Inside Slot Tech Magazine

August, 2002

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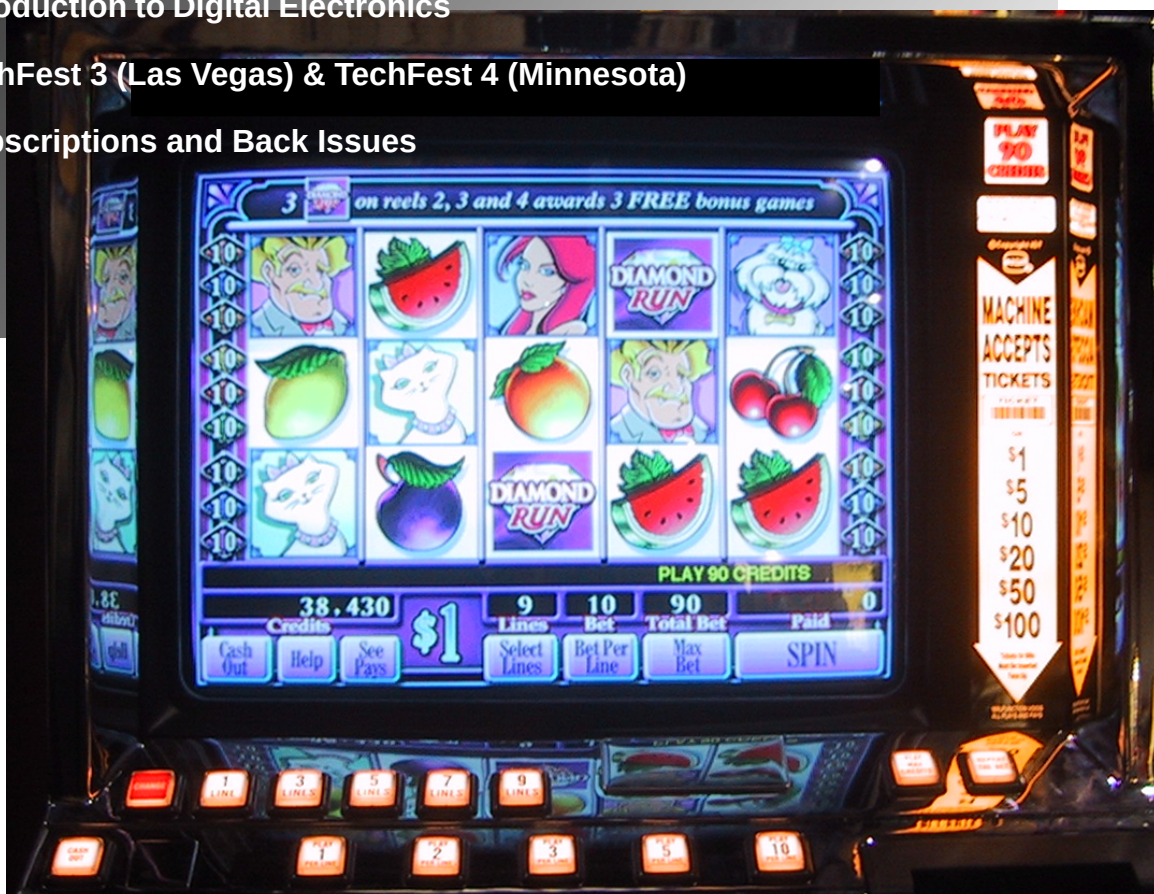

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Walking the Line

As a repair tech and technical writer, I am always walking a fine line. On one hand, I enjoy the topic of how things work and, more importantly, how to fix things when they break. On the other hand, I don't want to offend anybody by implying that his or her product is a piece of junk that breaks down all the time just because it has to be repaired from time to time.

Randy Fromm's
Slot Tech Magazine

Editor
Randy Fromm

Technical Writers
Dion Anderson
Bart Holden
Olson Jake
Ken Locke
Gordon Lowe
Ed Morgan
Kevin Noble
Herschel W. Peeler

Advertising Manager
Dennis Sable

Slot Tech Magazine is published monthly by
Slot Tech Magazine
1944 Falmouth Dr.
El Cajon, CA 92020-2827
tel.619.593.6131
fax.619.593.6132
e-mail
editor@slot-techs.com
Visit the website at
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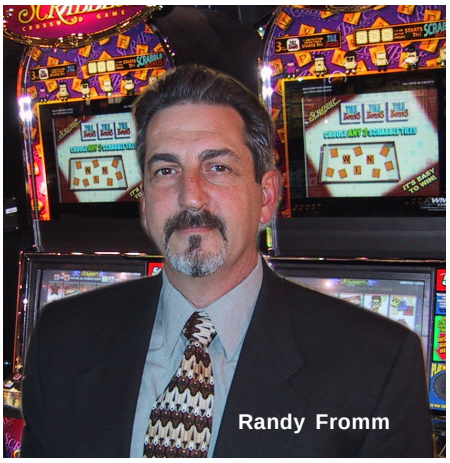
Recognizing the fact that "shit happens" the manufacturers have always been extremely cooperative with me when I have asked for help. In some cases, it's schematic diagrams. Wells-Gardner, for example, has supported me for the past twenty years, generously supplying my students with service manuals and schematic diagrams and even hosting my tech schools numerous times at their manufacturing plant in Chicago.

Monitor manufacturer Ceronix recently supplied the Slot Tech Magazine tech lab with two brand new monitors for evaluation and training purposes, absolutely free of charge. By the way, Ceronix has a brand new service manual that covers all of their newest models. It even has foldout schematics. It is available from Ceronix. It's also posted in PDF format at the Slot Tech FTP site. The server name is slot-tech-ftp.serveftp.com User Name = Slot Tech Password = kxkvi8

When I needed to demonstrate calibration techniques for Coin Comparators to a tribe that was new to gaming, Coin Mechanisms, Inc. sent me their entire testing package, including the mech stand and power supply, along with complete schematic packages for each student in the class. JCM sends their training team anywhere they're needed. The same holds true for Asahi Seiko, WMS, Aristocrat and just about all of the others



as well. This is starting to sound like an Academy Awards acceptance speech so if I've left anyone out, the band is playing and I gotta hustle.

Which brings me to this month's contribution from IDX. We've covered their coin validator previously. This month, they have shown their support of Slot Tech Magazine by taking a full-page ad as well as contributing a technical article on some things to look out for on their unit. I guess what I'm trying to say in this regard is that all of these manufacturers, including IDX, have put their collective asses on the line by publishing or allowing me to publish all kinds of stuff about how their products might fail and how to fix them when they do. I hope you will see this in the spirit it was intended and not as any sort of criticism of the product under discussion.

A big Slot Tech "thank you" to everyone with the cojones to do the right thing.

See you at the casino.

Randy Fromm

Randy Fromm

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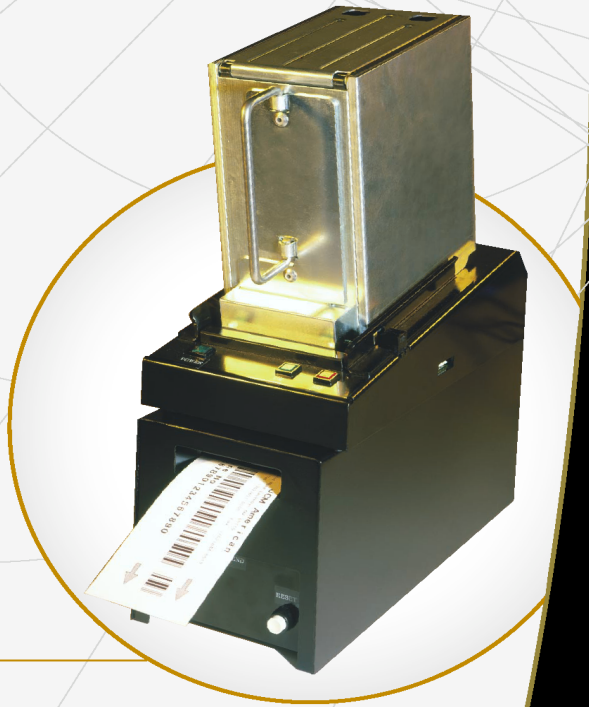

Intelligent Cashbox System

JCM's new cash-handling system uses a memory module, reader, and printer to efficiently eliminate errors in the conventional soft count process.

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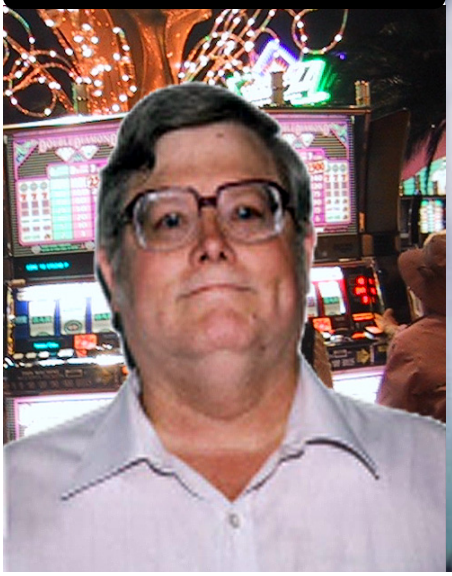
Slot Tech Feature Article



Condor CN130

By Herschel Peeler

Unlike the Coin Mechanism line of coin comparators (CC-xx and MC-xx devices), the Condor series is not a coin comparator. There is no reference coin required. Instead, the Condor is put into a "Learn" mode called "Teach and Run." Sample coins are inserted during a short learning process (described later). Once taught what a good coin looks like, the Condor compares all future coins against the pattern it learned.

Like some of the Coin Mech parts, it has built in optics for Coin-In optics operation. Other optics are used to sense coin size. Some of the optics are reflective, some are not. There are eight sets of optics inside the Condor.

The Condor comes in a variety of types, each with different characteristics, and four different cabling options. The one we will cover is the CN130. A breakdown of the part number gives the following characteristics:

CN (standard Condor line prefix)

CN1xx specifies that this acceptor will accept only one denomination of coin. (Other versions of the Condor can set to accept as many as 12 different coins at one time.)
CN13x specifies the type of connector(s) used. In this case, a single 7-pin AMP connector (p/n 640456-7).

CN130 specifies that the Inhibit input is used, and will be a High when operation is Inhibited. A Low in allows operation. If not pulled low, it floats high, to the Inhibit condition.

These options make basic operation similar to that of a CC-16, 13 V, Inhibit – type Coin Comparator, or CC-62, with some differences.

Pinout

1 - Ground
2 - VACS signal (explained later)
3 - Alarm output (explained later)
4 - Credit output
5 - (not used)
6 - Positive supply voltage (+12 to +32 V, 70 mA (typical) to 500 mA (peak).
7 - Inhibit input

"VACS" stands for "Valid Advanced Coin Signal". This output tells the game that a good coin is being accepted but is not the "Credit" output. Since the Condor line is capable of accepting multiple denominations of coins, this output tells the game a coin has been accepted, and the Credit output tells it what kind of coin it was. This is a 12 ms pulse, low, open collector output. This is comparable to the "A – optic" in other Coin-In optic schemes, like IGT.

The "Alarm" output tells the game an error condition was experienced. A Stuck Coin, Reversed Coin, or Condor malfunction causes this output give a 12 ms low pulse out. If the optics are blocked, the Alarm signal will remain active (low) until the blockage is removed. Some errors will cause the Alarm signal to repeat every 2 seconds.

The "Credit" output tells the game that a coin has been accepted. This is comparable to the "B – optic" in other Coin-In optic schemes, like IGT. In the case of the CN130, this is a 12 ms low pulse. For multi-denomination this is a string of 12 ms pulses, 20 ms apart. The number of pulses tells the game what coin was accepted.

Teach and Run

Since the Condor has no reference coin, it must be "Programmed" for the coin it will accept. This is a simple process. On the back of the acceptor there is a 16-position rotary switch, an LED, and a "Programming" button, just below the rotary switch.

1 - Set the rotary switch to "0". If all is well, the LED should be green.
2 - Set the rotary switch to "1", and press the "Programming" button. The LED should go red.
3 - Feed a coin of the proper denomination through about four times, or until the LED flashes green. Once the LED flashes green, that coin has been memorized. Press the "Programming" button again. The LED should go to solid green.
4 - Turn the rotary switch back to "0". The acceptor is now ready to be put into service. The Inhibit input must be pulled low before it will accept coins.

Once the acceptor has been programmed, the rotary switch has a different function. Starting from the "0" position, turning the rotary switch clockwise (toward the "7" position) increases sensitivity, increasing fraud rejection; turning the rotary switch counter-clockwise (toward the "9" position) will make it accept coins more readily.

"0" is nominal.
"8" is not used.

Diagnostics

At the equipment manufacturer's request, internal diagnostics of the Condor may be enabled or disabled. To tell which you have turn power off, insert a coin in the Accept path at the exit of the Condor, and turn power on while blocking the Accept path. If the LED goes green, diagnostics are disabled. If the LED blinks red, diagnostics are enabled.

Diagnostics are performed at Power Up. Blocking the Accept path during power up should cause Diagnostics to fail, if they are enabled, making the LED blink red. We deliberately cause a "Stuck Coin-In", and it fails on Power up.

Diagnostics performed at power up are:

1 - Coils
2 - Reflective optics sensors
3 - Diameter optics sensors
4 - Credit optics sensors

If all checks are okay this process should take about 60 ms. If diagnostics fail, the LED will flash red, no coins will be accepted, and a 12 ms pulse will come out of the Alarm output, repeating every 2 seconds.

The Condor is a micro-controller-based instrument, like the MC-xx series by Coin Mech. A Phase Locked Loop (CD4046) generates a signal (about 70 KHz) that is fed through the sense coil. Coins passing through the coil change its inductance, which makes the frequency shift. The frequency shift is noted by the micro-controller. Different coins, different metals, or different quantity of metal results in different shifts. The micro-controller looks for a predictable shift to evaluate a good coin. There is no "Null" adjustment to make, as with the CC-xx and MC-xx devices.

The pattern of a "good" coin is stored in an EEPROM (93C56). A Voltage regulator (LM317T) brings the +12V in down to +5 V for the digital circuits.

Other than the micro-controller, all of the parts look like they have standard part numbers. The micro-controller has both program and data memory contained within it, and is proprietary. The board looks repairable if you have can work in the surface mount world without a schematic.

Removing the board from the housing is much less friendly than it could be. The back side comes off easily, giving you access to the board. To remove the board from the housing you must unsolder a bunch of optic devices and the coil.

At a purchase price around $125, I would say, "If you can't see what the problem is right away, send it out or buy another one." When I enquired about a repair price, the answer amounted to, "I don't know. We've never had one fail." The only "failures" I have encountered have been spilled drinks (that cleaned up easily), and Condors that have been moved from nickel to quarter games without going through the "Teach and Run" process. They seem to be pretty reliable devices in my opinion.

Bench testing the Condor

I believe all the outputs are an open-collector design, capable of supplying up to 50 mA of current. Output voltage should not exceed +6 Volts. They should be able to drive TTL inputs using a pull-up resistor.

The Inhibit input is a Common – Emitter, base input, with no current limiting resistor. Some versions have a pull-up resistor. The CN130 has said resistor, but the value is not specified. For test purposes, drive this input with an open collector output, or just a switch to ground, and let it float high.

Since all the outputs are pulsed low with a short (12 ms to 20 ms pulse), I suggest that the output drive a single shot (Pulse Stretcher) to blink an LED at a visible rate. The Alarm output can be monitored for both a static and dynamic signals (see suggested schematic).

Power requirements are +12 Volts (actually, +12 to +32 is quoted in the manual). At 12 Volts, it should draw about 70 mA when idle, and peak

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at about 500 mA when the Accept coil energizes. The manual says to fuse the Condor at 3 Amps, using a fast blow fuse. I would be a little more conservative and keep current limited to 500 mA. Perhaps at higher operating voltages, current requirements are more.

The "Inhibit" input may be a simple toggle switch to ground. Pulling the Inhibit input low should allow normal operation. Letting it float high (confirming the internal pull-up resistor) should inhibit operation.

The "VACS" and "Credit" outputs are open-collector drivers, suitable for driving TTL or CMOS. Both of these outputs are active low, and only a 12 ms pulse. Since it's hard to see a 12 ms pulse, I suggest monitoring these outputs with a "Pulse-stretcher".

The "Alarm" output may be a constant (static) low out indicating an error, or a pulsing 12 ms low, repeating every 2 seconds (dynamic). We need to check for both possible conditions in the test fixture.

References:

Money Controls, Inc.
6672 Spencer Street
Suite 400
Las Vegas, NV 89119
(702) 739-8263 voice
(702) 739-1911 fax
sales@moneycontrolusa.com
www.moneycontrolusa.com

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2925 E. Patrick Lane
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Slot Tech Casino Opening

California's Smallest Casino Opens in San Diego

Okay, calling this 30 machine "Slot Arcade" a casino might be stretching it a bit but on May 21st, 2002, San Diego County's ninth casino opened inside a convenience store on the La Jolla Indian reservation. The casino occupies a 15-by-40-foot section of a mini-mart on rugged State Route 76 near Palomar Mountain.

The La Jolla's slot business will augment its nearby campground, water slide and go-cart track. Standing next to a reel slot (holding a copy of Slot Tech Magazine) is former go-cart mechanic, now slot tech, Erik Miner. Somehow, the terms "deer" and "headlights" seem to come to mind but hey, it's only 30 machines, right?

The 700-member La Jolla band constructed the slot arcade and stocked it with IGT machines by investing almost a half-million dollars of its own money, including its allocation of revenue-sharing funds from other gaming tribes .

Chet Barfield, indian gaming reporter for the San Diego Union, quotes Mitzi Magante, who runs the store and is chairwoman of the tribe's eight-member gaming oversight committee as saying "It's a huge step for us. It's something new. I think it's a smart move."

"I know we'll do well," she said. "Two years ago we surveyed 500 campers, and every one of them wanted slots. Everyone except two, I think."

The casino will be open 8 a.m. to 11 p.m. Mondays through Thursdays, and around the clock from 7 a.m. Fridays to 11 p.m. Sundays. Hot and cold sandwiches and other food will be available from the store's grill and deli during most hours except the early mornings.

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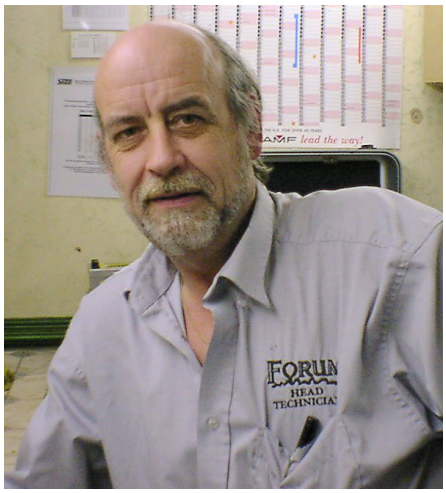
A Plumber's Guide to Fruit Machines - Part 5

By Gordon Lowe



Section 2.a. Payout assemblies

Coin Controlsr is the most prolific supplier of single denomination payout units (there's a mouthful for you)! All are easily serviced with all parts readily available. Be careful that you use the correct parts; bases, slides, caps are not compatible. The only parts that are interchangeable are the coil and return springs.

Description of the Single Denomination Payout Unit

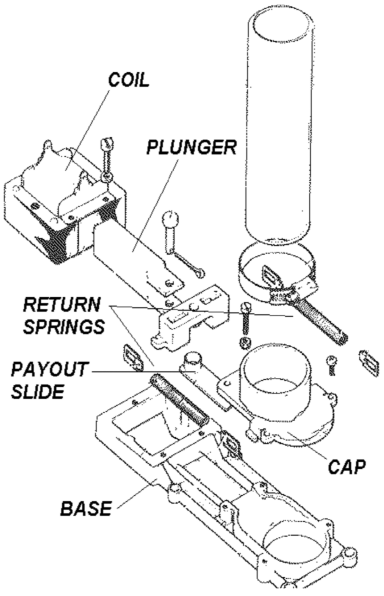
Most commonly, 50 volts AC is pulsed to the coil from the "TRIAC" control, dealt with at the end of this section. The coil then having a voltage across it, creates a magnetic field within it resulting in the plunger inserted within the coil being pulled sharply into it (more correctly these parts of the assembly are known as a solenoid).

Attached to the plunger is found the "payout slide" which in turn will allow a coin within the tube to be released to a point directly in front of the slide. Current to the solenoid then ceases and the return springs will pull the plunger back out which in turn will push the coin out of the assembly. This whole sequence takes place in a fraction of a second.

Note that a coin does not just drop out when the solenoid activates, but is a two part sequence with the coin firstly being dropped in front of the slide and secondly being pushed out. A coin can drop out of the assembly at the first part of the sequence when incorrect or worn parts are fitted, for example a wrong value payout cap fitted. This can and does result in incorrect payouts.
Let's deal with the "Standard" version first (see illustration) Found in large quantities on less recent machines, this has proven to be a very reliable piece of hardware. One of the first parts to fail will be the slide, which will wear down or even snap. Should you find it broken, suspect foul play first. It has been known for tampering to take place from the front of the machine. Replacement of the slide is straightforward but ensure that you use a replacement for the correct coinage as different coin denominations use different thickness slides. The same applies to the base where the depth of the area where the coin leaves the payout unit differs with coinage. The payout cap is colour coded for coinage and varies in internal diameter.

Colour coding as follows: Purple = œ1, Yellow = 50p, Brown = 20p, Red = 10p and 2p, Orange = Token.

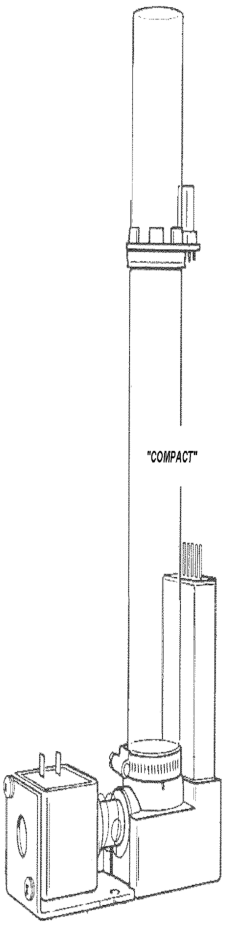
Coils on this unit are interchangeable and are now at a standard operating voltage of 50 volt AC (this is identified by a red spot on the coil). On very old machines, occasionally you may find the same



type payout assembly operating at 240 volt AC (marked with a blue spot). Put the wrong coil on one of these machines and the coil will burn out on the first payout, often taking out the TRIAC that controls it. Although now obsolete, all parts are readily available through all the suppliers listed.

Coin Controlsr have improved on this unit with the "Compact" payout. The improvement here lies in security as it is difficult to drop a coin out of the unit manually due to the design. Examine one and you will see what I mean.

There are other manufactur-



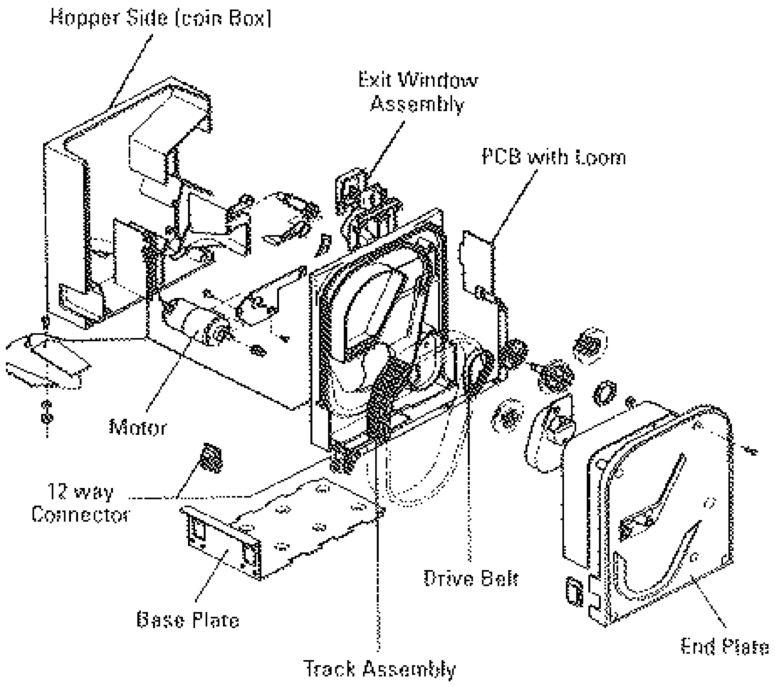
ers units used such as the "Pantherr" which again is a more secure unit and all previous comments apply.

Whilst on the subject of this type of payout unit, remember to check out the physical connection to the coil, usually 0.25" female spade connectors. This is one of the most common causes of payout failure.

Section 2.b. Hopper Payout Systems

Three different types in common use, Coin Controlsr "Universal Hopper" "Coin Controlsr Compact" and "Azkoyenr"

The Universal hopper would be one of the least found in AWPs and is far more common in Change givers, although manufacturers like Electrocoinr have turned out machines like the "Super Bar X" with these hoppers fitted. The reliability of this particular hopper has proved itself over a number of years. Its only drawback may be its physical size for use in what is quite often limited space in some of the latest machines. This is where the "Compact" hopper comes into its own. Requiring very little space, it is of very basic design with only a motor to drive a coin dispensing disc and an optical sensor to count the coins leaving the unit. Because of this, all control circuitry has to be built into the host machine. For all its simplicity, it will be found reliable.



Section 2c Coin Controls "Universal" hopper

Parts for the Universal are readily available, if seldom needed. The one problem that you may come across is that the unit requires cleaning internally.

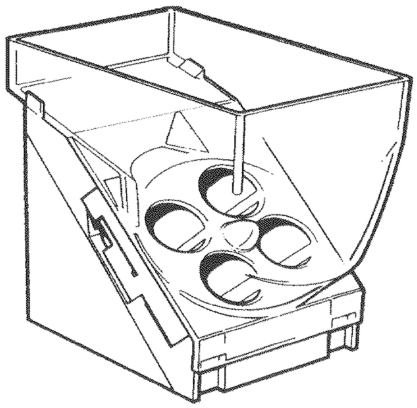
Remove the 7 screws on the side opposite the motor. Remove the plastic coin belt, taking note which way it fits. The cog that drives this is unattached and can also be removed. Check the belt for damage, particularly the pegs, which run in the slot. Any found broken need replacing. Individual sections are available. Wash them in warm soapy water and replace, putting the cog back in position last.

While you have the unit stripped down, clean all visible areas with a dusting brush, taking particular note of the opto unit at the coin exit (this unit can be removed for better access). Re-assembly is just a reversal. One tip that will make it easier: Leave off the translucent blue cover when screwing the side back on. This can be fitted as the last stage. A cutout can be seen that will allow this to be slid in.

Section 2d Coin Controls "Compact" hopper

The Compact hopper operates at 24 volts DC. As voltage is applied to the motor, the coin disc rotates and dispenses the coins (go on, tell me I am stating the obvious). Fitted to the coin exit of the unit is an opto sensor used to count the coins leaving the exit. The host machine deals with all control.

Built into the unit is a jam detection circuit. This is governed by excessive current



being drawn by the motor (a result of a motor jam). It then reverses the motor briefly which will hopefully clear a physical jam and payout will continue.

Parts are available (see illustration for description details) but note that should you require a replacement "Disc bed assembly" then you have to state the coinage required. All other parts are standard.

It is probably worth stating here the correct method of clearing a coin jam (as recommended by Coin Controls) 1. - Remove power from hopper 2. - Remove all coins from the bowl 3. - Remove bowl 4. - Remove disc bed assembly (see note on dismantling) 5. - Clear jammed coin by: a. - Rotate disc manually clockwise then anti-clockwise or b. - Grip jammed coin with pliers and remove or c. - Push coin in with another coin

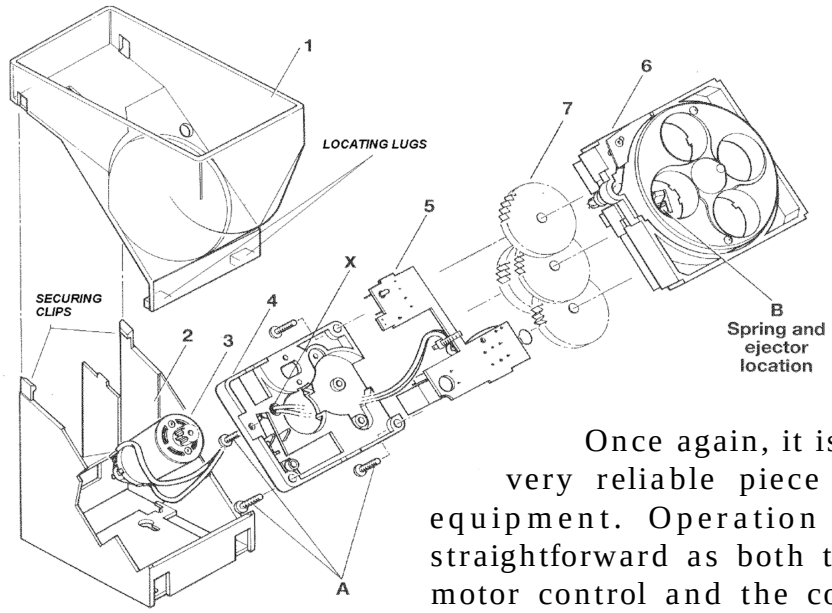
A common cause for jams is damaged coins. Beware not to return these coins back into the bowl otherwise you will have to do it all again later. Sounds obvious but it's easily done. Whilst you have the unit apart, check for any damage. In particular, the eject fingers are a common failure. Replace as necessary. Clean the opto sensor with a small brush or cotton bud. Re-assemble and test.

Note on dismantling:

i. - Gently pull outwards the securing clips on the back of the base ii. - Tilt the bowl forward until it is clear of the clips iii. - Slide the bowl forward until the locating lugs are clear of the slots in the base. iv. - Disconnect the cable (if fitted) from the motor assembly.

Re-assembly is simply a reversal of this sequence.

Section 2e Azkoyen hopper



Comparatively new to the scene as regards AWPs is the Azkoyenr hopper. Gaining rapidly in popularity with manufacturers, this will probably be the most common you will come across.

Should you find it necessary to replace the unit, ensure that the correct voltage motor is fitted. Two types are available: 12 volt and 24 volt. Either will work but the incorrect type fitted can result in spurious payout, in other words monies can be dispensed when they should not be.

The correct name for the particular Azkoyen hopper you are likely to come across is the "Mini NR Hopper." Two different types are manufactured: the "White Disc" which uses an opto sensor to count the coins, and the "Black Disc" which uses a microswitch, the latter being the unit commonly used in our industry.

Once again, it is a very reliable piece of equipment. Operation is straightforward as both the motor control and the coin count output are controlled by the host machine.

Solely found on this manufacturer's hopper is an optional "high level" switch incorporating a microswitch as the detector. This operates on the weight principle and is fully adjustable. Where this is fitted (and not all the machines found with these hoppers are) the adjustment of the tension on this microswitch can effect the point when the host machine "thinks" the hopper is full and re-routes coins to the cash box. This can easily result in hopper coin starvation.

This unit is classed as "non coin specific" meaning that it will handle most coin types without any alterations. The advantage of this is that if you have faulty or suspect hopper, it can be changed in seconds without worrying about changing parts, but remember to check the motor voltage.

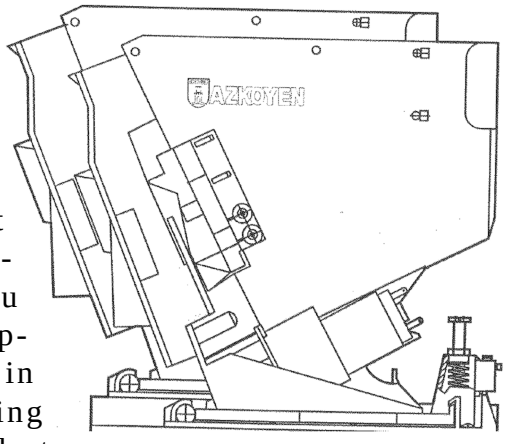
Motor Voltage: Not identified on the motor, look to see if the back of the motor is flush in the housing. If it is, then this is 24 volts. The 12 volt motor will protrude from the housing approximately one-eighth of an inch.

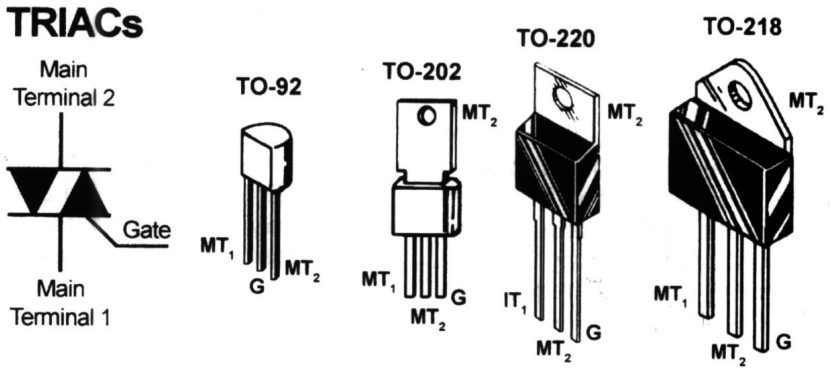
Summary of Hopper Payout Systems

AWP manufacturers have swung strongly towards the hopper payout. Reliability is good, problems are few and coin jams are unusual. The only advice I would add is to take care when clearing a jam. More damage can be caused by an engineer attempting to force a coin free than any damaged or stuck coin can do on its own.

Section 2f TRIAC control of payout

The description of a TRIAC is a "Solid State Switch." In other words, a switch that is controlled by electronic means. Compare it to a light switch except that instead of manually





pressing the switch, on and off takes place by an electrical pulse (usually around 2 volts) to the control input of the TRIAC, known as the gate. See the May, 2001 issue of Slot Tech Magazine for more details on the TRIAC and how it works.

A summary of what happens is this: The main MPU (microprocessor unit) within the machine is in a situation where it decides there is a payout to be made, lets say 2 x œ1 coins and 2 x 20p coins. Two pulses will be sent to each of the TRIACs controlling the œ1 and 20p payout units. These TRIACs will then switch the 50 volt AC voltage on and off to the payout coils.

The TRIACs may be mounted on the main MPU or mounted on a separate PCB (printed circuit board).

TRIACs do fail and replacement is straightforward. This will be dealt with under the section of the MPU but do not forget to check the 50 volt AC fuse before looking for component failure, as the fuse will usually blow first. While we are on the subject of fuses, let me just state here that a visual check is inadequate. Time and time again I have looked at a fuse which appears OK, then when you meter it, it's found to be blown. Always use a fuse checker or meter. You may save yourself a lot of hassle later!

- Gordon Lowe
glowe@slot-techs.com

These Two Guys Go Into a Casino…

By Ken Locke

The following is what's known in writer's parlance as a Think Piece. That's a really nice way of saying there is not much in the way of technical data being put forth. But, bear with me.

Shortly after the release of May's issue, I received an email from a gentleman named Joe inquiring about a future career as a slot technician. He was in his forties and claimed to be an able electronics technician. He went on to cite a bit of schooling, work experience and some formal training to back it up. There seemed to be genuine enthusiasm piping through his letter and I could tell he was on the level. You really have to respect someone who has the guts to start his career all over again.

I obliged him with what I knew about typical wage earning potentials, gaming locales and what kind of background casinos want. I also told him they are always looking for monitor guys out there. Be a monitor guy.

He thanked me for the information, surprised at my quick response. We, of course, left the door open for future exchanges. I am reasonably sure I will hear from Joe again someday.

This really got me to thinking about the future of slot tech-"nishing" altogether. What is in our crystal ball?

Jump cut to last week at yet another EZ Pay install somewhere in the vast gaming universe. It's 11:37 p.m.

Normally, once I am done training and we flip the switch on a new ticket system, there's really nothing left for me to do but wait for stuff to go wrong, which it rarely does. I am resigned to coaching cashiers on their duties and occasionally educating a patron to cashless gaming, as it's come to be known.

While I was malingering near the cashier's cage, a customer approached with ticket in-hand and presented it for redemption. "Sir, did you know that you can put that ticket right back into another machine if you like." I said, selling the soap a little. He said he was aware of that and, as it turns out, he was also doing a bit of spying.

He claimed to be a muckity-muck in at least two Nevada 'locals' properties and was doing a bit of lurking since the casino we were in was his direct competition. "And?"

He sternly proclaimed he would "never, never install EZ Pay or any other ticket system" in his house. Of course I had to know why. He said in his casino the customer was number one. When patrons are in his joint, they get personalized treatment from the moment they have the door held for them. I, like you right now, was curious to know what this had to do with tickets.

"These things make floor people lazy," He said waving the ticket in the air. "Patrons don't tip with these, and when they don't tip, my floor attendants have no incentive to serve the customer. You're extracting the people aspect of the casino experience with EZ Pay."

And there it was. There can be no doubt that cashless gaming is here or coming to a casino near you, but is there a chance that you are going to feel stuck with it a year after you put it in? Did this guy have a point?

My instinct was to immediately defend my product's honor by extolling the virtues of reduced coin handling (remember the If-It-Moves-It-Breaks Rule), less down time and overhead costs. But I deferred to his point of view, mostly out of being polite and partially because despite what you may have heard, I don't know every-freakin'-thing and it might be worth hearing a different point of view.

"I want players in my casino to receive high-fives when they hit. I want one-on-one attention." He went on like this for at least thirty minutes. Honestly my impres-

sion was that he seemed a bit jaded by all his years in gaming. Along the way I also learned he did not seem to have any love lost for my company either. Not an uncommon feeling but I dig working for IGT, so sue me.

When he was done, my heart went out this guy. I was convinced that in a year's time, there would be dozens of casinos ready to kick tickets to the curb because of the rampant depersonalization and subsequent profit loss it had caused. I had the entire night to consider his diatribe and in the end all I can say is, "What a load of crap."

Ticket systems do exactly what they were intended to do—create tickets, eliminate coins and appeal to customers as a cleaner more efficient means of payout. What does EZ Pay, or any software application for that matter, have to do with how floor attendants care for our customers? Sure, customer service is not purely altruistic, but is the bellman always expecting a tip every time he holds a door open? Should you toss two bits to the hotel desk clerk when she is professional, cordial and smiling a genuine smile? Is security expecting a little something when escorting an old lady to her car? What's motivating these nice folks?

Tickets are not a panacea nor are they the plague. It's just another New Thing. It works and works well. So while I will probably make an enemy for life with my defense of tickets, I stand by it. Think I am just toeing the company line? Tough.

My point, (and I do have one) is to illuminate the two very different mindsets of these individuals. As technicians we sincerely wait for the next "cool shit" with baited breath. And most of us can identify with Joe. But occasionally its good to hear the flip side of things.

Working were I do, I forget that you don't get to see the latest gaming technology coming down the pike. All the yet-to-be-released stuff that you can't wait to tear apart is just down the hall from me. And, perhaps these two gentlemen have brought a bit of perspective (at least to me) on how the casino world really thinks.

Now, don't think for one minute that I am going to spill my corporate guts, forsaking the 'real job' that puts groceries on my table. But I will tell you this: Hang on to your tool belts boys. Oh.. And be a monitor guy.

- Ken Locke
ken.locke@igt.com

IDX INC

IDX INCORPORATED
06/27/02 Revision
WWW.IDXINC.COM

THE FOLLOWING ARE IDX PROBLEMS AND SOLUTIONS THAT HAVE BEEN DOCUMENTED BY OUR FIELD PERSONNEL. CALL THE FACTORY (800-643-1109) FOR COMPLETE TECHNICAL MANUAL AND FEELER GAUGES.

The diameter spacers falling out of the unit.

Spacers for the Xeptor's® are factory recommended to be glued into the unit using Scotch Grip #4475. Not with superglue, as some customers have tried to do. The boxes and spacer for the units are both made of a polycarbonate material and when superglue is applied on the spacers it melts the spacers to the box of the unit. In order to remove the spacer now you have to tear them out. This tears up the spacers and the box, damaging both to the point that they cannot be used again. If the correct glue (Scotch Grip #4475) is used, all that is required in order to take existing spacers out and securely replace with a new set is to first push the blade of an Exacto knife in between the spacer and the box working from one end of the spacer to the other. The spacer will pop away from the box leaving the spacer and box with the ability to be used again. To install new spacers into the unit, you need to take the Exacto knife and clean all the old glue off the box of the unit. Then a **SMALL** bead of Scotch Grip is applied down the rib of the box where the spacers are to be installed. If too much glue is applied the coin or token to be used in this Xeptor® will not have enough room to fall through the unit. After applying the glue, place the spacers in the box and allow time for the glue to dry. The unit now has spacer's securely in place and at the same time can still be removed and replaced with a different size (color coded) per denomination.

Problems with the white ribbon cable pulling out of the housing of the Xeptor®.

The IDX factory received calls from a few casino properties that were experiencing this problem. But after speaking with them, it was discovered that when the technician or floor personnel was opening the front box of the Xeptor® they were opening it too far, pulling the cable out of the housing. After the factory discovered what was happening they immediately came up with the solution to lengthen the white ribbon cable, also to glue (RTV) the cable to the housing of the Xeptor®. Thus promptly eliminating this problem for the customer.

IDX Xeptor's® will not stay programmed and this makes them high maintenance on the floor.

The IDX Xeptor® reads the coin or token closer than any other acceptor on the market. In order for the Xeptor® to program this reading, the Xeptor® must first be aligned correctly in the Xeptor® mounting brackets. If the Xeptor® is not aligned correctly then when they are programmed the coins that are dropped through for programming are dropping at a different location within the throat due to the misalignment or spacing of the thickness or diameter settings. Also check for the thickness or diameter setting being changed after programming coins. Another reason for it to look as if the Xeptor® will not stay programmed, is if the thickness spacer is set too wide when programming the unit there will be a variation in the distance between the coins and the metal sensor reading between when the coins are dropped during programming and when coins are dropped by customer causing the coin or token to be rejected. This is due to the metal reading not being within the window of acceptance. Both of these situations initially look as if the unit has lost its programming. When the units are being programmed taking a few moments to check and see if the unit's thickness and diameter is set properly for the correct coin size is very important.

Problem with R10 burning up on the Xeptor®.

Typically when this occurs it is discovered that the personality plug was incorrectly pinned into the 8pin connector on the Xeptor® causing an electrical short that burns up R10 on the Xeptor®.

Xeptor® Solenoids causing troubles and stealing coins.

This is an incorrect statement. The Solenoid is designed to open the rake in the Xeptor® if the coin is good, allowing a coin or token that is programmed in the Xeptor® to fall straight through to turn on the credit optics of the slot machine or to give a credit. These credit optics are located under the Xeptor® on the slot machine and is the slot machines responsibility to give the customer credit after the Xeptor® has sent the signal to turn on the optics as the coin or token being dropped through is valid and matched the peripherals programmed in the unit. So, it is impossible for the Xeptor® to steal any coins or tokens; but it is possible for the credit optics not to be on when the coin passes through them or the signal wire broken that turns on the credit optics for the normal time of 32 milliseconds.

Our reputation and growth is due to our capability to read and validate marked coded tokens, both Smartmark® and X-Mark®

But if it is a non-coded token, our X-20 has been designed with the capability to:

* **Distinguish between a US 25 cent coin and all Boston slugs**
* **Distinguish between the three different metals used for the Canadian 25 cent coin**
* **Distinguish between the five different metals used for the Canadian 5 cent coin and eliminates 5 cent Canadian coins from being played in slot machines located in the U.S.**
* **Check the metal of the coin six different ways for a higher level of security**

IDX Inc.
400 West Cedar
El Dorado, Arkansas 71730
1-800-643-1109
sales@idxinc.com
www.idxinc.com

Please contact us for further information

Setting the credit pulse & tilt time correctly.

There are several listed credit pulse & tilt times and which one that is to be used will depend on the slot manufacturer and Gaming regulations. If training and a good transfer of information on the IDX products from IDX, Inc. or slot manufacturer is given to the customer they then know the correct pulse tilt time. But if this information is set incorrectly it will cause the Xeptor® to reject coins/tokens.

Same Country; Same Coin; Different metal.

The situation mentioned here happened in Canada, because they use two (2) different quarters that have two (2) different metal compositions. The size of these quarters is the same, but the metals are different. IDX Xeptor's® read the metal composition multiple times with multiple sensors and have 6 switch settings to store up to six different coins/tokens. Program quarter 1 in switch position #1 and quarter 2 in switch position #2 and we will validate each coin type and accept both Canadian quarters. For this reason the IDX Xeptor® is leading the way in new technology.

The following IDX problems and solutions that have been documented by our field personnel:

1. Coin jams on $0.05 nickel Xeptor's®. We have seen the thickness setting on Xeptor's® in $0.05 machine set at .087 for a $0.25 quarter and not set at the correct setting of .097 for a $0.05 nickel. I was informed that sometimes conversions are made from a $0.25 to a $0.05 machine and this thickness setting must be moved to the correct position for a $0.05 nickel. It is the same as when you change a $0.25 hopper to a $0.05 hopper in relation to conversions.
2. It has been discovered that some slot shops have no feeler gauges for setting the correct throat size in case a floor person gets carried away and decides to open the Xeptor® too far and bends the pivot arm. The technician sets the thickness at the correct position for the coin but the throat is too wide due to a bent pivot arm and the readings due to a large throat don't match what the memory was when it was programmed or is too large to be programmed. The feeler gauge for an X10 is .087 and the feeler gauge for and X50 is .110. We ship the feeler gauge at no charge with order of Xeptor's®.
3. Old units shipped in 1999 or before had problems of programming the Xeptor's® with the front door removed and then replacing the door after programming. The door pushes the capacitor down and moves the printed circuit board and sensors attached to the board in relationship to the coin. Making it look as if the Xeptor® had lost its memory, as the distance between the metal sensors and the coin is different with the door removed, than with the door in place. The numbers will not match and the Xeptor® will reject the coin because of this fact. To eliminate this problem, please see attached picture for installing screw into the bottom left of the old unit. (See figure #1)
4. The thickness and diameter settings must be set correctly as determined by the thickness and diameter of the coin to be used. The Xeptor's® tolerance is as follows:
   a. Thickness setting for the Xeptor® is .020 more than the coin that is to be used.
   b. Diameter setting for the Xeptor® is .075 more that the coin that is to be used.
5. The tilt time setting in all old units is at three (3) seconds and is a re-triggerable one shot. If any coin goes through the Xeptor® during this three (3) second tilt time then the tilt time will reset for another three (3) seconds and will continue to reset for an additional three (3) seconds as long as coins are being played. By using the **"P"** command and set the tilt time to **"00"** which turns this option off or change to a **"03"** which equals one (1) second tilt time. For example, **"P20000000"** followed by **"S"** command to save. Does not turn off on WMS games if question comes to mind call IDX, Inc. for correct setting?
6. Some of the IGT old S+ and PE+ brackets need two mounting holes drilled out and a washer placed on the screw head so the bracket can be moved towards the edge of the door where the door key is located. This will align the coin head with the Xeptor® and fix the mechanical misalignment problem. In no way do we need to move the thickness setting gauge or the diameter spacers in the Xeptor® which would open up the throat of the Xeptor® to correct this mechanical alignment problem. All slot manufactures have corrected their mounting bracket so that this mechanical problem no longer exists on new machines.
7. We have seen some of the $0.25 diameter spacers cut at an angle, which would cause the coin to block the drop sensor, and the coin would be rejected due to the diameter. The guides can be trimmed to the top of the unit but cannot be trimmed below the top of the unit and into the throat. See picture attached. (See figure #2)
8. The wiring harness for the power cable inside some of the old slot machines have a cable wrap around which causes the wires to hold open the spring loaded Xeptor® door, which changes the thickness setting. Please remove 2 to 3 inches of the cable wrap and this problem will disappear.
9. The model X50 or X70 consist of two (2) separate components and have the same serial number with an A-side and a B-side, which are calibrated when they leave the factory. If you change one part and replace it

with another, then you must recalibrate the A-side and the B-side and then reprogram all coins stored within the Xeptor® or they won't match memory and it will reject coins.

Our experience is that IDX is:

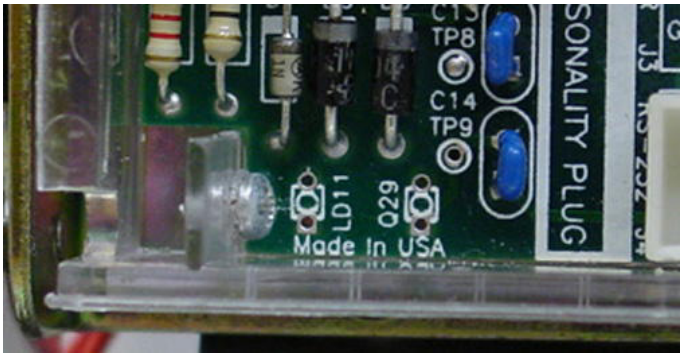
1. Not similar nor do we function like Coin Mechanism acceptors! The experienced technicians understand a CC-16, but to use the IDX product he/she must be receptive and trained to understanding new technology and how it functions.
2. Our experience is that some casinos have a good transfer of information and technology to all technical personnel, so the information has to be transferred to one or two people, which is then transferred to other personnel. Some properties have IDX train all three shifts, (offered from IDX free of charge), with travel paid by the customer, but these properties have made a commitment to spend the time needed to understand how IDX Xeptor's® work.
3. The directors should make the commitment to make **SURE** that all of their personnel have the ability to learn, transfer information, and be dedicated to seeing that the transition is carried out. Also that every tech understands this new technology and is not afraid to apply it.

Questions about service issues, warranty work and part access/availability.

a. **Service problems and issues.** IDX has Outside Sales Technicians that have been educated and factory certified on the complete line of IDX products. Each one of them is fully capable of handling any service issues that a customer may have. Each of these technicians spend a great deal of time traveling to the casino properties checking to see if they have any service issues that need to be dealt with. But should an issue or problem arise with the IDX product the factory is only a toll free number away from talking to the people who work day to day with the IDX products.

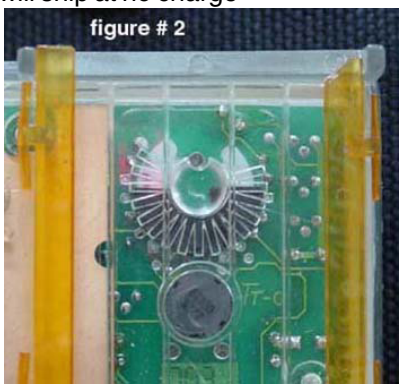
b. **Warranty work.** As per the IDX terms and conditions it states that all IDX products, except for certain accessories and components, are warranted against defective materials and workmanship for one (1) year from the date of manufacturing. **There are no other Warranties expressed or implied.** Defective units or parts should be returned to the factory with transportation prepaid. If inspection shows them to be defective they will be repaired or replaced without charge, FOB factory. IDX **does not** assume any liability for damages.

c. **Parts access/availability.** See list below for example on lead-time for a quantity of 100.
   1. X10 and X50 Spare Parts – After receiving Purchase Order, parts can ship in 3 to 5 working days
   2. X10 without credit optics – In stock & after receiving Purchase Order, can ship in 3 to 5 days
   3. X10 with credit optics – In stock & after receiving Purchase Order, can ship in 7 to 10 days
   4. X50 without credit optics – In stock & after receiving Purchase Order, can ship in 3 to 5 days
   5. X50 with credit optics – After receiving Purchase Order, can ship in 7 to 10 working days
   6. X-Key – In stock & after receiving Purchase Order, can ship the next day
   7. X-TRACKER – In stock & after receiving Purchase Order, can ship the next day
   8. Complete Xeptor® manual call 800-643-1109 and we will ship at no charge



Old units shipped in 1999 or before might reject the coin because of a possible misalignment. To eliminate this problem, install a screw into the bottom left of the old unit.

figure # 2



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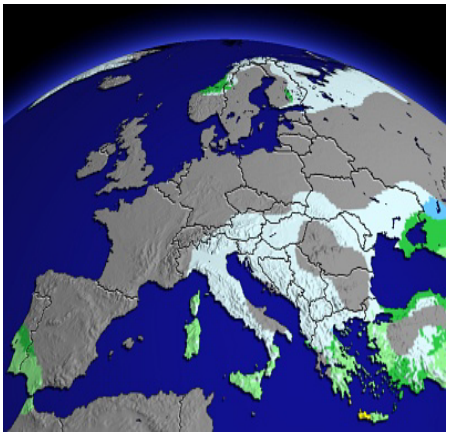
International View

By Martin Dempsey



HAPP CONTROLS EUROPE Ltd

Happ Controls Europe Ltd - "The Millennium Baby Comes Of Age"

"From little acorns" Is how the saying goes and this applies to all things especially business. In the case of Happ Controls Europe this has meant starting from nothing to become the fastest growing replacement parts specialist in Europe in just 2 years. Started in 2000 from premises in Broadstairs and mirroring the service already offered by its parent company in the United States, Happ Controls Europe has endured the recent decline in the Coin-Op market with unabated growth. Utilising experienced and dedicated staff has allowed Happ to grow by reputation for both product and service throughout Europe. For further details on Happ products contact Ray Hazelton or Geoff Spencer on
tel: + 44 (0)1843 871100
fax: + 44 (0)1843 871122
europe@happcontrols.com

SCAN COIN

All Change as Scan Coin Teams Up With MDM

MDM Leisure has been appointed exclusive UK channel distributor for SCAN COIN's top-of-the-range AC3 change machine. The AC3 note and coin changer has been specially designed for the amusement, leisure and gaming sectors in which MDM will have the distribution rights. "The AC3 has already established itself in this competitive and demanding market," said SCAN COIN's Steve Fitton. "We now want to build on this initial success and believe that working with MDM is the most sensible way forward. We have an exceptionally high-spec product with a proven track record and they have the market experience; together we can deliver a machine that will enable operators to optimise earnings through effective and efficient change giving." Further information contact Steve Fitton
SCAN COIN.
Phone + 44 (0)161-873 0500.
E-mail
sfitton@scancoin.co.uk

New Spares Catalogue Available Now

Eurocoin's latest Spares Catalogue is now available in both online and printed formats. The catalogue is updated quarterly and gives comprehensive listings of Eurocoin's most frequently requested spares and components along with part numbers and pre-discount pricing. To view the catalogue on line go to http://www.eurocoin.co.uk To receive a printed copy of the catalogue
email sales@eurocoin.co.uk
More information from Colin Veitch at Eurocoin:
Tel: +44 (0) 208 275 3000.
Email:
Colin.Veitch@eurocoin.co.uk

Top Exec Training Programme

More details of the slots training course, aimed at senior business executives in the casino industry, have been announced by organisers ATE. Presented by Chris Brammer, who has over 16 years of international slots experience, the two-day course entitled 'Managing the Profitability of Slot Gaming Growth' will be held at the Sopwell House Hotel, Country Club & Spa in St Albans, United Kingdom on 10th and 11th September. Explaining the rationale for the event, Chris Brammer said: "The course will provide an in-

depth look at the technical aspects of operating slots, providing casino industry board and senior management with a sound knowledge-base of their core business money spinners. The fee for the course, excluding hotel expenses but inclusive of lunches and light refreshments, is £845 plus VAT. For more information, contact Samantha Byrne at ATE on (tel) +44 (0) 20 7713 0302, (fax) +44 (0) 20 7713 7454 or e-mail mailto:sbyrne@atei.co.uk

6 Shooter - Even Quicker On The Draw

6 Shooter is the latest exciting new, hi-tech £25 Jackpot AWP game to be launched by Vivid Gaming. Designed for cash box success in pubs, arcades and LBOs, quality test results and positive player feedback have already resulted in major retailer approvals and substantial orders for this product. Peter Davies, director of sales at Vivid Gaming, is confident that the new game with its innovative new bingo card feature and great visual appeal is well set to take markets by storm. He said, "6 Shooter is a very player friendly, yet clever game that provides a varied play format to ensure players keep coming back, time and time again. To help during play our flashing 'Vivid' button awards a variety of game hints." 6 Shooter - a game quick to draw a crowd! For further information please contact Peter Davies at Vivid Gaming. Tel + 44 (0)1283 500066. E-mail: mailto:peter.davies@igt.com

Tim Parker Joins Endx Ltd

Endx Ltd, providers of leading Casino Management Solution Intelligence, have announced the appointment of Tim Parker as Business Development Manager. The appointment was announced by Nick Boyes-Hunter, MD of Endx Ltd. Intelligence provides an integrated and real time solution to the management of all aspects of a casino. The solution is comprehensive, flexible and modular allowing for a perfect fit to a large range of requirements. Tim, well known as a leading Solution provider over a number of years, will lead the expansion of the Endx range throughout Europe and Africa to further consolidate the companies position. Nick said "We are delighted to have someone of Tim's calibre onboard, this appointment compliments not only the quality of our software but also the quality of the on-going relationship that we have with our clients." For further information contact Tim Parker, Endx Ltd., Hollinwood Business Centre, Albert Street, Oldham, OL8 3QL. Phone + 44 (0)161 683 3300. Fax + 44 (0)161 683 3311. E-mail tim.parker@endx.co.uk
Web http:/www.endx.co.uk

John Farrell Appointed As Product Support Manager For Red Gaming

Red Gaming, the independent product design house, has announced the appointment of John Farrell as product support manager. John, who joined Red Gaming in November 2000, now takes formal responsibility for all product support matters including the important work of test machines and test results, working closely with the company's sales and technical teams. He now becomes the first point of contact for customers requiring information on Red Gaming products. John will also work very closely with the Barcrest technical support team, who continue to deal with customers' Red Gaming product technical enquiries or problems. For further information John can be contacted on + 44 (0)7884 361224 or email john@redgaming.com.

Slot Tech Quick Fixes

The DBV-145/200 Power Supply in a Nutshell

By Ed Morgan

I have been working on DBV-145/200 power supplies for a couple of years, and have learned that there are basically two types of failures that occur: either no output or too much AC ripple on the 12 VDC output. These two conditions account for at least 95 percent of all the failures I encounter. The following is a brief description of what causes both conditions:

No output: Replace the following components, TR21(NTE 2398), ZD21(NTE 5022A), D21(NTE 519), SS11(NTE 5332), and the fuse (it will be blown). If any of those four components fail, they invariably take out the other three with them.

Excessive ripple: Excessive ripple can cause DBV-145/200s to steal bills, not vend, or go to sleep. You can measure the amount of ripple on the output by setting your O-scope to AC coupling and obtaining your waveform. I typically set my scope for 20 mv and 100 msec per division. The ripple should be less than 60mv. The signal will appear to be a series of sinewave pulses on a fairly flat string (See figure 1). If you see a storm of noise on the output (See figure 2), then C13 (82uf/200v/105 degree) has gone bad and needs to be replaced. If the ripple is slightly high, 60-100mv (See figure 3), but otherwise looks normal, then the likely culprit is TR21. The last type of ripple is the string between pulses having a curve to it (See figure 4). This can be fixed by replacing C61 (820uf/25v/105 degree) and/or C65 (220uf/25v/105degree). I replace C61 first and that usually corrects the problem, but sometimes both are required.

- Ed Morgan
emorgan@slot-techs.com

Ed Morgan is a slot tech at Harrah's Shreveport.

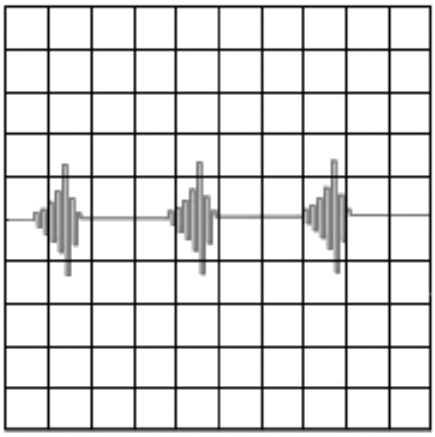


Figure 1

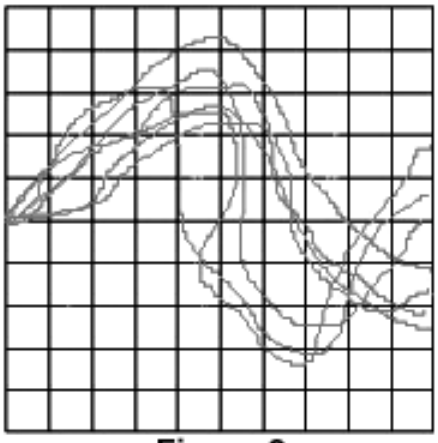


Figure 2

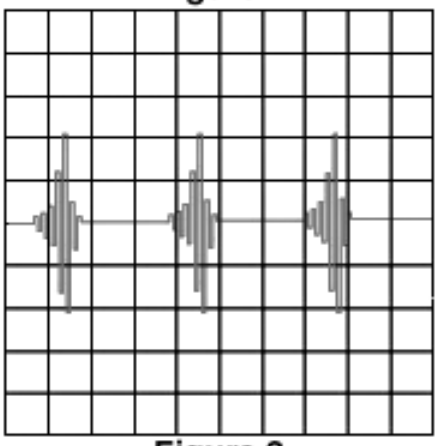


Figure 3

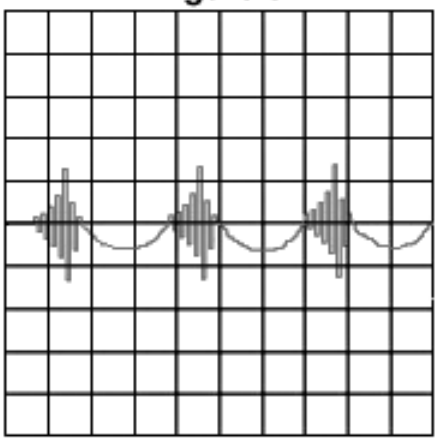
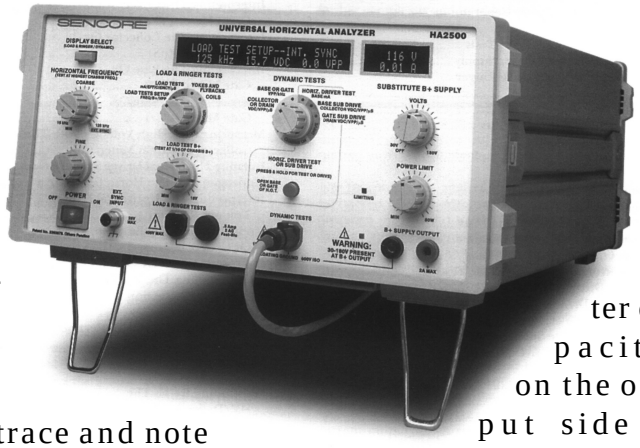


Figure 4

Introducing Sencore's HA2500 Horizontal Analyzer Part 2



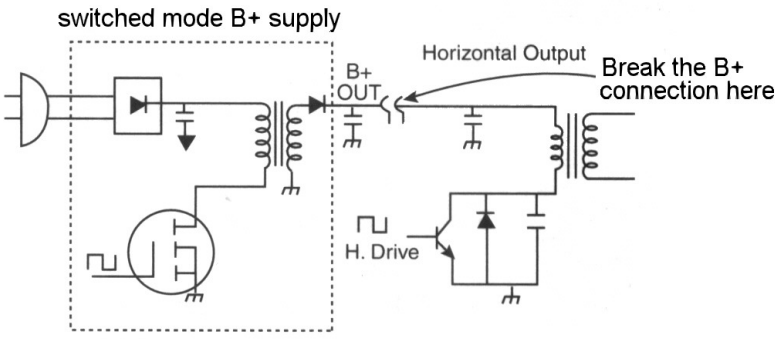
It's pretty obvious that using a substitute B+ Supply requires that the chassis B+ power supply path to the horizontal output stage be opened. This prevents the chassis B+ voltage from reaching the horizontal output stage. Once the chassis B+ voltage path is opened, the HA2500's substitute B+ supply is connected and used to provide the B+ voltage to the horizontal output stage. You've got to be sure about this when you do it. Failure to open the chassis B+ supply path may damage the chassis power supply and/or the HA2500 as you will have both power supplies on simultaneously. You may get lucky and have to unsolder only one end of a resistor or coil in order to isolate the chassis B+ power supply. In the worst case, you'll have to cut a trace but try like heck to find another alternative. I hate to see trace-cutting where there is a viable alternative.

If you do not have a schematic you can identify the B+ input pin to the horizontal output stage flyback or coil using a combination of methods. Trace from the collector of the horizontal output transistor to the output coil or flyback transformer. Use an ohmmeter to identify windings with continuity to the collector trace and note components connected to these circuit board traces. The B+ voltage input commonly has a bypass capacitor of 47uf to 100uf to ground. This is the cap that fails often in all monitors.

Once you have identified the B+ input path to the horizontal output stage flyback or coil, open a coil, resistor, or wire trace jumper to open the B+ voltage path.

The B+ voltage output from the main power supply can be identified on the schematic or board by finding the largest DC output voltage or highest DC voltage rated filter capacitor on the output side of the switch mode power supply transformer. Trace the B+ supply output voltage to the horizontal output stage. A coil or jumper may be unsoldered and lifted from the board to open the B+ output voltage path. When opening the B+ voltage path near the switching power supply circuitry, be careful not to open the feedback voltage path for the regulator control of the switch mode power supply.

With the chassis B+ path opened, connect the B+ SUPPLY LEAD clips from the B+ SUPPLY OUTPUT Jack to the chassis. The AC voltage to the

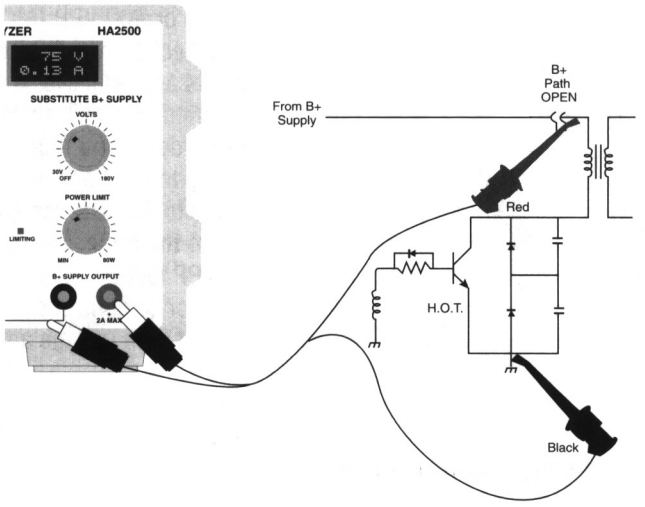


This is a typical B+ voltage path and recommended location to open the B+ path when using the substitute power supply.

chassis should be turned off and the VOLTS control should be set to "OFF" when connecting and disconnecting test leads. Connect the black banana jack to the black B+ SUPPLY OUTPUT jack and the black clip to the horizontal circuit ground of the chassis. Connect the red banana jack to the red B+ SUPPLY OUTPUT Jack (+) and to the horizontal output side of the opened B+ voltage path.

When substituting for the chassis B+ voltage, start at a reduced voltage or power level. This creates reduced voltages and currents in the horizontal output stage. Operating at a reduced voltage or power does not harm or threaten the horizontal output stage. Slowly increase the voltage or power until full operation of the horizontal output stage is reached or you see, hear or smell something wrong.

The VOLTS and POWER LIMIT controls provide the versatility needed to operate the horizontal output stage at reduced levels and increase it to normal operating levels. Start with the VOLTS control to OFF and set the POWER LIMIT control to a power setting near the anticipated power demand. If you are unsure of the normal power demand, set the POWER LIMIT to 1/2 scale (approx.40 watts.) This is a good starting point to limit current in the event of a breakdown problem. You may need to increase the POWER LIMIT control as you near full operating voltages.



It's easy to connect the HA2500 so you can substitute the chassis B+ with the substitute B+ supply.

Substituting the B+ isolates symptoms to either the B+ power supply of the chassis or the horizontal output stage. Identify the B+ voltage path of the chassis between the output of the power supply regulator and the B+ input pin of the flyback transformer. Refer to the schematic when possible to identify the B+ input to the flyback or horizontal output coil.

Substitute the chassis B+ voltage with the HA2500's substitute B+ Supply following the steps outlined here. If the monitor fires up and you get your high voltage, the horizontal output stage is functioning normally. To verify, you can measure high voltage, focus, and/or screen voltages to confirm that you have normal output voltages from the horizontal output stage. Basically, if it works, it works!

If the chassis power supply and signal processing stages are functional, the CRT of the monitor can be used to determine if the horizontal output stage is working properly. Apply a video signal to the display. A near normal video on the CRT indicates normal high voltage and/or deflection is being generated by the horizontal output stage.

You will use the HA2500's Dynamic Tests to determine abnormal or normal operation of the horizontal output stage when substituting for the chassis B+ voltage. Stay tuned for more in the future.

For More Information, Call Toll Free 800-SENCORE (736-2673)

3200 Sencore Drive, Sioux Falls, SD 57107 Fax: 605-339-0317 www.sencore.com

Making sense of SENET

By Herschel Peeler

IGT does most of their I/O (Input and Output) over a serial port. In newer games, this serial port is called SENET (See Slot Tech Magazine, December 2001, page 12). There are no new concepts with SENET. The 8032-based games used about the same circuits for inputs from switches and outputs to lamps. The newer games (80960-based, Winner's Choice / GameKing or newer) use about the same design. The improvement has been in the expandability and modularity of the design. Instead of all the I/O circuits being on the board (8032 designs) the I/O is spread throughout the game on modular I/O cards. Most games have a "Door I/O" card and a "Lower Cabinet I/O" card. The design allows expandability to add other cards as the design evolves.

Both of these cards have about the same design and function about the same way. The major difference is in the design of the output drivers. This article should shed some light on how SENET works and how the I/O boards work. It should aid in understanding how the I/O sections of the games work and assist in troubleshooting both game problems and board repairs.

General Overall View

The game sends out a sequence of Clock, Address, and Data pulses. There are also Strobe and Reset outputs from the game. The following is a list of these lines used by SENET, and what they do. An address is shifted out the Address line to select the board to be talked to. Once a board is selected, data is written to the board and shifted into shift registers. Then, a Strobe line enables the output of the shift registers. When inputs are being read from a board, the address of the board is included in the data being read.

Each board has 16 Inputs and 16 Outputs. The addressing scheme allows for up to 16 boards so there is a maximum of 256 inputs and 256 outputs on a game.

"SENCLK", SENET Clock, is the Clock Pulses.

"SDATA_ADR", SENET Address, is the Address of the device being sent data.

"SDATA_TxA" is the data being outputted from the game that will become outputs to turn on lamps, coils, meters, and such.

"SDATA_TxB" is a second data output that may, or may not be used. On the Lower Cabinet board it is not used. On the Door I/O board it is.

"SENSTB" is SENET Strobe. Once the shift registers have had data shifted into them the Strobe enables the outputs. For a more complete description of this operation, see the circuit description of the 4094.

"SENRST" is SENET Reset. This signal goes active during Power on Reset, System Reset, or when Self-Test is going on. As with all these lines, this output is under control of the game's CPU.

"SDATA_RxA" is SENET Data being returned to the game.

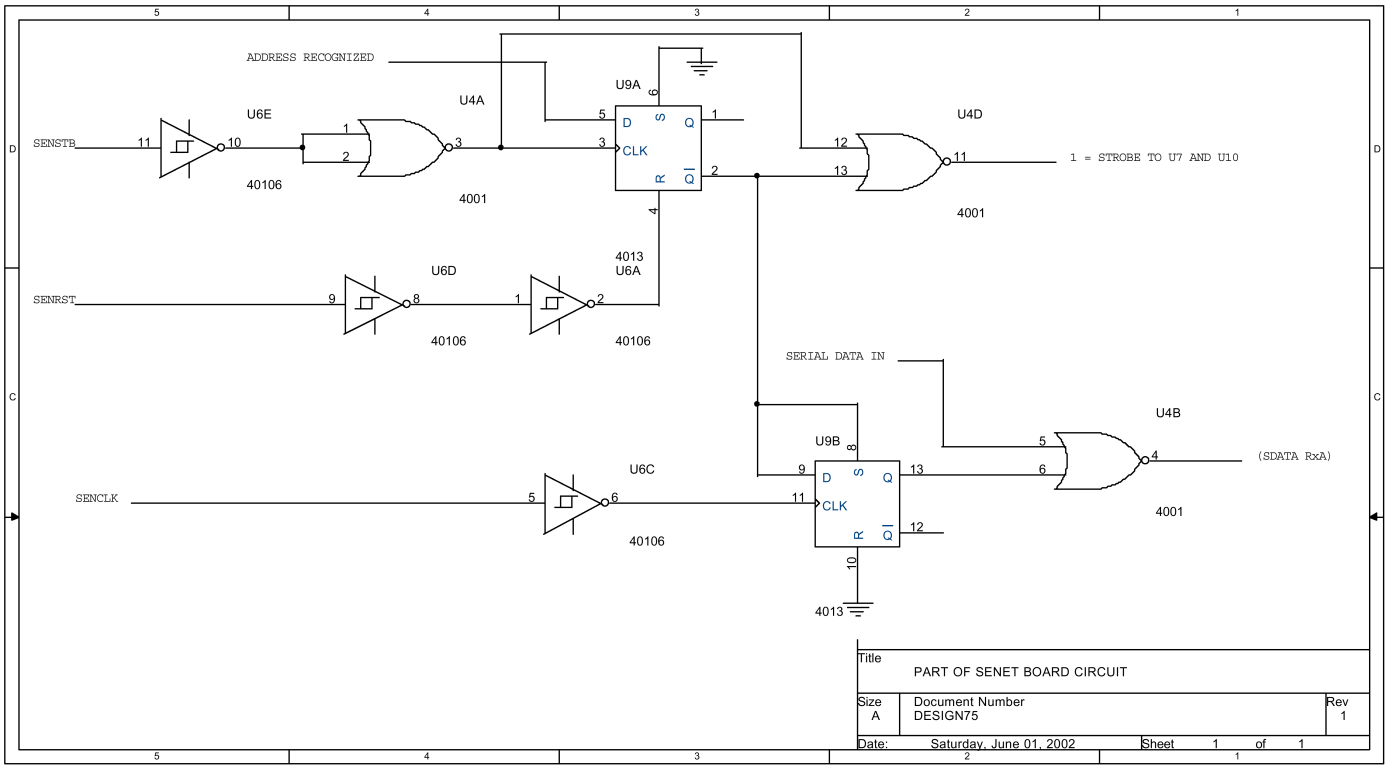
The ICs Used

You will have to reference a schematic of one of the SENET boards to make sense of the following descriptions. Refer to the December, 2001 Slot Tech Magazine. If you have a game with these boards, I assume you also have a set of schematics. Look for "Door I/O" or "Lower Cabinet I/O" boards.

I also assume you have a basic understanding of digital logic at the level of understanding gates, latches, and registers (If you don't, you need to come work at our casino for a year and go through our training program.).

14106 – This is a hex inverter, Schmitt Trigger. It has six inverters. This is a simple creature. You put in a high and you get out a low. You put in a low and you get out a high. The Schmitt Trigger design allows noisy, slow rising and falling inputs to get changed to clean smooth square signals at the outputs.

4001 – This is a quad 2-in-



put NOR gate. A high on either input makes the output go low. If both inputs are low, the output will be high. It may be drawn either way. My complements to IGT for drawing them as they are used in the circuit.

4013 – This is a basic D-Type flip flop, with Set and Reset inputs. If the "D / Data" input is high when the "CLK / Clock" input goes high, the latch will set. "Q" goes high. "Q\" will go low. The latch will stay in this condition until Reset by the "R / Reset" input goes high, or a clock pulse occurs with the "D" input being low. The "D" input is synchronous. Its operation must happen in cooperation with the "CLK" input.

The "S / Set" and "R / Reset" inputs are Asynchronous inputs. Their operation is not synchronized with the "CLK" input. As with most Asynchronous inputs, their operation overrides synchronous operations. If you try to Set the latch using the D and CLK inputs while Reset is active, Reset wins.

As the drawing implies, the CLK input is an active high edge. When CLK goes from low to high D will be transferred to Q, and Q\ will be the opposite of Q. Set and Reset are active high inputs. When S is high the latch will be forced into a Set state (Q high and Q\ low). When Reset goes high the latch will be forced into a Reset state (Q low and Q\ high).

SI9959DY is a dual N-MOSFET transistor. It is intended to be used as an Open Drain driver. Each transistor has a "S / Source" lead, that normally goes to ground; a "G / Gate" input that is the gate of the transistor; and a "D / Drain" output (on two pins). When Gate goes high the transistor turns on and Drain goes low, or to whatever voltage the Source is connected to.

4503 is a hex tri-state driver. When the enables ("DA and DB") go high, the inputs (I1 through I6) are transferred to the outputs (O1 through O6). When the enables are low the outputs are in a high impedance state and the 4503 is, in essence, removed from the circuit.

4585, or 14585, is a 4-input digital comparator. It compares two sets of four inputs (A0 – A3, and B0 – B3) and enables one of three outputs depending on the relationship of these two values. Either "A<B" (A is less than B), "A>B" (A is greater than B), or "A=B" (A equals B). It also has three inputs allowing multiple 4585s to be cascaded to compare groups of multiples of four bits. In the design of IGTs board these three other inputs are set to tell the 4585 that all other things are equal. When the A input equal the B inputs, A=B goes high. This is used for the board to recognize its address, as set up by the

jumpers on the B inputs. Each different board function has a unique address.

4094 is an eight stage shift register with an eight section latch on its output. It converts serial data to 8-bits of parallel data. The output of the latch has a tri-state buffer. The shift register gets data shifted into it from a serial data string in the D input, and clocks on the CLK input. A bit of data is applied to the D input. CLK is put high, and one bit of data is shifted into the shift register. CLK then is taken low and the next bit of data is applied to the D input. As data is shifted in the D input, the last stage of the shift register is shifted out of the QS output. This allows the shift registers to be cascaded. The IGT design connects two of these together allowing 16 bits of data to be shifted through them.

Once the data has been shifted into the shift registers the STR (Strobe) input of the 4094 is taken high, transferring the contents of the shift register to the output register. When OE (Output Enable) goes high the contents of the output register show up at the Q1 – Q8 outputs.

4021 is also a shift register, but it converts 8-bits of parallel data into serial data. The A through H inputs of the 4021 are the eight parallel inputs. The "P/S" input is the operating mode control. When high, clocks on the CLK input load parallel data into the shift register. When P/S is low clocks shift the contents of the shift register out the QH output one bit at a time. Latch H gets shifted out. Latch G gets shifted to H, F goes to G, and so on. Multiple 4021's may be cascaded, as IGT has done, to string multiple 4021's together, the QH of one device gets shifted into the A latch of the next shift register.

ULN2004 is a bipolar transistor array of seven NPN Darlington transistors. They function as an inverter (high in makes the output low). Each output has a protection diode with the cathode connecting to pin 9. The purpose of the diode is to protect the transistor from spikes when driving inductive loads, like meter coils.

RT1, RT2, RT3, and RT4 are poly fuses rated at 0.500 Amps. These are self-resetting fuses. Normally that should have about one ohm of resistance, as far as what will show up on a meter is concerned. As current is drawn through them their resistance increases sharply at a certain current rating. If you draw about one amp of current through them they heat up and resistance increases to be an effective open, just like a fuse. When they cool down, the resistance returns to normal. These are not fast. They respond about the same way as a slow-blow fuse. At 100% over the rated value they will "blow" is about a second or two. At more than about five times the rated value they will "blow" more quickly. They are designed to "hold" at the rated value.

Operation of the Board

The description that follows will apply to any SENET board schematic you have. This section of the SENET cards all work the same way, and is what makes SENET what it is.

Initial Conditions

Lets start with a Reset, so we know what state everything is in. SENRST goes high disabling the outputs of the shift registers and clearing U9A. U9A Q\ output goes high forcing U9B into the Set state, making U9B Q output high.

When the game finishes its Self-Test and is ready to resume normal game play. SENRST goes away.

The Board is Set Up

A string of pulses are sent out SDATA_ADR, accompanied by Clock pulses on SENCLK. SDATA_ADR is inverted and becomes MUX_ADR into the shift register for the Address Recognition circuit. After eight address bits are sent out by the game Strobe (SENSTB) goes low, gets inverted, goes to the STB input of the Address shift register and enables its outputs. All SENET devices get this information. Only one should get enabled.

The comparator compares this address against those set by the jumpers on the board. If the values compare the A=B output goes high.

When SENSTB goes high (the ending of the Address Strobe) it gets inverted and becomes the CLK input to a flip flop whose D input comes from the A=B signal, setting this latch. This signifies that this board has been

selected. Its Q\ output goes low, removing the high from the Set input of the other section of the flip-flop.

Sending and Receiving Data

The board is now selected and the CPU starts sending clock pulses through the SENET. SDATA_TxA is data being sent out from the game CPU. Each clock pulse sends out one bit of data. At this same time data is shifted from the 4021's, being gated through a NOR gate, into a SI9959DY, and to SDATA_RxA, back to the game CPU. After 16 clock pulses, both 8-bit output shift registers are full of data, and the contents of both input shift registers have been sent to the game CPU.

Part of the Input data word comes from the jumpers used to determine the device address. In this way, the game confirms that the data came from the proper selected device.

All SENET cards work about the same way. The only difference is where the inputs come from, and what kind of output drivers are used.

The Lower Cabinet I/O card uses five SI9959DY drivers, giving nine output data drives (the tenth driver is used to return SDATA_RxA back to the SENET buss), seven ULN2004 drivers (driving the meters). Thirteen inputs come into the SENET board. Six inputs are used to return the board's address to the CPU. One input (IN4 Handle Input) does double duty as both a game input and an address bit.

The Door I/O board uses sixteen inputs, sixteen SI9959DY outputs (plus another 9959 for SENET Serial Data back to the game. But how, you may ask, does it use all sixteen inputs if inputs are also used to return the address to the game?

The high bit of the shift register used for address recognition is used to enable the 4503 into the data shift registers, allowing the SENET controller to read the Data separate from the Address.

Troubleshooting a Bad SENET Board

These guys can be repaired at the average workbench. The best test fixture would be to have a Dynamic Test Fixture that is capable of emulating a SENET controller. That project is coming along slowly, so the next best thing to do is Static Test the board.

Apply +12 V to pin 9 of the SENET connector, and ground to pin 12. This brings the board up under power. Check for good voltage across power and ground at a couple of the ICs on the board.

All ICs should at least have good highs and low on their inputs and outputs. If you have a known symptom, work from the part of the circuit that deals with what you know, and go from there. If you don't have a symptom, just start probing around with a meter. Voltages on all inputs and outputs should be good highs (about +12 V) or lows (close to ground). Inverter's inputs and outputs should be opposite one another. If the input is low, the output should be high. Gates are also easy to troubleshoot.

Any voltage other than a good high or low should be investigated. Inverters that don't invert or NORs that don't NOR should be investigated.

All inputs to the board should float high. Most of the failures I have found on these boards have been inverters close to the SENET connector. I suspect the failures were caused by technicians or slot attendants pulling on connectors with power on. (Thus the need for our quite intensive training program at Eagle Mountain Casino.)

Most of the ICs on this board fall into the $0.25 to $0.50 range. If in doubt, replace it. The parts are much cheaper than your time. (Mouser has them all. Their address is included below.) Make sure you purchase the SOIC (Small Outline IC) device. These IC's usually have part numbers ending in "M", instead of "N" which is the same IC in a DIP case.

I have yet to see one that didn't have a problem that couldn't be found by static testing. I just can't confirm proper operation this way. The Dynamic Tester (see previous articles about the test fixture built from the Telpar printer board) is the solution, but I never get a chance to work on it. I'm too busy repairing boards.

- Herschel Peeler
hpeeler@slot-techs.com

Introduction to Digital Electronics Part 1

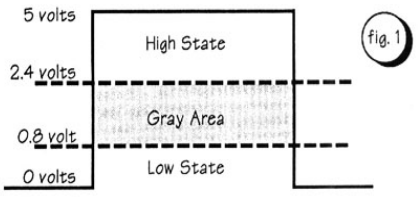
There are two distinct types of electronic circuits: analog and digital. If you've been working on power supplies and monitors (on the video amplifier circuits or the vertical deflection circuit or the horizontal deflection circuit) or your garage-band's Fender Twin-Reverb amplifier, you have been working on analog circuits.

So, what is meant by digital electronics? What's the difference between the two? Well, there are lots of differences between analog and digital electronic circuits. In fact, they're so different that you really don't have to know much about analog electronics to be successful in repairing digital systems. Some of the best techs I've ever met are great on microprocessor systems but aren't worth a damn when it comes to fixing monitors.

In the analog world, you'll work on circuits that have all kinds of different voltages. As little as 7/10s of a volt will turn on a transistor. A video signal may have anywhere from 0 to 4 volts on it. The power supply circuit voltages are +5, +12, and even -5 volts! A monitor will have a B+ supply of +88 to +136 volts. There's even 15,000 volts or more at the second anode!

The world of digital electronics is much simpler than the chaotic realm of analog circuits. You know how all the CPU boards are powered by +5 volts DC or 3.3 volts DC? Well, in digital electronics, that's just about all you'll see. If you use an oscilloscope to probe just about any "node" (any connections between integrated circuits are called nodes) you'll see that the voltage there will be either around +5 volts (or 3.3) or it will be close to 0 volts (or it will be alternating between the two as shown in figure 1). This is called "pulsing." That's it. In fact, if you see anything else, you've probably found something wrong—a circuit fault of some type.

Modern slot machines use a family of integrated circuits known as TTL—Transistor, Transistor Logic. They also use another family of ICs called CMOS (Complimentary Metal Oxide Semiconductor). To make the discussion a bit simpler, let's discuss TTL first. There are only two states allowed in TTL, digital electronics. Either a signal is at a logic "high" or a logic "low. A logic high isn't really exactly 5 volts. There's a threshold voltage of 2.4 volts. Anything above 2.4 volts is considered to be a valid logic high.



There are only two TTL logic levels. A logic "LOW" is from 0 to .8 volt. A logic "HIGH" is from 2.4 to 5 volts. Anything in-between is a disallowed state called the "gray area."

The threshold for a logic low is .8 volts. Anything in-between is a "disallowed state" called the "gray area." Normally, you will not see signals in the gray area. That's one of the things you look for when troubleshooting digital circuits. If I'm probing around in a circuit and I see a signal that's in the gray area, I gotta think that something's not correct. A gray area violates the "rules" of digital electronics and that's what I'm looking for.

Digital electronics follows very specific rules of opera-

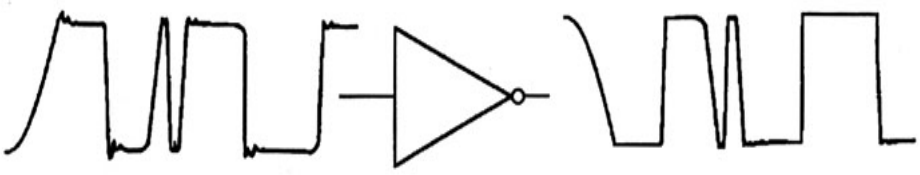


fig. 2 The inverter flips the signal upside-down. In the process, the signal is also cleaned-up!

tion. The rules state things like "if this input is high, this output will be low" or "if these two inputs are both low, the output will be high." This is called "digital logic."

Troubleshooting digital electronics is kind of like playing baseball. If you don't know the rules, you can't play the game. The rules of operation are contained in a reference book called a "databook." It contains a fact sheet (in some cases, many fact sheets) on each device and tells you how the integrated circuit is supposed to operate. It's the rulebook! Without this book, you can't play the game. Individual datasheets are also available online from numerous sources. Your best bet here is to perform a Google search for the part number. Another good source is http://www.chipdocs.com.

There are other books available, too. Radio Shack (believe it or not) has a number of books and pamphlets on the subject of digital electronics. These were written by well-known technical writer Forrest Mimms. Another one I highly recommend you get is the "TTL Cookbook" by Don Lancaster. Just about anyone interested in learning digital electronics should get this one. Another is the "CMOS Cookbook."

The Inverter & Buffer

The simplest circuit is called an "inverter." To invert something means to flip it upside down. That's exactly what the inverter does. If the input signal to an inverter is mostly high, with narrow, downward going pulses, it comes out upside down; the pulses are now going up (figure 2). Sometimes a signal is upside-down from what we need in a circuit and an inverter is used to flip it right side up.

So, the rules for the inverter are: when the input is low the output is high and when the input is high the output is low. The rules are printed in the "truth table" that's in the data book (figure 3). A is the input; Y is the output. 'Nuff said?

A	Y
0	1
1	0

Fig. 3 - The Truth Table

The 7404 is called a "HEX INVERTER" because there are actually six inverters in the one package. They only share a common power connection.

You may notice that the signal looks cleaner that it did before (figure 2). See how the input is not a clean waveform but the output is? In addition to inverting the signal, the inverter also cleans it up. Remember, anything above 2.4 is a high. Anything below .8 is a low. The inverter ignores all the garbage. Digital circuits kind of clean themselves up as the signal is passed from device to device.

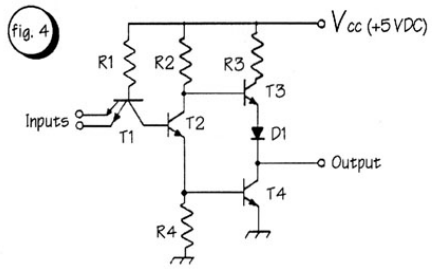
If we need to clean up a signal without inverting we can use a circuit called a "buffer." The buffer passes the signal through unchanged but cleaner. The buffer is also used when the output of an IC is used to drive a lot of other inputs. This is called "fanout." A typical fanout for TTL is 10. That is, the output of one chip can drive up to 10 inputs on other integrated circuits. Each input is called a "unit load." A typical TTL output can drive up to 10 U.L. If you're a designer, this is an important consideration. As technicians, it's not generally too important. By the way, some inputs are more than 1 U.L. and some are less. Again, this is more important to design engineers than technicians, who are only interested in locating and replacing bad parts.

Totem Pole Output

The output of a TTL device is known as a "totem-pole" output (see figure 4). The way it works is really simple. To make the output go high, (output a logic 1) transistor T3 is turned on. This allows the +5 volt power source (also known as Vcc) to pass through resistor R3, transistor T3, and diode D1 to the output pin of the chip. When the output is high, the chip is said to be "sourcing" current.

To bring the output low, transistor T4 is turned on. This

grounds the output pin, making it 0 volts; a logic 0. When the output is low, the IC is "sinking" current.

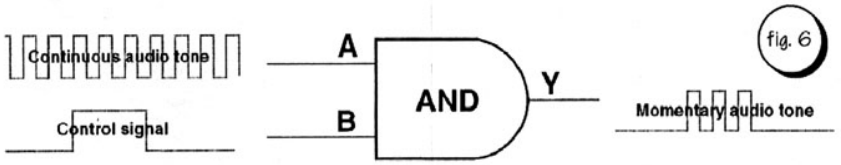


TTL gate with Totem-pole output

Never connect two totem-pole outputs together. If one output goes low while the other tries to go high, the low will always win over the high because transistor T4 connects the output directly ground. A logic high must be delivered through resistor R3 and the diode. Also, the "high" output chip might be damaged due to excessive heat dissipation across R3, T3, and the diode.

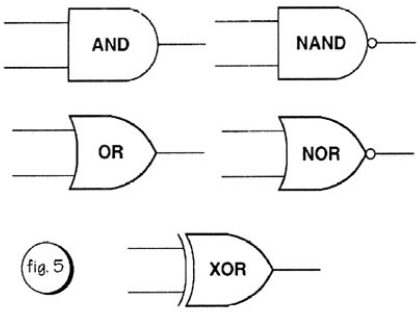
A different type of digital IC known as a "tri-state" device allows multiple outputs to be wired together. Tri-state devices can completely disconnect themselves from the common output, allowing only one active output regardless of the fact that the output pins of the integrated circuits are hard-wired together on the printed circuit board. Tri-state devices are common in microprocessor systems.

Since the totem-pole output does a better job of "sinking" current than "sourcing" it, the "active" output of an integrated circuit is often a low rather than a high. An "active low" function is called a "NOT" function. That's what the small circle on the end of the inverter symbol is for. The circle is sometimes called a "bubble" or a "zirc." The circle indicates the NOT function. That is, whatever function the device performs, the output comes out LOW.



The AND gate in action using a continuous audio tone on one input and control signal on the other. The output is a momentary audio tone.

The Gates



The 5 basic types of gates

Inverters and buffers can't make any logical decisions. To do that, we need to use something called a "gate." Gates are the building blocks for all the logical functions in digital integrated circuits.

The first gate we'll look at is called an "AND" gate (figure 5). It looks like the letter "D" with the inputs on the flat side of the D and the output on the rounded end. If both inputs are high, the output will be high. That is to say, if one input is high AND the other input is high, the output will be high.

Offhand, that may seem pretty limited but here's what you can do with it. If you have a signal that needs to be turned on and off (for example, a momentary audio tone that sounds off when an event occurs) you can connect a continuous audio signal to one of the inputs of a gate (figure 6). The other input is connected to the "control" signal - a momentary pulse that goes high when the event occurs.

When the control signal is low, the audio signal is blocked and the output of the AND gate is low. Remember, both inputs must be high in order to get a high out. But when the control signal is high, the audio signal is passed through to the output. It's like opening a gate and letting the signal through. That's why it's called a gate!

To be continued next month

Slot Tech Magazine's

TechFest 3 - Las Vegas, NV - August 14, 15, 16 2002
TechFest 4 - Mille Lacs, MN - October 22, 23, 24 2002

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.

TechFest 3 will be held August 14 - 16, 2002 at the Boardwalk Hotel & Casino in Las Vegas, Nevada. TechFest 4 will be held October 22 -24, 2002 at the Grand Casino Mille Lacs in Onamia, Minnesota. Registration fee is $390.00 per person and includes lunch each day.

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 Hoppers**
- **Coin Mechanisms, Inc. - Coin Comparitors**
- **Mars - Bill Validators**
- **3M Touchsystems - Touchscreens**
- **Sencore - Test Equipment**
- **Seiko - Ticket Printers**

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

BE A BETTER SLOT TECH

Come and spend 3 days at TechFest. 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.

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.

Schedule of Events

Wednesday, August 14th, 2002
Tuesday, October 22nd, 2002

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

1:15pm - 3:15pm
Asahi Seiko - Hopper troubleshooting and repair

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

Thursday, August 15th, 2002
Wednesday, October 23rd, 2002

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

1:15pm - 3:15pm
Mars Electronics, Inc. - BV troubleshooting and repair

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

Friday, August 16th, 2002
Thursday, October 24th, 2002

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

1:15pm - 3:15pm
Sencore - Monitor Troubleshooting and Repair - Using sophisticated test equipment to speed through monitor repairs

3:30pm - 5:30pm
TF3 Only - Seiko ticket printers - Printer troubleshooting and repair.
TF4 Only - JCM Bill Validator Troubleshooting and Repair

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

Space is limited - Register today!

TechFest 1 and 2 were both sold-out events.

Subscriptions & Back Issues

Why back issues of Slot Tech Magazine are important to own . . .

Slot Tech Magazine is strictly technical. As such, the magazine's contents are not time critical. The repair information and technical data contained in past issues is just as valid today as it was the day it was published.

Additionally, current and future articles more-or-less assume that readers are already familiar with what has been covered in past issues. This editorial policy assures that Slot Tech Magazine's contributing writers are not limited to "writing down" to the level of a novice technician but are free to continue to produce the most comprehensive technical articles in the gaming industry.

Randy Fromm's
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For further details on the contents of each issue, please refer to the website at slot-techs.com

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