and measurements that will pinpoint the cause of a failure down to a single component.

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.

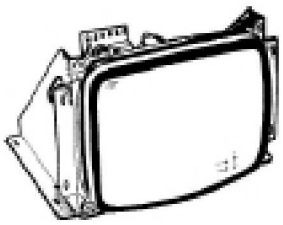
SCHEMATIC DIAGRAMS

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

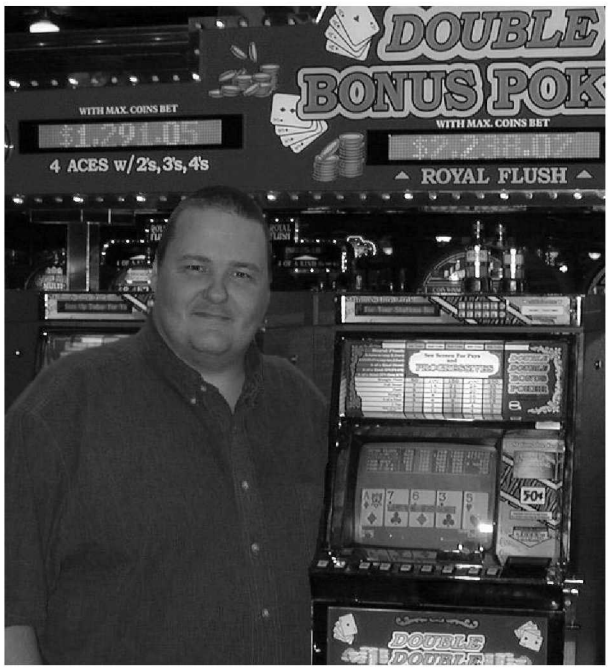
The monitors used in video slots are designed for quick, easy, and safe repair. Students will learn the theory of operation of all types of monitors and how to repair monitors down to the component level. Of course, monitor safety will also be discussed.

You do not have to send your slot techs to Las Vegas or Atlantic City for training. Randy Fromm's Casino School brings the training to you. Contact Randy Fromm's Casino School today to reserve a date for your slot tech school.

Randy Fromm's Casino School 1944 Falmouth Dr. El Cajon, CA 92020-2827
tel.619.593.6131 fax.619.593.6132 e-mail CasinoSchool@randyfromm.com
For a complete brochure, visit the website at: slot-techs.com

Check Your Chips

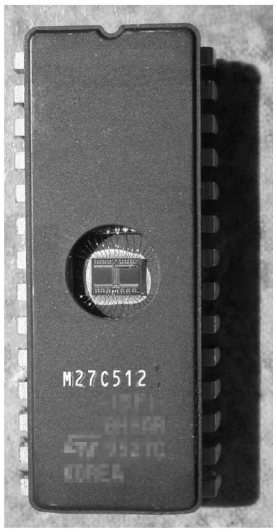
By Scott Reynolds



Hi gang. Randy thought it would be a good idea if I went into some detail about the Kobetron MT-2000 memory tester that I use almost every day. After some email snafus, I was finally able to get in touch with Greg Kobe, owner of Kobetron who has been very helpful in supplying me with information for this article. Thanks Greg. For part two of this month's article I want to go into a little bit about the job market out here in Las Vegas.

As I have mentioned previously, one of the items a slot file needs is an EPROM Worksheet. This sheet lists the game EPROMS, their numbers, lab numbers and sizes as well as the unique signature of the chip. The Kobetron MT-2000 uses its circuitry to determine this signature.

When looking at the unit, there doesn't seem to be much to it: an on/off switch, a zif (zero insertion force) socket, 10 buttons and a 10 character alpha-numeric display but this one piece of equipment can determine an electronic ID if there is one present on the chip, determine whether or not the chip is blank, perform signature calculations and do a bit by bit compare to verify that the exact same program is on each chip. It can do this for any 24, 28 or 32 pin chip you have. At Boulder Station, I use it primarily for determining the digital signature, which I will explain to you now.



When the unit is powered on, the words "KOBETRON" and "VER 1.2" are displayed while it goes through its self-test. This takes about a minute. The display changes to "UNIT OK" and it is ready to be put to work.

First, determine the size of the chip. In this case, I am using a 27C512 (see figure 2). Press the "MENU" button and use the arrows to choose "MANUAL ID" (the unit can

determine the chip's electronic ID if it is stored in memory but since we already know it, it is not necessary). Insert the chip in the zif socket and lock it down. Press "Select" then "Verify" and finally "Execute." The display will read CALCULAT. The Kobetron will now perform its calculations and depending on the size of the chip, 5-90 seconds later you will have your ID number (see figure 3). While gaming does not require it at this time, the Kobetron can also provide you with an 8-character or extended signature.

When burning several of the same type chips, I will sometimes use the bit-by-bit compare feature. Our chip burners have the ability to perform a checksum calculation on the chip. Theoretically, if the checksum is the same, the program should be the same. I found out earlier this week that this is not necessarily the case. An install team was onsite doing some game conversions and they were having trouble getting one of the machines (an S-Plus) to work properly. They took a like chip, put it into the machine that was having problems and it began working perfectly. Both chips were brought into the office and a checksum calculation done on them. They were identical. However, when a bit-by-bit compare was done, it showed a difference in the chips. In a bit-by-bit compare, one chip is loaded into the memory of the Kobetron and a second chip is compared "Bit by bit" to ensure the exact same information is on both devices. This unit has proved invaluable in my job and if your casino doesn't have one, they should. Kobetron's newest product, the GI-3100 is a "Handheld" version of the MT-2000.

Last month, I had the pleasure of meeting a gentleman by the name of Jim Ellis. You may remember his article about trying to break into the business in last month's Slot Tech Magazine. We talked at length about the employment situation here and I'd like to talk to you about it. I am originally from the eastern United States and back there, when you applied for a job, nine times out of ten you had some kind of an answer within a week or two of your application. Out here in Las Vegas however, it seems as though 1-2 months is the norm for a response from an interviewer. I've been told it has to do with the transient nature of this city. Businesses are more cautious of who they hire, afraid they will just pick up and leave without warning. It can be very discouraging to a newcomer. I will tell you that getting into the slot tech field is not an easy task. You've probably heard the expression "it's not what you know but who you know that counts" To me, it seems that this is still the easiest way to get in anywhere in Las Vegas. I'm not saying you will not get a job without connections. There are ways of breaking in. You can start out by sweeping floors or maybe as security and work your way up and into your desired position. Perhaps you can start at one of the small downtown casinos whose hiring policies are more liberal. There is nothing wrong with either of these routes, just don't come to town and expect to get hired into your chosen profession right away. It won't happen unless... say it with me "you know someone." Another thing to keep in mind is that unless you live here, most places will not even talk to you because they're afraid you haven't made the commitment to stay

I guess the most important thing is, don't get discouraged while looking for work in Las Vegas. It may take a while but ultimately, you will be successful.

-Scott Reynolds
sreynolds@slot-techs.com

JCM's "SENTRY"

A new concept in BV technology

By Peter Hand, JCM Engineer

There's only one thing everyone in a casino wants to know about a bill validator – is it enabled and working properly? As Bart Holden mentioned in a recent article, the bezel lights are not a reliable guide to the health of the BV and they can be a maintenance headache. JCM American Corporation has developed a new kind of bill entry – the Smart Bill Entry, or SENTRY - that not only gives you (and the player) a reliable indication when it's ready and able to accept money but also tells you what's wrong when it's down.

The idea is quite simple. The bill entry monitors the messages between the BV and the game, and uses them to drive indicator lights that show what's going on. The SENTRY's multicolored LEDs are bright and distinctive enough that you can see at a glance whether or not the validator is working, even from forty feet away.

THAT'S NICE, WHAT DOES IT DO?

When everything is enabled and working, the bill entry displays an eye-catching animated pattern of green entry lights that draws money into the throat. When the BV is busy accepting a bill, it displays a different light pattern; running rapidly from side to side to show that although it's working, you can't put a bill in it at that moment.

It also displays the denominations currently enabled, which can include barcode coupons, and indicates the last bill accepted by changing the color of the appropriate light from green to orange.

It's when the validator is *not* working that the SENTRY really earns its keep by telling you, the overworked tech, exactly what's wrong. There are basically three kinds of problems – those that can be fixed easily without disturbing the cash box, those that need cash box access, and those where the validator probably needs be taken out for repair. SENTRY has six indicators which, alone and in combination, tell you what the problem is and who needs to come out and service it before you even open the machine to look.

For a general problem indication, there's a bright blue flashing light. There are not too many bright blue, flashing lights on slot machines. This is very easy to see from a distance or out of the corner of your eye when you walk down an aisle. The graphic on this indicator is an ambulance and its message is self explanatory – *if there's a flashing blue light, something needs attention.*

SHOW ME WHERE IT HURTS

The blue light flashes alone with no other indicators when there's a communications problem between the machine and the bill validator. This isn't something that's likely to happen very often, as it usually means cable damage or disconnection but you may see this indication when a machine is first powered up and the validator is waiting for it to complete its power-up self test. As a bonus, you'll also see it if the machine (rather than the BV) crashes and locks up.

As a rule, the blue light is accompanied by a red light behind some other indicator. On the standard bezel, the graphics are (from left to right) a key, a crossed circle, an eye, and crossed hammer and wrench to the left, and to the right, a large "cash box full" indicator (graphics may vary). These graphics light up bright red to indicate particular situations.

I CAN FIX THAT

Crossed tools indicate a problem

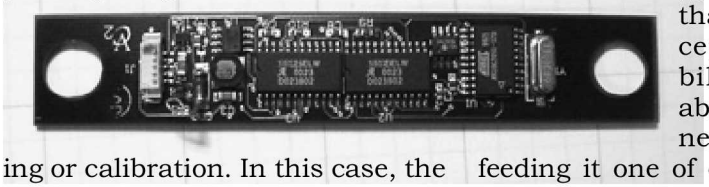
that can usually be fixed out on the floor without cash box access – things like a bill jammed in the transport. Once you take care of it, the BV recovers by itself. When the crossed circle lights, the validator has detected a fairly serious problem such as a ROM verification error or a jammed motor. You will probably have to take it out and fix it in the workshop, so when you see this light you can possibly save time by taking a replacement unit with you when you go to look at it.

The key will light up red if there's a problem with the cash box – either it's not present or not secured properly. What this means is you need someone with cash box access to service the problem. The explicit "cash box full" indication means you need a drop crew. Once the problem is cleared, the error indicators will go off and the validator will return to normal operation.

UH OH, CALL SECURITY

The eye indicator has two purposes but they both suggest that you may want to inspect this unit. If the eye lights up accompanied by the blue light, the validator thinks it's detected a cheat attempt; someone trying to pull back a bill from the stacker. This is an extremely unusual event. To the best of our knowledge, nobody has ever succeeded in "stringing" a WBA . Even if it were possible, it's unlikely anyone would try it under the surveillance cameras of a casino.

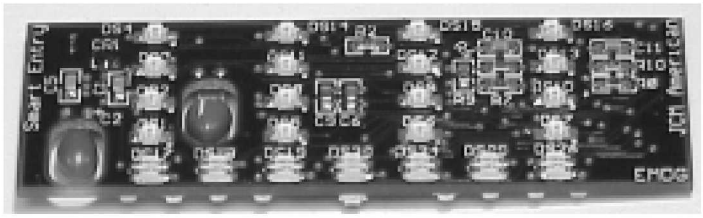
The second use of the eye is to warn that the validator has rejected several bills in a short time, possibly a sign that it needs cleaning or calibration. In this case, the blue light *will not* come on and the validator stays enabled with the entry pattern running normally but also showing a red eye. It can still take money in this condition. The indication is based on the short-term reject rate and it's smart enough not to count multiple attempts to insert the same torn bill. It clears on its own when the validator accepts a number of bills consecutively without any rejects but the trip sensitivity is temporarily increased to bring the indicator back on if acceptance continues to be less than perfect.



If for some reason the game disables the BV on purpose, SENTRY won't show any lights at all.

LET'S SEE SOME ID

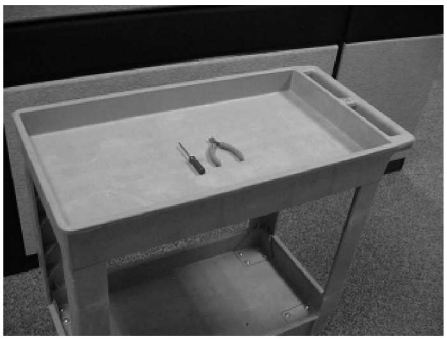
Currently, the SENTRY is available for most machines that use JCM's standard WBA bill entry, with a version for S-Plus machines (WBA or DBV) coming close behind. Other configurations for other games will follow – our aim is to be able to fit the whole floor. Obviously in order to understand the messages between the BV and the game, the SENTRY has to speak the same language, so there will be different versions for different IDs. At the moment there are three – ID023 and ID024 for IGT machines, and JCM's standard ID003 protocol. Any physical configuration can be supplied in any ID version.



Some ID interfaces support a message saying which bills are enabled. If the SENTRY sees one of these messages, it automatically updates its denomination lights to match. Other IDs don't have such a message. Even when the message exists, the game may not use it. To cover these cases, the SENTRY assumes (quite reasonably) that if the BV accepts a bill, that bill must be enabled. You teach a new unit simply by feeding it one of each denomination the machine is set to accept. The results are stored in EEPROM, so you only have to do this once. You can either do it right there on the machine or in the back room. Need to change it? There's an easy way to erase the memory and start over.

CLIPS RIGHT IN

Installing the unit as a retrofit is a very simple matter – here's a picture of my installation tool cart.



On a WBA, it's a matter of sliding out the transport, replacing the internal harness (2 screws, 2 plugs, 2 cable ties), clipping the intelligent bezel to the face and replacing the unit in the machine. On an S-Plus it's a little more involved as the unit mounts to the door instead of the validator but it's almost as quick – two screws, two connectors, half a dozen cable ties, press out one plastic molding and replace it with another. In either case it's about a five minute job. We'll include hands-on SENTRY training sessions in our free Friday tutorials.

2nd LAW OF THERMODYNAMICS

With solid-state lamps instead of incandescent, the SENTRY requires no maintenance and its life can be measured in decades. But entropy rules the universe and occasional failures will happen. *Before you ask: yes, it is possible for you to repair this unit.* Most of the components are commercially available from distributors. However, it takes extraordinary skill to rework a compact surface mount board like this, unless it's a simple problem like a burned out LED. The time spent usually costs more than a replacement board. JCM recommends replacing the board and using the old one to practice your SMD soldering skills.

JAY SEE EM-PATHY

Here at JCM, we really care about slot techs. We know who's opinion really counts when it comes to choosing optional equipment and we do our best to make your lives easier by supplying the most reliable equipment and giving you all the practical help we can. We think the SENTRY is one of the most useful ideas in casino equipment since the bill validator. When you've had a chance to see it in action, we think you'll agree that whatever benefits it may have for the player and the bottom line, you'll benefit the most.

Repair Log

By Kevin Noble

Problem: IGT, Takes bills in, waits and returns. Option 16 is not selectable.
Actions: swapped BV, P.S., options checked, motherboard replaced, along with the cash box and housing.
Solved: needed hard clear by shorting CMOS cap

Problem: IGT Board repair (video) no video
Solved: On a 039 CPU board, C1114 takes out the video, and Pixel #2 EPROM (most cause will be broken traces under this EPROM.

Problem: All WBA bills jamming between stacker and transport
Solved: center solenoid optic bad

WBA TRANSPORTS DATA

- The are 3 optics in the transport. (1) front optic, (2) solenoid, (3) back.
- Functions are, to tell where the bill is located in the transport.
- Back optic de-activates the #2 solenoid optic.
- The 2nd solenoid de-activates when the bill reaches the back optic. The 2nd optic will still be blocked because it's arms rest on the bill until the bill passes the arms. If the solenoid arms are still resting on the bill, the transport motor will stop. This leaves the bill stranded in the transport because the front and back optic are blocked and the center solenoid optic is not blocked.

Problem: IGT 24v 6 amp fuse blows
Solved; shorted orange/green wire going to the handle solenoid
Others: bad SP EPROM or bad crystal

Problem: WMS Secure memory faults
Solved: bad E square on motherboard

Problems:
No sound-C39, EPROM U51 (km-6264 bl)
RAM will not clear- short C34
CMOS will not clear- Short CMOS pins on tray, replace CMOS
No outputs:

1. U33, U13, U34, U26 if that fails
2. U8, U9,U23, U24 or
3. U12, U21, U22 or
4. motherboard or power supply

Problem: Hopper overflows
Solved: U34 opto

Problem: diverter not working
Solved: Q17
Problem: BV not working
Solved: K4, SSR, or shorted C7

NO LOCKOUT- Q18
NO HANDLE RELEASE-Q16
NI INSERT COIN LIGHT-Q5
NO COIN ACCEPT-Q4
NO BET MAX-Q1
NO BET 1-Q8
NO CASHOUT-Q2
NO CANDLE LIGHT-Q9
NO SPIN-Q7
DOOR OPEN FAULT-Q26
NO MIKOHN SIGNALS-Q19

Problem: Sigma no spin
Solved: MP4501 or 74ls74

Problem: IGT optics constant 21
Solved: Q4

Problem: IGT optics- accepts 1 coin then goes into a tilt
Solved: optic "A"

Problem: Bally optics rejecting coin, no insert coin light, BV light on
Solved: Q3 on CI optic board

Problem: Bally optics- BV stays on when door is open
Solved: Q3 on CI optic board

Problem: Bally optics- machine will not clear coin fault
Solved: U3 on CI optic board

Bally Reel

Problem: Game is locked up in JP mode, Mikohn reported $0.00 to the cage, no soft

meters could be accessed, and the game will not reset.
Solved: needed a partial clear

Problem: Jackpots not reporting to the cage, and manuals are needed.
Solved: replace U25

Problem: On a progressive you cannot change Option #2 to 4, when this option is changed the BV, IDX, and the insert coin light blinks 6 times and shuts off.
Solved: U25 needs replacing

Problem: Constant 88 code
Solved: needed a partial clear

Problem: When changing out a CPU board with a New one, U25 was found to backwards. After positioning the U25 back in normal position, the BV, and coin mech was disabled.
Solved: The CPU needed a RAM clear again.

Problem: On a stand-alone progressive, the game locked up with any combination. On a reel test the JP was awarded on any combination.
Solved: changed the progressive DUART

Bally Video

Problem: The machine was missing 1 complete game on the monitor screen, but the EPROM for that game was present.
Solved: The 1 game's EPROM needed replacing

Problem: Constantly borrowing bills
Solved: Changed DUART

Problem: Touch screen was not working, you had to manually use the bet button and go into the test mode for the touch screen. The games asks you to touch anywhere on the screen. Next go into calibration touch screen

Problem: Gamemaker-SAFERAM fail on power up
Symptoms: After RAM clear the problem went away for about a month and came back
Solved: Replaced CPU board (battery problem)

Problem: message "all SAFERAM failure" after replacing new CPU board
Solved: battery needs to be jumped to on position

Problem: Each individual game had the "insert # coins" missing, and re-showed some portion of the display in its place
Solved: replace CPU board

IGT reels

Problem: Diverter was engaging and disengaging after each coin, credit, or pseudo coin was played.
Solved: Smart optic pin placement was wrong, the top optic pin needs to be jumped to the bottom 2 pins.

Problem: 23 codes could not clear (coin sensor error)
Action: CPU boards were swapped in another game and the problem goes away
Solved: DUART needed replacing

Problem: 7 segment display keeps blowing fuses
Solved: Tower light shorting, coin diverter rectifier, and handle solenoid, shorting

Problem: 16 MHz boards keep freezing up (constant 61 codes)
Solved: Pull CPU and short CMOS cap

Problem: 8 amp fuse keeps blowing after a new fuse was insert a minute later, lost all display lights on the door
Solved: hopper smart optic board

Problem: constant 65-0 code
Actions: CPU and SS EPROM were replaced
Solved: bad motherboard

Problem: IDX light will not come on
Solved: CPU board bad

Problem: Game goes into a 3100 code, BV light flickers on and off, credit paid out increments
Solved: Smart optic board

Problem: On the "Wheel of Fortune" 45 code
Solved: (1) CPU board was bad (2) Do reel strip test to clear

Problem: On the "Wheel of Fortune" no sound
Solved: Power supply bad

Problem: On the "Wheel of Fortune" progressive display shows all "0"'s
Solved: bad CPU board

Problem: Constant 41 codes in meal book from opening
Actions: Replaced reel motor, basket, harness, power supply, CPU board, motherboard,
Solved: SS and SP EPROMS were bad (but passed AGCO

verification)

IGT Video

Problem: Hopper probe not being recognized by the game
Solved: bottom set of jumpers set wrong, they need to be jumped.

Problem: Monitors touch screen not working, "B" door says open, acts like the game is frozen
Solved: BV access door switch not fully closed

Problem: Coin-in tilt will not go away, and the IDX light will not come on
Solved: PCB I/O card on door not fully pushed in

Problem: "Touch screen Communication Failure"
Solved: Power game down, pull monitor, power game back up and wait for about 30 seconds. Power game back off, return monitor, turn game back on. This message should go away

Problem: IGT PLAYERS EDGE PLUS error message "CALL ATTENDANT" CMOS DATA message
Actions: not the fault of the CPU, motherboard, or CMOS, problems continues after a RAM clear
Solved: Press and hold self test switch until the ding appears (this could take up to 30 seconds) and close the door and turn the JP reset key

Problem: Excessive coin-in timeouts
Solved: behind the coin out optic a small spring loaded arm influences the smooth flow of the coins across the optic, tighten or lockite the screw

Problem: constant "Hard meter Disconnected" error
Solved: door panel I/O card needed to be reseated

Williams Video

Problem: Will not go into test mode or meters
Solved: needs RAM clear

Problem: "ROM Checksum Error" cannot to cleared
Solved: reseated the EPROMS on the CPU board

Problem: BV not cycling, no BV light
Solved: RS 232-communication board bad

Problem: Tower light not working
Solved: I/O board bad

Problem: IDX stays on constant, accepts with door open
Solved: I/O board bad

Problem: Monitor screen stays blank after power up
Solved: CPU board bad

Problem: No BV enable, not cycling, blinking BV lights, no bill denomination to reject or enable, no soft bill meters, started by a "memory fail" the previous day.
Action: changed RS 232 communication board,
Solved: needs RAM clear

Sigma reels

Problem: Constant message reading " display error"
Solved: replace 9-line distribution board

Problem: Coin-in, drop, and bill meters do not match
Solved: Calibrate the SIB board, power off game and SMIB, but power both up at the same time. The SMIB board must be powered on and off at the SMIB board.

Problem: Game constantly freezing up, needs RAM clear to get back to playing mode.
Solved: On test point #2 on the CPU board, adjust the voltage on the power supply to 5.21 volts.

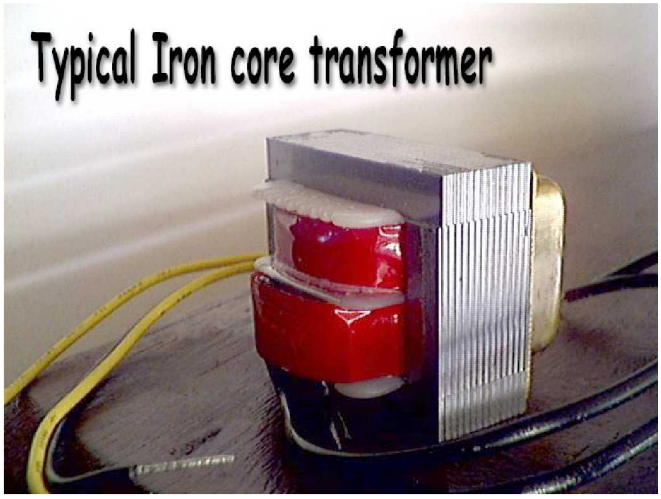
Problem: Constant "ATTENDANT 0" message flashes on the screen
Solved: replace system #2 EPROM (failed during AGCO verification)

NOTESIGMA REEL: When changing the dip #6 on the CPU board and powering up, this allows the machine to go through all the machines software functions and reconfigures its set up.

NOTE IGT REEL: When swapping 2 CPU boards out, and bill testing the second (known good) board will increment the bill meters. On the second board when replaced back into the original game the bill meters returned as if nothing was done to it. When the first board is returned to it's original game, those soft meters did not increment. The hard meter drop did increment to bills to drop.

- Kevin Noble
knoble@slot-techs.com

Transformers, Transformers, Transformers Everywhere



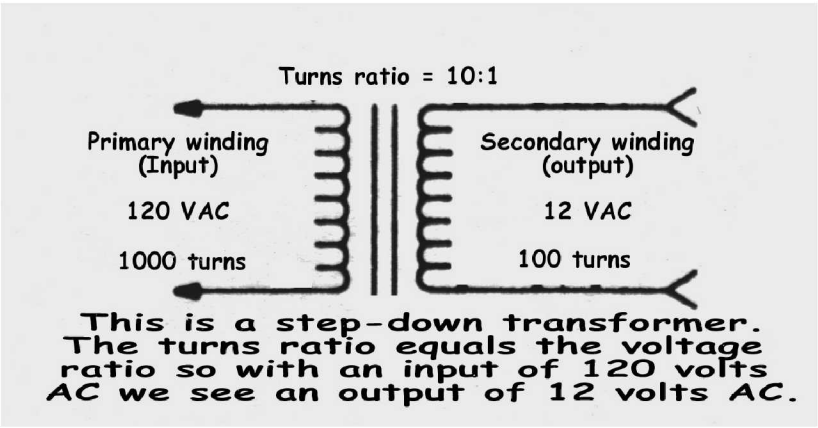
Transformers vary between applications. They vary in construction. They vary in materials. They vary in operating frequency and they vary in reliability. Some transformers are as reliable as the iron that is at their very core. Others self-destruct in a blaze of high-voltage glory.

In a nutshell, a transformer is a couple of coils of wire, typically wound around some type of ferromagnetic core material. One of the coils is the input to the transformer. The input coil is known as the primary winding of the transformer. The other coil is the output of the transformer. It's called the secondary winding.

Much of the time, a transformer is used to change an AC voltage. It is the most common use of a transformer. We're all familiar with those ubiquitous little black boxes plugged in to power receptacles all over your home and office? You know, the ones that power your radio, charge your cellular telephone batteries and energize dozens of other small electrical devices. There's a transformer in each and every one of them. They take the 120 volt AC from the wall receptacle and "transform" it to a lower voltage like six or twelve volts.

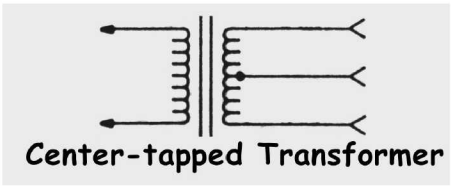
At the heart of a transformer is its core. The core material in these transformers is iron. It's not just a solid hunk of iron, however. The core is made from iron laminates, thin pieces of iron that are stacked together. The laminated iron core allows a much greater flux density than that of a solid core of the same dimensions.

Transformers change voltage by virtue of their "turns ratio." Let's say for the sake of discussion that the primary winding of the transformer is made from 1000 turns of wire and that the secondary wind has just 100 turns of wire. This turns ratio of 10:1 creates a voltage ratio of 10:1. That is to say, if the primary winding of the transformer is connected to 120 volts AC, the output of the transformer will be 12 volts AC. This type of transformer is called a "step-down" transformer for pretty obvious reasons, it steps the voltage down. As you can imagine, a transformer that has more turns of wire on the secondary than the primary will raise the output voltage. Naturally, this is called a "step-up" transformer.



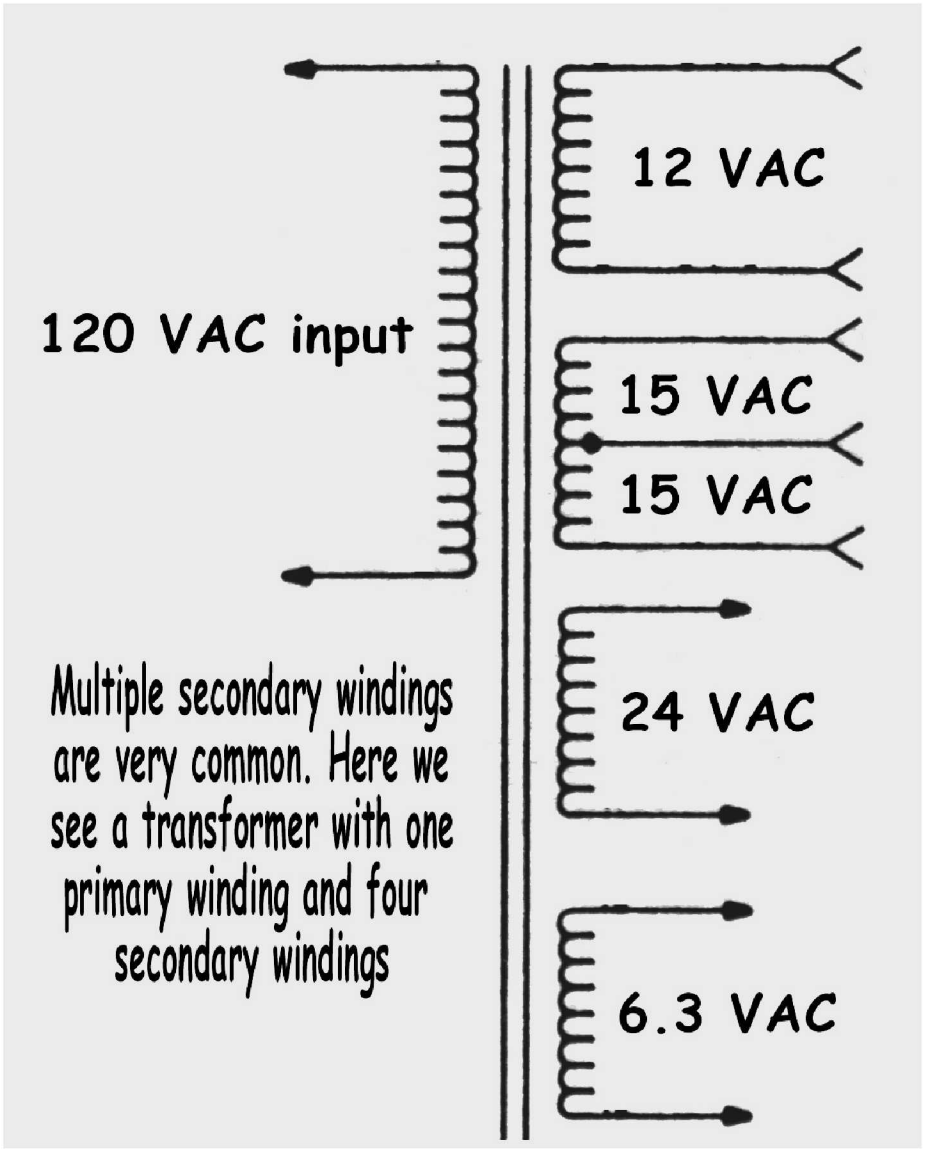
Transformer windings may be "tapped" to obtain different voltages. Since the number of turns of wire in the secondary winding determines the output voltage, tapping the secondary wind-

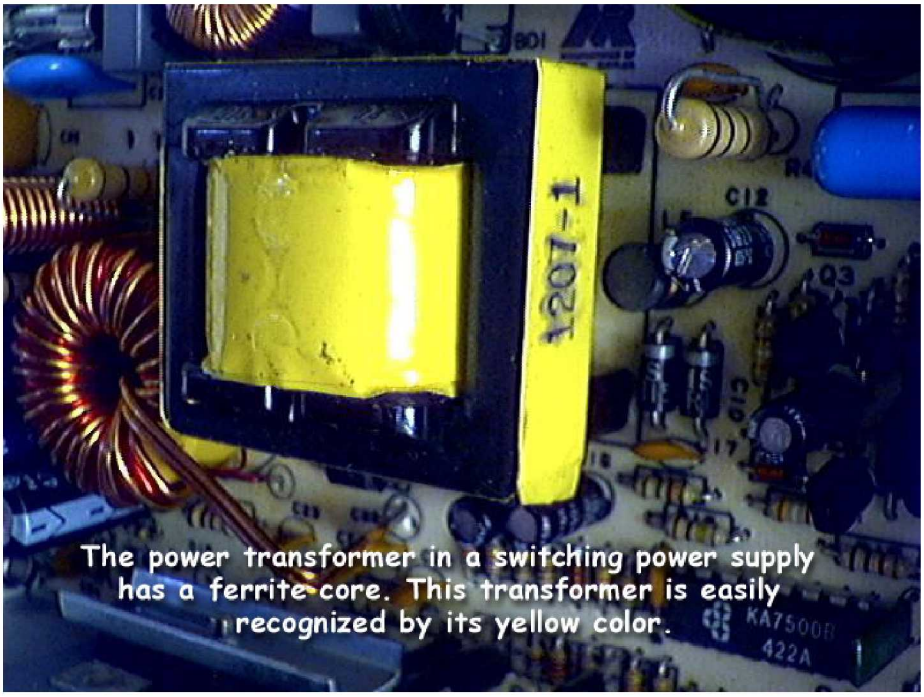
ing at various points allows a single transformer winding to provide many different output voltages. Often, the transformer's secondary winding is tapped exactly half way through the winding process. This is known as a "center tap." Center-


Center-tapped Transformer

tapped transformers are extremely common in power supplies. Almost without exception, this center tap will be grounded.

Another common configuration for transformers is multiple secondary windings. Since we often need many different voltages, this is a practical way to create them. It would be silly to have an individual primary winding, secondary winding and iron core for each voltage when we can have just one primary winding, one core and simply wind as many different secondary windings as we need for whatever it is that we're building.





Isolation Transformer

Another type of transformer has a one-to-one turns ratio. Sounds useless, huh? Here's the deal:

When a monitor with a switched-mode power supply (SMPS) is powered directly from the AC power line (also known as the "mains" in Europe and elsewhere) the primary side of the SMPS is hot with respect to ground. If you attempt to connect an oscilloscope ground to the primary

SMPS ground, you will vaporize the ground connection.

We get around this problem by using an isolation transformer. With its 1:1 turns ratio, an isolation transformer produces an output voltage that matches the input voltage. With a 120 volt AC input, we get 120 volts AC from the output of the transformer but lose the ground. In other words, there is no longer a neutral side that is connected to the Earth. The transformer has a 120 volt AC output that is isolated from any connection or reference to the Earth. With the neutral/earth ground connection broken, the oscilloscope can be safely grounded to the monitor's power supply. Isolation from a ground-referenced source of power also reduces the chance of shock.

Ferrite or Powdered Iron Core

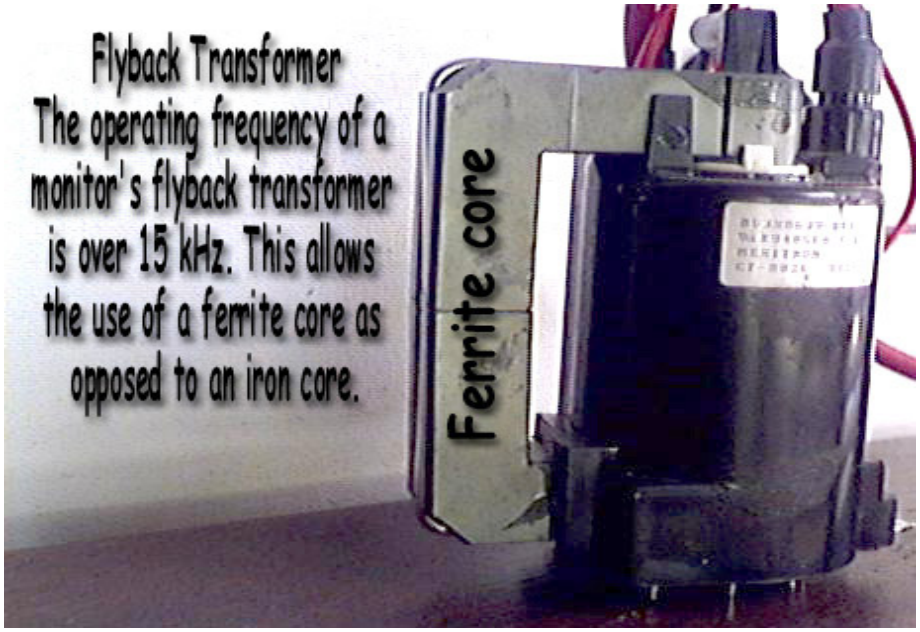
Iron cores are required when a transformer is operated at a low frequency such as our 60hz AC power. However, laminated iron-core transformers are bulky, heavy and expensive. Modern power supplies get around these limitations by raising the operating frequency of the transformer to 40 kHz or even as high as 100 kHz in some designs. At these frequencies, the core material will be made from a material called ferrite. Ferrite is a mixture of iron and ceramic. The familiar refrigerator magnet is one example of ferrite. Ferrite core transformers are much smaller, lighter and less expensive than their iron core cousins.

One way to identify a ferrite core transformer is that they are almost always yellow. I have no idea why this is so but it is rare to see a ferrite core transformer that is not covered in yellow Mylar tape. We find these transformers in all modern monitors with switched mode power supplies and in all low-voltage switching power supplies.

There are other ferrite core transformers to be found in a monitor as well. The little horizontal drive transformer has a ferrite core. Since the operating frequency of a monitor's horizontal deflection circuit is 15 kHz or higher, an iron core trans-

former won't work here.

Iron core or ferrite, all of the transformers mentioned above are very reliable. It is extremely unusual to see failures in transformers like these. Failures may be caused by an open primary or secondary winding, causing no output voltage. A bad transformer might also smoke like crazy before blowing a fuse or opening an internal thermal protection device.



Flyback Transformer

One very obvious ferrite core transformer is the monitor's flyback transformer. Like many transformers, the flyback has more than one winding. The primary winding is also "tapped" at one point to obtain approximately 175 volts. This high frequency, AC output is then rectified with a diode and filtered with an electrolytic capacitor to obtain a +175 VDC power supply. This supply is used to drive the video output transistors on the neck board, which in turn control the electron guns in the CRT.

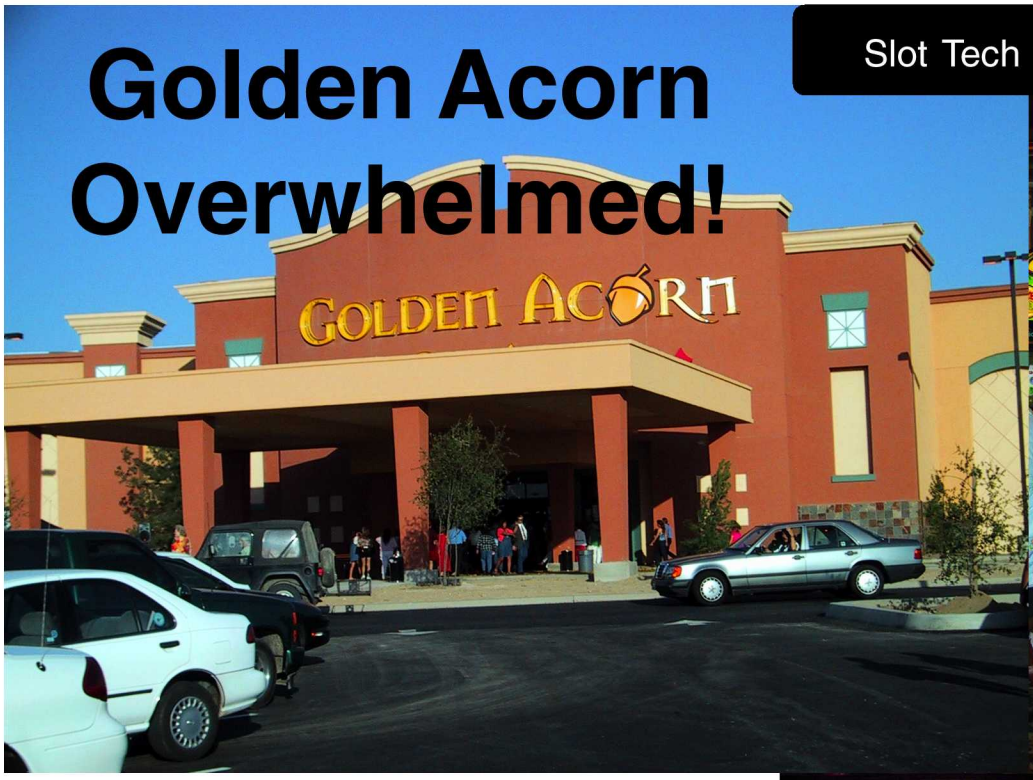
There are some really high voltage output windings on the flyback transformer. One is the "screen voltage." The screen voltage comes from a high voltage winding on the ferrite core. Another high voltage output is the "focus" voltage. The highest voltage output of all is the second anode. This can be as high as 25,000 volts or more.

There are some low voltage secondary windings on the flyback transformer as well. For example, the cathodes in the electron gun assembly in the CRT must be heated. The orange glow you can see in the neck of the picture tube is the CRT heaters at work. The heaters are powered by a low voltage winding on the flyback transformer. Just a few turns of wire are all it takes to get enough voltage.

There are one or two other low voltage windings on the flyback transformer that are rectified and filtered to create low voltage, DC power supplies. These power supplies are generally used by low-voltage transistor circuits such as the video amplifiers, the sync amplifiers and the blanking circuits. They are often used to drive the vertical deflection output circuitry as well.

A good example of this is the Wells Gardner K7000 series that uses the flyback transformer to create two, separate, low voltage power supplies. One is a +12 volt DC power supply that provides power to IC1 and most of the discrete transistor circuits. The other is a +24 volt DC power supply that powers IC3, the vertical output integrated circuit.

Golden Acorn Overwhelmed!



It was successful in every way you could imagine: A beautiful casino in a beautiful setting in the mountains east of San Diego. A fabulous grand opening party complete with confetti cannons, mimes and a mysterious bubble lady from outer space. An absolutely first-rate advertising campaign that brought people by the thousands from both sides of the USA/Mexico border. Everything was ready . . . except for the machines.

This woman was one of many I saw desperately trying to push a bill into an out-of-order machine.

This panorama tells the story of Golden Acorn Casino's grand opening. The place was packed with people from both the USA and Mexico, with banks of machines not ready for play.

Subscriptions

Randy Fromm's

Slot Tech Magazine is published monthly by:

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

Subscription rates:

Domestic (USA)
1 year - $60.00
2 years - $120.00

International
1 year - $120.00
2 years - $240.00

Company Name _____

Contact _____

Address _____

Address _____

City _____ **State/Prov.** _____

Country _____ **Zip/Postal Code** _____

Telephone _____ **Fax** _____

E-mail _____

Type of card: **[ ] American Express**
[ ] Discover
[ ] MasterCard
[ ] Visa

Account Number: _____

Expiration Date: _____

[ ] 1 year subscription, domestic
[ ] 1 year subscription, foreign
[ ] 2 year subscription, domestic
[ ] 2 year subscription, domestic