

**NOVEMBER, 2001**

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**F**resh on the heels of the recently held Global Gaming Expo, this month's Slot Tech Magazine is a mixed bag of informative articles. In fact, the first presentation on common machine problems, solutions and repairs is a mixed bag in its own right. This is a quick reference guide that may help you jog your memory when it comes to the common types of problems seen on casino floors every day. Another presentation focuses on Kristel Monitors and Atronic button boards while still another contains seven tips from techs and slot managers across the United States.

### Randy Fromm's Slot Tech Magazine

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Also in November's issue are articles on bar codes and ticket printers, as well as a suggestion on percentaging your games for an automobile as the grand prize. Included as well is some abbreviated show coverage from the highly successful Global Gaming Expo, held last month in Las Vegas.

On the electronics education side of things, you'll find two articles. For the novice technician, Slot Tech Electronics 101 presents the most basic of electronics training. Start here if you know nothing about electronics. For the intermediate technician, you'll find a discussion of the video amplifier in monitors.

-----

Randy,

Great magazine! Hopefully as the market for Slot-Tickets grows we can afford ad space.

I wanted to pass along a hint on how to solve a problem with the Seiko printers in the new coinless and EZPay IGT machines. The printers are designed to alert on low paper so a tech can refill the printer prior to it running out of paper. While this maybe useful in some casinos, it results in an accumulation of small stacks, less than 20, of tickets that are either discarded or spliced into bigger packs. I think the best approach is to block the low paper sensor and let the machine soft tilt. The last ticket prints out on cashout, so I can't imagine any customer inconvenience.

I picked this tip up from our customer Bill Guinazzo, who heads



the slot shop at The Sun Coast (702-636-7111).

There are over 20,000 printers in casinos now, so I expect slot techs around the country have stories to tell. A new article? The tickets as well as the printers have their share of the good, the bad and the ugly, of course our tickets are beautiful! Slot-Tickets was the original developer and provider of tickets for the IGT EZPay machines, which has now spread to almost all slot OEMs and several printer OEMs.

Tom Mitchell, CEO  
Slot-Tickets

*Dear Tom,*

*Thanks for the interesting tip. You are certainly correct about ticket printers and their place in the "new" gaming industry.*

*Look for an in-depth review of ticket printers in the near future.*

*- rf*

Enjoy this month's Slot Tech Magazine. I'll see you at the casino.

A handwritten signature of Randy Fromm in cursive script.

**Randy Fromm**



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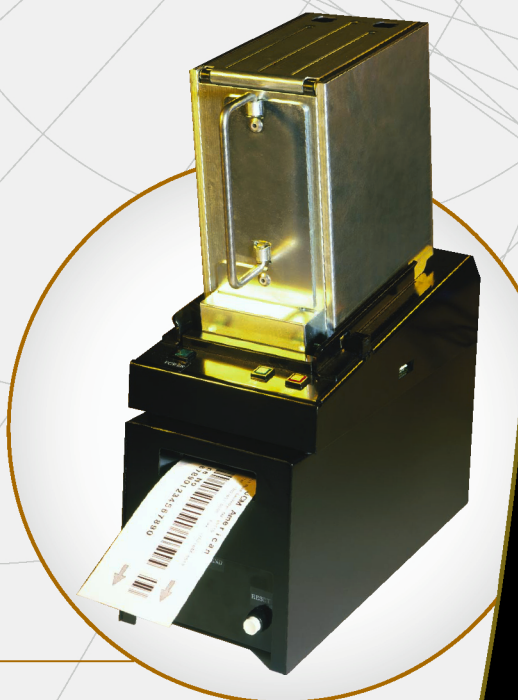


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# Common Machines Problems, Solutions and Repairs

By Kevin Noble

## COIN IN JAMS

- BENT AND JAMMED COINS IN IDX
- PAPER JAMMED IN OPTICS AND/OR IDX
- COINS JAMMED AT DIVERTOR, RETURN CHUTE, OR DROP CHUTE
- COMPARTOR NOT SEATED IN HOUSING
- WRONG COIN HEAD
- WRONG OPTIC BLOCK
- MIS-ALIGNED COIN ENTRY
- COINS JAMMED BEHIND IDX DOOR ADJUSTER TAB

## NOT ACCEPTING COINS

- COIN MECH SHUT OFF
- BROKEN COMPARTOR WIRES
- BAD COIN OPTIC
- IDX NOT PLUGGED IN
- NOT THE CORRECT TOKEN FOR MACHINE
- AT MAX BET
- TILT HAS OCCURRED
- DOOR NOT CLOSED
- SPIN IS NOT OVER
- BV IS ACCEPTING A BILL
- BAD COIN IDX
- COIN PATH DIRTY
- IDX LOST PROGRAMMING
- IDX TIME DELAY STILL IN EFFECT.
- GAMEMAKER (S/T): COIN TRAY HITTING IDX COVER
- THICKNESS SETTING INCORRECT

## COINS NOT REGISTERING

- DIRTY OPTIC PATH
- PAPER BLOCKING OPTICS
- AT MAX BET
- BAD OPTICS
- COIN ACCEPT LIGHT BURNT OUT
- MIS-ALIGNED COIN ENTRY
- VIOLET COMPARTOR WIRE BROKEN AND/OR LOOSE
- BAD CONNECTIONS, WIRING OR IDX
- OPTIC BLOCK WORN GROOVE

## HANDLE / SPIN BUTTON NOT WORKING

- NO COINS PLAYED
- BROKEN TORSION SPRING
- RATCHET JAMMED
- SOLENOID LINK MISSING AND/OR COTTER PIN
- OPTICS DIRTY, MISSING, AND/OR BROKEN
- MICROSWITCH BROKEN
- HANDLE SWITCH MIS-ALIGNED
- GAME IN TILT MODE

## COIN OUT JAMS

- BROKEN KNIFE, MIS-ALIGNED, GROOVED, TIP MISSING, AND WARPED
- BENT COIN
- PAPER STUCK IN FRONT OF OPTICS, BEHIND THE PIN-WHEEL
- FOREIGN OBJECTS ( NUTS, BOLTS, TIE STRAPS) STUCK BEHIND THE PINWHEEL
- COINS JAMMED IN RETURN CHUTE TRAY
- DIRTY OPTICS
- WRONG DENOMINATION OF COIN WEDGED BETWEEN PINS
- BOWL PLUG PINS PUSHED OUT OR MISSING
- AGITATOR MISSING, WORN
- HOLLYWHEEL HOPPER COIN WEDGED BETWEEN BOWL AND HOUSING
- MIS-ALIGNED COIN OUT CHUTE ON MACHINE DOOR
- DOUBLED UP COIN ON TRANSMISSION COVER AND/OR SPRINGS
- DIRT AND PAPER JAMMED IN ESCALLATOR GROOVES
- ROLL PIN MISSING OFF ROCK N' ROLL ASSEMBLY
- HOPPER BOARD BAD
- IGT DC SECURE COUNT NOT JUMPED
- HOPPER MOTOR DRAWS TOO MUCH CURRENT
- HOPPER OPTICS NEED TO BE JUMPED (BALLY)
- ROLL PIN SHEARED UNDER PINWHEEL

- TOO MUCH WEIGHT IN HOPPER BOWL

## HOPPER OVERFLOW

- BROKEN HOPPER PROBE WIRE
- BOWL PLUG PINS PUSHED OUT, BROKEN
- DIVERTOR NOT WORKING
- BALLY SMALL TOKENS WEDGED BETWEEN DROP CHUTE AND DIVERTOR
- COINS PILED AROUND HOPPER PROBE (NOT ALLOWING A COIN TO TOUCH)
- PLUGGED OR JAMMED DROP CHUTES
- DIVERTOR SOLENOID BAD, PINS NOT IN, INPLUGGED

## HOPPER OVERPAY

- NO SPRING ON HOPPER BRAKE
- PAPER IN OPTICS
- ROCK N' ROLL ASSEMBLY MISSING ROLL PIN
- DIRTY OPTICS
- WRONG SIZE TOKENS NOT BEING COUNTED
- KNIFE NOT SET CORRECTLY
- COINS GOING BELOW OPTIC AND/OR PIVOT AND NOT BEING COUNTED
- ESCALATOR FLAG MISSING, LOOSE, PIVOT ARM BENT AND/OR MISSING
- DEFECTIVE COIN OPTIC OR MICROSWITCH
- STICKY MOTOR BRAKE
- DEFECTIVE HOPPER CONTROL BOARD

## COINS COUNTED, BUT NO ACTUAL COINS

- PAPER IN OPTICS
- BROKEN KNIFE
- COINS BLOCKING EXIT
- SLANT TOP COIN TRAY CHUTE JAMMED WITH COINS
- SLANT TOP COIN TRAY CHUTE BLOCKED WITH PATRONS COIN
- BENT DEFLECTOR PLATE
- MIS-ALIGNED COIN OUT SWITCH OR OPTIC



- GROOVES ON HOPPER KNIFE
- COIN DUST PILE-UP ON KNIFE

#### REEL ASSEMBLY PROBLEMS

- COINS, AND FOREIGN OBJECTS INSIDE OF REEL BUCKET
- HARNESS UNPLUGGED
- HARNESS CONNECTION, COINS COMING LOOSE
- REEL CONTACT ( MEAL BOOK, WIRES, SLUG ENVELOPE)
- ENCODER FLAG DAMAGE OR MISSING TEETH
- MOTOR GRINDING OR BOUNCING
- 55, 51 CODE DURING REEL SPIN
- MACHINE DOOR OPEN DURING REEL SPIN
- CASHBOX SWITCH LOOSE, BROKE, OR BAD
- LOOSE WHEEL ON HUB
- FLOURSCENT LIGHTS FLICKERING

#### BV OFF LINE

- JAMMED BILL IN HEAD
- BAD WIRING AND/OR CONNECTIONS
- DEFECTIVE OR MIS-ALIGNED CASHBOX SWITCH
- IMPROPER SEATED CASHBOX

- BV NOT PLUGGED IN
- STACKER JAM, HARDWARE ERROR, STACKER DIRTY, OPTICS
- TOKEN IN BV HEAD, PLAYERS CARD, PAPER
- BURNT OUT LIGHT
- COUNTRY CODE WRONG
- OPTION #9 DISABLED
- AT MAX CREDITS (WILL NOT ACCEPT NO MORE BILLS)
- CASHBOX FULL
- WRONG DIP SWITCH SETTINGS
- POWER SUPPLY NOT WORKING
- BROKEN WIRES ON TRANSPORT
- DIRTY OPTICS IN TRANSPORT
- BV HEAD LATCH NOT TIGHTENED DOWN
- BILL STUCK IN HEAD
- LOST CALIBRATION
- CASHBOX HARNESS FOR CONSTANT 99-1 AND 99-2 CODES
- WMS- BAD INTERFACE BOARD BEHIND CASHBOX

- CONSTANT DOOR OPEN/CLOSED
- DEFECTIVE OR MIS-ALIGNED SWITCH ON MAIN, BELLY GLASS, OR BV
- BAD OPTICS

- NO CASHBOX INSERTED
- BAD CHERRY SWITCH, OPTIC, MAGNET
- BAD PIGGY BACK BOARD ON SMIB
- FILL DOOR WIRE BROKEN, DISCONNECTED
- BAD DOOR HARNESS CRIMP

#### WINNING COMBINATION, BUT NO PAY OUTS

- REEL STRIPS MOVED OUT OF POSITION
- NOT ENOUGH COINS PLAYED (BUY PAYS)
- REEL STRIPS IN WRONG REEL POSITION

#### SWITCHES NOT WORKING

- BAD MICROSWITCH
- SWITCH PLUNGER STUCK IN DOWN POSITION
- SWITCH WIRING HOOKED UP WRONG
- BROKEN WIRE/ CONNECTIONS/ CONNECTORS

#### PTM NOT READING

- FOREIGN OBJECTS STUCK IN READER
- SMALL PIN MISSING OR LOOSE
- DIRTY

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- SNAPPED APART
- PCB BOARD CRACKED
- WRONG PTM CHIP INSTALLED

#### NO MACHINE FUNCTIONS

- POWER CORD DISCONNECTED AT POWER SUPPLY OR OUT-LET
- FAULTY POWER SWITCH
- BLOWN FUSE
- POWER SUPPLY
- CPU BOARD NEEDS RESEATING

#### NO SOUND

- BROKEN BAD, OR CONNECTIONS
- SPEAKER DEFECTIVE
- VOLUME TURNED DOWN

#### TOWER LIGHTS

- LAMP BURNT OUT
- CHANGE LIGHT FAULTY, BAD, CONNECTIONS
- FUSE BLOWN
- CASH BOX JAM
- TOWER LIGHT WIRES SHORTED TO CHASSIS

#### FLOURESCENT TUBES AND LIGHTS

- STARTER BAD
- LAMP BURNT OUT
- BALLAST DEFECTIVE
- BROKEN WIRES AND CONNECTIONS
- PLUG AT POWER SUPPLY NOT MAKING CONTACT

#### STATISTIC DATA / NO DISPLAYS

- FAULTY RESET KEY SWITCH
- GAME NOT OVER
- BROKEN WIRE
- BAD 7 SEGMENT DISPLAYS
- BAD DISPLAY BOARD
- CPU BOARD NOT SEATED RIGHT
- DOOR CABLE GROUNDING PCB.
- MAIN EPROMS BECOMING LOOSE IN GAME SOCKETS

#### SELF TEST MODE WILL NOT ENABLE

- COIN ACCEPTED AND NOT PLAYED OFF
- GAME NOT OVER OR COMPLETED
- MACHINE IN TILT MODE
- BAD BARREL SWITCH

### TIPS

- STOP REEL GRINDING NOISES- MASKING TAPE ON SHAFT DOWELS
- COINSTANT COIN IN CODES- CLEAN COIN MECH COIL, PATH, AND OPTICS WITH WIPES
- TEST FOR CASHBOX FAULT- TEST 27-1, IF LIGHT COMES ON THE PROBLEM IS WITH THE CASHBOX TRANSPORT.
- BALLY UPRIGHT M00 CODES, CAN BE CLEARED BY OPENING AND CLOSING THE DOOR, IF THIS DOES NOT CLEAR, NEEDS PARTIAL
- BALLY S/T- MACHINE OPTION #2 SET TO 1 FOR TOP LOCK-UP AWARD ONLY.

### SIGMA REEL

- CREDITS DISAPPEAR AFTER DOOR CLOSED, HAVE CUSTOMER PLAY 1 GAME.
- METERS NOT MATCHING- CALIBRATE ALL SIB OPTIONS
- POWER DOWN GAME AND SMIB BOARD, POWER BOTH UP TOGETHER
- CANNOT PERFORM RAM CLEAR- SHORT BATTERY ON CPU FOR 5 SEC.
- MESSAGE "ATTENDANT 0" FLASHES- BAD SYSTEM 2 EPROM

### **WILLIAMS VIDEO**

- VIDEO USES 3 DIFFERENT CPU BOARDS AND 2 I/O BOARDS
- SERIES 3 CPU- NO DIODES LOWER LEFT CORNER
- SERIES 3 CPU- NO DIODES

LOWER LEFT CORNER, BUT HAS U26 CHIP (JP PARTY ONLY)

- SERIES 4 CPU- NUMEROUS ROWS OF DIODES IN LOWER LEFT CORNER
- SERIES 3 I/O- LAST 2 NUMBERS IN PART # (03)
- SERIES 4 I/O- LAST 2 NUMBERS IN PART # (04)
- YOU CAN REPLACE ANY SERIES 3 CPU OR I/O WITH A SERIES 4, BUT YOU CANNOT GO DOWN A SERIES.
- TO MAKE SURE GAME CLEARS DURING RAM CLEAR, REPEAT THE CLEAR ALEAST 3 TO 5 TIMES.
- HEAP CORRUPT ERROR- BAD CONNECTION BETWEEN THE P.S., MONITOR, OR CPU BOARD

### BALLY VIDEO

- DOES NOT CASHOUT CREDITS- NEEDS A PARTIAL RAM CLEAR
- CLEAR CHIP GOES INTO SOCKET P10 TO THE MOST RIGHT SIDE
- TERMINAL ADDRESS NOT SET TO 1, THE GAME REMAINS IN DEMO MODE
- S/T NOT ACCEPTING COINS, REMOVE IDX COVER

### IDX

- THICKNESS TAB SET TO WRONG POSITION
- WRONG TYPE IDX IN GAME
- COIN MECH WIRES PINCHED BY COVER

- Kevin Noble

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**Slot Tech Magazine welcomes our new contributing technical writers Kevin Noble and Jake Olson.**

**Are you a slot tech with something to say? Do you have some special technical tips you'd like to share with your fellow slot techs around the world? Slot Tech Magazine is read by slot machine technicians, slot managers and engineers in Argentina, Australia, Canada, Cyprus, Germany, Gibraltar, Ireland, Korea, Mexico, New Zealand, UK, Japan, Saipan, South Africa and casinos across the US. For writer's guidelines, visit the website at slot-techs.com**





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# Bar Code Coupons and Paper Tokens

By Herschel Peeler



The WBA models 12 and 13 bill acceptors and the DBV-200 compatible head series are designed to accept currency, bar code coupons, and paper tokens. The HBP-5 Note Hopper is designed to complement these bill acceptors.

This article will compare and contrast Bar Coded Coupons and Paper Tokens so you can become familiar with each of their benefits.

## Overview

Bar Coded Coupons and Paper Tokens have a number of characteristics in common. Bar Coded Coupons originated in Class 2 jurisdictions where cash payouts are not allowed. They are also used in Class 3 jurisdictions for promotional awards of free slot machine play.

Paper Tokens were conceived

as a profit center for Class 3 jurisdictions. These are paid out of the games using a printer in place of a hopper.

These two aspects are not mutually exclusive.

## Appearance

Bar Coded Coupons are more likely to be plain and simple. They are typically printed on in-house printers (laser or ink jet). They may be printed to represent any value that fits the immediate need, such as a hopper payout.

Paper Tokens usually have a more esthetic appearance, and convey a look and feel of value. They can be made to look almost like currency. Paper Tokens usually are printed in an even currency denomination (\$20 paper token, for example.) These are usually printed by a bank note printer.

## Cost

Bar Coded Coupons can be printed in-house at a low cost. The dispensing printer is about half the cost of a bill hopper. Paper stock is cheap (thermal paper). More changes to the central management system can be required and many of the features can tie in with other parts of the system, such as Player Tracking. Lowest entry cost.

Paper Tokens are usually printed by a bank note printer and handled the same as chips. Some amount of time must be allowed for lead-time. Higher entry cost. Professional design and special printing requirements make for more planning and lead-times. Bill hoppers tend to cost more than printers. It may be implemented in such a way that no special monitoring system or slot software changes are required. (Personally, I wouldn't consider that prudent.) The tokens collected as memorabilia may well offset the total cost of the issue.

## Security

Bar Coded Coupons can be easily copied, and are secure only within the computer system that is used to validate them. Each coupon is a serialized transaction and can only be redeemed once.

Paper tokens can be more difficult to counterfeit. Paper tokens can be made as good, or better, than US currency when properly designed.

## Handling

Bar Coded Coupons are serialized when printed. A central computer system oversees the generation of the coupons, and validates each coupon as it is redeemed.



These are intended for one use only.

Paper Tokens can be handled the same as cash within a casino. Each token may have its own serial number, and can be tracked and validated the same as a coupon. It may even be used as cash within the casino for other purposes even if a currency acceptor is not used.

### Equipment required

Bar Coded Coupons are accepted by many modern bill validators. Printed on a laser, ink jet, or even a thermal printer of common capability. Can be dispensed by a printer in the game. In this case, a thermal printer is most typical.

Paper Tokens are also accepted by the same bill validators. It is not suggested that they be printed in-house by even the best commercial printers. These should be printed by a bank note printer. Tokens can be dispensed by a bill hopper, just like bills from an ATM.

### Collectible value

Bar Coded Coupons are not likely to be collected and saved as memorabilia. You can count on every one that is printed to be redeemed.

Paper Tokens have the potential of being collected like gaming chips. In this case, many of the tokens may never be redeemed. This gives the casino a small rev-

enue source. Tokens may have commemorative themes, enhancing their value to a collector.

### Use as a promotional item

Bar Coded Coupons can be registered to a particular player when used with a Players Club card system. Centralized control allows the coupon to be issued as credits only.

Paper Tokens can also be promotional items, but are used as cash, and can only be controlled as cash within the casino.

### Regulator Interest

Minor changes need to be made to the slot monitoring system to allow for bar coded coupons. Coupons leave a

trail that can be followed.

Paper Tokens require no changes in procedure since they are used the same as chips. Tokens leave no trail to be followed and can be handled the same as cash. It is expected that they will be regulated by an amendment to Regulation 12.

### Summary

Paper tokens, even if they are printed on bank note quality paper may have a life measured in months. In some ways, this is more good than bad. Each issue can be a commemorative issue. It can be expected that many of these tokens will never be redeemed.

- Herschel Peeler  
[hpeeler@slot-techs.com](mailto:hpeeler@slot-techs.com)

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# Tech Tips from Sky City

By Jake Olson



I work at SKY CITY as a board level tech. I mostly repair monitors. One thing I'd like to share with the techs out there is some repair tips for the power supply in the Kristel monitor, 48cm.

Instead of going through the whole process of troubleshooting the power supply, I'm sure there are some techs that would like to take a shortcut as I do. Changing out the following capacitors will solve the power down problem:

**C513-100uf@25v**  
**C614-100uf@25v**  
**C616-100uf@25v**

When C616 capacitor is bad, be sure to test the horizontal output transistor, Q606. Replace C803-220uf@16v. This capacitor is connected to the 12 volt regulator, if the regulator has a burned board around it, this regulator needs to be checked or replaced. It wouldn't hurt to check capacitor C522-47uf@160v. This would also cause no 88 volts to the set.

Changing out these caps should solve your problems. The monitor will go another year or two. I recommend the use of labels on your monitor showing when they have been repaired and maybe what has been replaced as well.

## Atronic Green Button Board

I say green because the new Atronic machines have a red button board.

I have been sending these boards in to have them repaired or replaced but it is expensive and there's no telling how long you have to wait for a replacement. You can repair it yourself and save your casino the expense and the down time.

The symptom is that there is no power to the comparator and the coins drop back to the tray. You have already checked all the wiring that is connected to the comparator, mindful of the fact that a bad connection (broken wire) would also cause no acceptance.

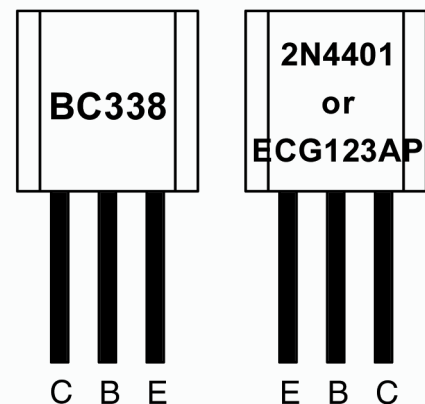
The solution is to replace the transistor that is sitting at the upper left-hand corner of that board, designated as T2.

This transistor's part number is BC338. It will cross to an ECG123AP if you don't have the original part. You can also use the commonly available 2N4401.

When replacing it with the ECG123AP or 2N4401, you have to solder the transistor in the opposite direction. There is a transistor sitting next to it. Note that the transistor is soldered in toward the outer edge. This is about the simplest way I can explain it.

Later and happy troubleshooting

- Jake Olson  
 jolson@slot-techs.com



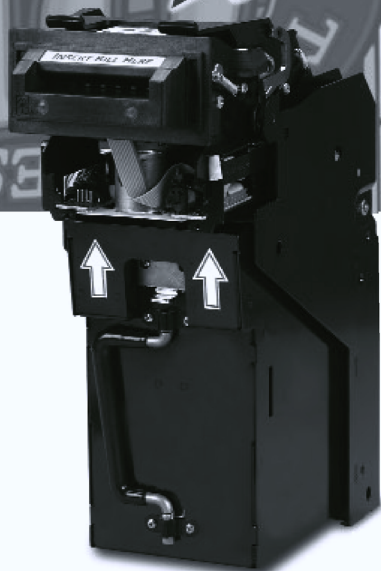
**The BC338 can be replaced by a 2N4401 or an ECG123AP. Remember to mount the transistor the opposite way as the leads are reversed.**



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# Seven Keys to the Successful Slot Floor

By Ken Locke



**W**hat's the secret? What is the diabolical formula that allows one casino to make millions every weekend and one right across the street to falter? Is it marketing and advertising? Well, yes. That is a big part of what gets them in the door. Is it the biggest sign or greatest headliner act in the showroom? Maybe it's a cool roller coaster surrounding the property. Perhaps it's just good old-fashioned customer service.

Truth is, it's all those things: A total package, an all-encompassing entertainment experience (at the very least, one that is better than the other guy's). The one common factor between them is the slot machine.

No matter how bright the lights are, no matter how tall the towers or ideal the location on the strip, it is still the slot machines you futz with every day that are the Kings of the Casino Moneymakers. That having been said, what are the ingredients to a successful and prosperous slot floor?

Slot Tech Magazine pooled its vast resources (eye roll) and talked to seasoned slot pros from all over the gaming planet. We asked precisely what it takes to keep machines humming, players happy and cash rolling in. Here's what they said.

## #1 Testing, Testing, 1, 2, 3 . . .

Most, if not all of today's modern slots have very comprehensive diagnostic procedures imbedded in the game instruction firmware.

Mike Provost, Service Tech III for Sodak Gaming says, "Rule number one, know your self tests. Rule number two, see rule number one."

Mike's not a wordy man, so I pressed for a more specific answer.

"Knowing your diagnostics is essential to maintaining and troubleshooting any slot. If you've got a complete Input/Output test from a slot, chances are you've got a good machine."

If you have ever set foot in any Native American Casino, you have at least heard of Mike Provost and you know he's right.

These are simple things to learn and practice. Assign your newbies to do complete I/O tests until they're fully proficient. It helps them to understand what system

they are testing.

Mike also adds, "it's not a bad idea to buy lunch for your manufacturer's techs occasionally... no wait, always."

## #2 Cut back on the Gadgets

If you have ever been to one of the big gaming shows in Vegas, you have seen every conceivable doodad that can be bolted to a slot machine. It's easy to get caught up in all the cool gizmos (see tip #4).

One of these things is the so-called automatic hopper filler upper. If you haven't seen this thing, it's a shovel-like apparatus affixed just under the reel shelf. It's filled to the brim with coins. An additional hopper level probe detects a low state and sends a signal to drop the shovel into hopper. Sounds pretty cool, right? However, while we fill only half as often, we will fill it up twice the amount. It might be a wonderful device but I just don't see the advantage.

Another is the cleaning strips designed to be inserted into a bill validator to easily remove gunk from the sensor and belts. While sound in theory, we're still using a solvent here. Alcohol and acids are both corrosives and as such leave a residue, cloud-



ing optics and degrading belts and pinch rollers. The real kicker here is that use of these products may void the manufacturer's warranty on the unit. And yes, they check.

But there are some good gadgets too. I like the new white LEDs to replace the incandescent bulbs in player panel switches. They last longer, dissipate less heat and have a much cleaner and brighter look.

### #3 A Lay of the Land

Dave Souther from the good ship Belle Terre in southern Indian had this to say: "One thing that bothered me about the early Gulf Coast property (where I used work), was how banks of machines were placed in a haphazard arrangement. The whole layout was confusing, not only to me as an employee but for the patrons as well. I can't count the times where I have helped a lost guest to find their way to the bar, bathroom, cashiers cage etc."

His point? The arrangement of the floor counts. While most technicians don't have a large say in the actual layout of the floor, good slot directors listen to your suggestions. So, speak up. Encouraging more play and ease of movement for the players is paramount but giving credence to day-to-day maintenance of the machines is also a consideration. As it is, some of us already feel like glorified furniture movers.

Slot Tech Magazine

When Dave moved to his next casino, it was very different. "The entire floor was symmetrical. The banks were straightly aligned from one end of the floor to the other. All nine-inch top boxes were in the center of the floor. All others (round tops and casino tops) were reserved for locations along the wall. Also, no progressive signage

was placed in the center of the floor. This arrangement gave an open-air feel. The philosophy was that patrons would be more comfortable when they don't feel lost." Makes sense to us too.

### #4 Tool Time

Tools are great. I love tools. I am a tool junkie. But it's all good because I am a techni-

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cian. I know how use them and almost half the time I know how to fix stuff. A floor person, on the hand, is a menace to society with a tool. Floorons (rhymes with moron) as they are sometimes called in mountains of Colorado, could be responsible for 50% to 80% of hard breaks out on the floor. I actually saw one with a ten-inch flat head screwdriver in a kind of a holster.

Coin jams and bill jams are well within a floor attendant's purview but give them a whittled chopstick or something. Gouging coin entry assemblies can cause burrs that can cut a patron's hands. Scraping out quarters from an escalator will only increase the recurrence of jams.

A good rule of thumb is, if you can't fix it with your fingers, call a tech.

### **#5 Basic Training. Oorah!**

Our good friend and erstwhile editor-in-chief, Randy Fromm, can tell you there is a big difference between a slot tech and a formally trained electronics technician. He and I both have spanned the globe training novice and seasoned techs alike. One thing is always the same; they all needed training.

Training your techs, new and old, is critical to the ongoing success of your floor. New technologies and gaming platforms are rolling out almost every week. We have to keep up.

There is an old training

axiom, "If you think education is expensive, try ignorance." This gets truer every day for gaming. Try visiting [www.igttraining.com](http://www.igttraining.com) to get your folks up to speed (shameless plug).

Still too much of a cheap-skate? Start your own program. Start by bugging a machine and challenge your team to fix it. A good mentor system is a good thing too. Formal, informal and continuous on the job training are parts of complete training program.

### **#6 Play a Prevent Defense**

Uttering the words "preventive maintenance" gets me a lot of laughs in just about every property I enter. Why is this such a big joke? I know time is money. I know some of you work 5000 game floors, but PM is 'see-Spot-run' stuff. It's done in every other aspect of technology maintenance, so why not slots?

Here's a sample Preventive Maintenance schedule.

*Every month:*

*Clean and inspect*

*Bill Acceptor path, belts and sensors*

*Coin Path*

*Monitor screen and mask*

*Player panel switches*

*Reel Strips and Glass*

*Every Three Months*

*Bill acceptor belts and pinch rollers*

*Coin-in encoder optics*

*Vacuum the lower module*

*Reel and door optics  
Fluorescents and exhaust fans*

*Every Six Months*

*Clean and/or adjust: Hopper bowl, coin exit path, motor armature, coin optic sensor and coin level probe, wiper, coin comparator and slot handle microswitch.*

### **#7 That's the Ticket**

The future is TITO and TITO is the future. I refer, of course, to Ticket In Ticket Out systems. This really is a shameless plug considering my day job at IGT but hear me out.

The advent of thermal tickets generated as a cash voucher is a miracle for every slot operation. Quite simply, it replaces coins as a Cashout option. Consider for a moment just how much effort is involved in the storage, handling, security and dispensing of coins.

Coin dust, worn hopper knives, down time because of jams and empty hoppers. Shall I go on? It cuts back on almost every slot headache you run into. Although it may increase the whining of lazy floor attendants only showing up for tips.

This is no by means a definitive list but it's a good start. Look your operation. See for yourself if it is really all it can be. See you next month, dear reader.

- Ken Locke  
[ken.locke@igt.com](mailto:ken.locke@igt.com)





Pocket troubleshooting guides for slot machines have long been a mainstay and lifeline for floor techs. For the novice techni-

cian, they are critical to the quick and accurate interpretation of error codes. For the more experienced technicians, they serve as a gentle

reminder of some of the more obscure problems seen in the past but forgotten over time.

At the Global Gaming Expo, JCM announced and released a pair of pocket guides for their DBV-200 and WBA units. These handy reference guides contain all the useful information a floor tech is likely to need. Data such as troubleshooting guides, diagnostic tests, standard testing, DIP switch settings and error codes are listed along with preventative maintenance techniques and calibration procedures. Contact information for technical support and parts sales as well as JCM American regional offices are also listed. Durable, plastic pages assure indestructibility.

The part number for the WBA Quick Reference Manual is 960-000027. The part number for the DBV-200 Quick Reference Manual is 960-000028.

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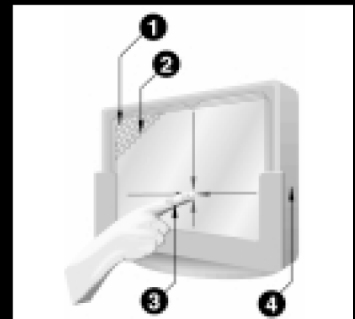
- Over 90% of all touch gaming machines rely on MicroTouch's capacitive touchscreens, worldwide.
- Capacitive touch technology is the most reliable touchscreen on the market, tested to over 225 million touches without failure
- Based on extensive field experience, there's negligible maintenance required and less machine downtime with MicroTouch touchscreens.
- Capacitive touch technology is unaffected by on-screen contaminants, such as spilled liquids, dust, and dirt.
- ClearTek® 3000 capacitive has antibacterial characteristics called "CleanScreen," which controls the growth of bacteria and other microorganisms on the surface of the touchscreen.

MicroTouch has been changing the way casino and bartop video games have been played for nearly 20 years. And, it's all due to the durability and reliability of MicroTouch capacitive technology.

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Voltage is applied to the screen (1) and the electrode pattern uniformly distributes the low-voltage field (2) over the conductive layer. When a finger touches the screen (3), it "capacitively couples" with the voltage field, drawing a minute amount of current to the point of contact. The current flow from each corner is proportional to the distance from the corner to the finger. The controller simply calculates the flow proportions to locate the touch (4).

**Editor's Note:** Slot Techs around the world have access to a wonderful resource in the Slot Tech Forum, hosted by Pete Bachran. This public forum is available at <http://forums.delphi.com/slottech>

*As an example of the type of valuable information available, here is a recent thread on the subject of grand prizes and payout percentages. Edited for readability and punctuation.*

**IGT - Par sheets and Proms**  
**From: TERRYAHARE**

Amongst our slots floor we have 12 S-Plus machines. They were originally meant to be linked progressives, but it never happened. At present, they're all \$1 with top awards of 28k and use SS6478 proms giving 92% PO.

My boss has the idea of replacing the top award for a new car (value of 15k) adjusting the PO% to 95% and also changing the denomination to 25c, by either tokenizing i.e. \$1 for 4 credits or a hopper conversion.

I've never really delved into payout percentages, etc and I thought these changes above would be a simple matter. However, after going through the IGT web site, I find there is no program available with a top award of 15k. I put it to my boss that

we could compromise by setting the machines on 50 cents, i.e. \$1 for 2 credits (yes, we can do that sort of thing in this part of the world!) and the top award would then be 14k.

Can anyone explain how this will increase the overall payout percentages, since we will effectively be giving an extra grand away on top awards? I spoke to an IGT rep. He said if I tokenize the machines for 4 credits per \$1 token and up the top award to 60,000 credits, it will increase the payout percentage from 92 up to 93.02%.

Sounds good to me, but can anyone explain to me in English, how he did his sums?

I must also thank Randy Fromm for his excellent work. I'm the type of tech his Magazine was made for. I have worked on most makes and models of Slots/Fruits around the world but because I am always moving about, it's very difficult to become competent in all makes, and you can't remember everything. Now thanks to Randy, I even understand a little about Par sheets. I look forward to seeing some exposure on Aristocrat 540s though.

Thanks also to Pete Bachran, your Forum really ROCKS!

Regards  
Terry

**From: ELRIC69**  
**To: TERRYAHARE**

What jurisdiction are you in? SS8908 is a 3-coin game with a top award of 15,000 coins, 7.89% hold. (don't know about linked progressive capability)

Also, if you have access to the IGT website, just email one of the marketing dweebs with what you want. I'm sure they'll give you an SS program that will make you (and the boss) happy.

**From: VANCEROWLEY**  
**To: TERRYAHARE**

The secret to a successful progressive or car jackpot is firstly how often you want it to hit on average. This range of course will depend on your business and coin-in you are getting. You need to balance this out first before you choose the cycle of the game. This is the primary factor. There is no point, for example, of having a 256 stop game with one top hit per cycle for a car; the players would lose interest as the top hit would be very scarce. This, in combination with the number of machines on the progressive, needs to be looked at.

The next thing to look at is the percentage. You will need to see from other existing games, what performance

you are getting per hold percentage per game, per denomination and so on. You don't want to reduce the "low to mid hits" down too much while allowing for a higher top hit. If you are going to use a standard EPROM and have a higher value prize, then this needs to be taken into consideration as well.

You don't need to choose a game with the exact top hit that you are looking for. You can, for example, use a game with a top hit of only 10,000 Dollars, but give away a car worth double that. All you need to do is to calculate the difference between the price of the car and your top hit as a percentage of the coin-in you would get in one cycle. Whatever this percentage works out to be, deduct that from the base hold percentage and this will give you the net hold percentage.

The same is true for a car with a lower value than the existing top hit but add the percentage instead.

Having said all that, the game and EPROM you have currently (SS6478) will normally be fine for the job. This is a 3 reel, 3 coin multiplier, 128 stop game with 2 top hits per cycle at 8% hold and is quite a common and popular game used for progressives and car prizes. Your cycle time will of course, depend on what coin-in you are getting (or will get) once you have a nice car there to entice the players. But of course, since you are operating these now as standalones, as a conservative estimate you can base it

on what coin-in per machine per day you are getting now.

I am surprised that your boss wants to increase the payout percentage while reducing the denomination. Maybe they are performing badly at the moment. If so, it may be a good idea to get a new game anyway so the players will see something new as well as the car. This could be done with one of the many clones of this game and you could still use the same EPROM anyway.

I am sure you get the idea of what to look at first from the above. Let's get to the nuts and bolts of the matter. I will need to make some assumptions to give you some figures on this, namely your coin-in per machine per day to estimate your cycle time.

Assuming a conservative figure of 5000 coins per machine per day based on 25 cents denomination (as you said either converted or use tokenization) although I would recommend conversion. You said 12 machines, right? OK. So your base hold percentage is 8%. You have a top hit of 28,000 coins, which will give you \$7,000 Dollars towards your \$15,000 Dollar car. This means of course, the hold percentage will change. So we calculate the price of the car as a percentage of coin-in you would get in one (net) cycle minus the current top hit. Meaning that the cycle of the 128 stop game is of course  $128 \times 128 \times 128 = 2,097,152$ . This is 2 hits per cycle, so the net cycle is  $/2 = 1,048,576$ . You have to assume max coin play

which would be 3, so  $1,048,576 \times 3 = 3,145,728$  coins in one net cycle or \$786,432 cash value coin in per net cycle. The value of the car is \$15,000 and your top hit is \$7,000, which leaves \$8,000 to go. So  $8000 / 786432 \times 100 = 1.02\%$ . This deducted from your base hold percentage of 8.00% equals 6.98% or 93.02% payout percentage. Exactly what your IGT rep told you.

Now as to how often this car will be hit on average is concerned, this will depend on your coin-in as mentioned, but assuming 5,000 coins per m/c per day is simply this divided by max coin per game of 3 to give you 1,667 handle per m/c per day. Then the number of days per cycle for one machine can be calculated as  $1,048,576 / 1,667 = 629$  days for one machine cycle time. Seeing you have 12 machines, this will be divided by 12 to give you an average cycle time (based on 5,000 coin in per m/c per day) of  $629 / 12 = 52$  days average per car.

You then need to look at your volatility index of 15.203 for this game and calculate your percentage deviation but I will leave that for another time. Let me know what kind of coin-in you are getting on this kind of game on 25c and how often you would like the car to hit on average and I could recommend a different EPROM or game if you like.

I hope this helps.

Vance.

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12:00pm - 1:00pm

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Asahi Seiko - Coin hopper conversion, troubleshooting and repair.

3:00pm - 3:30pm

Afternoon Coffee Break

3:30pm - 5:30pm

3M Touchsystems / MicroTouch - Touchscreen Technology

9:00 am - 12:00pm

How Monitors Work - Part 2

Narrow Down the Problem - Intermediate Level

12:00pm - 1:00 pm

Luncheon - Sponsorship available

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Global Payment Technologies - BV troubleshooting and repair

3:00pm - 3:30pm

Afternoon Coffee Break

3:30pm - 5:30pm

Coin Mechanisms, Inc. - Coin Comparitor technology and repair

9:00 am - 12:00pm

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# Performance and Politics

By Frank Sutter

**T**he main focus of my writing thus far has been to familiarize the novice slot technician with the basics of his new job. I have chosen this pathway because when I started the job of slot technician, I took extensive notes on everything that I learned and I laid down a coordinated plan to organize these notes in a service notebook. These notes, and my personal experience, provide me with the unique opportunity to go into very fine detail about things that all technicians learned in their first days, weeks and months, but which most forget that they even had to learn. I would take this knowledge for granted as well but my service notes remind me of every single nugget of knowledge and how I gained it. Keeping an effective service notebook has been the key to a lot of technical success for me. It's a habit that I highly recommend. Although a slot machine is not the most technical equipment I have ever worked on, the job of slot technician, with all the knowledge that the tech needs to acquire along the way, has to be the most complex job I have ever had overall. Believe me, notes are a good idea.

To illustrate the overall complexity of the job, I have noticed that even the very simplest jobs, the ones we first learn about, become increasingly complex rather than simpler as we learn more about them. After all, I started out to write a simple article on clearing hopper jams and ended up writing for four months! The deeper you go

into the topic of slot repair, the deeper the topic gets.

In my view, this is what separates the experienced technician from the neophyte, that is, gaining a basic understanding of an ever-greater scope of problems. We start with a basic command of the most common problems on the floor, such as hopper jams, coin jams, and customer service. With time, we begin to gain a broader understanding of the daily flow of the casino floor operation and how the slot department fits into this big picture. This month, I thought I would take a step back from my normal, up close perspective on the technical details of ordinary problems and take a look at the other end of the experience spectrum, a look at the bigger picture.

In every job I have ever had, there have been two aspects that define the prospects of keeping the job and how well I might do in that position. Of course, there is a myriad of details contained within each major aspect but I find that when I set big-picture strategies, the details seem far more likely to shake out into their proper places. The two overall aspects that apply to any job are performance and politics.

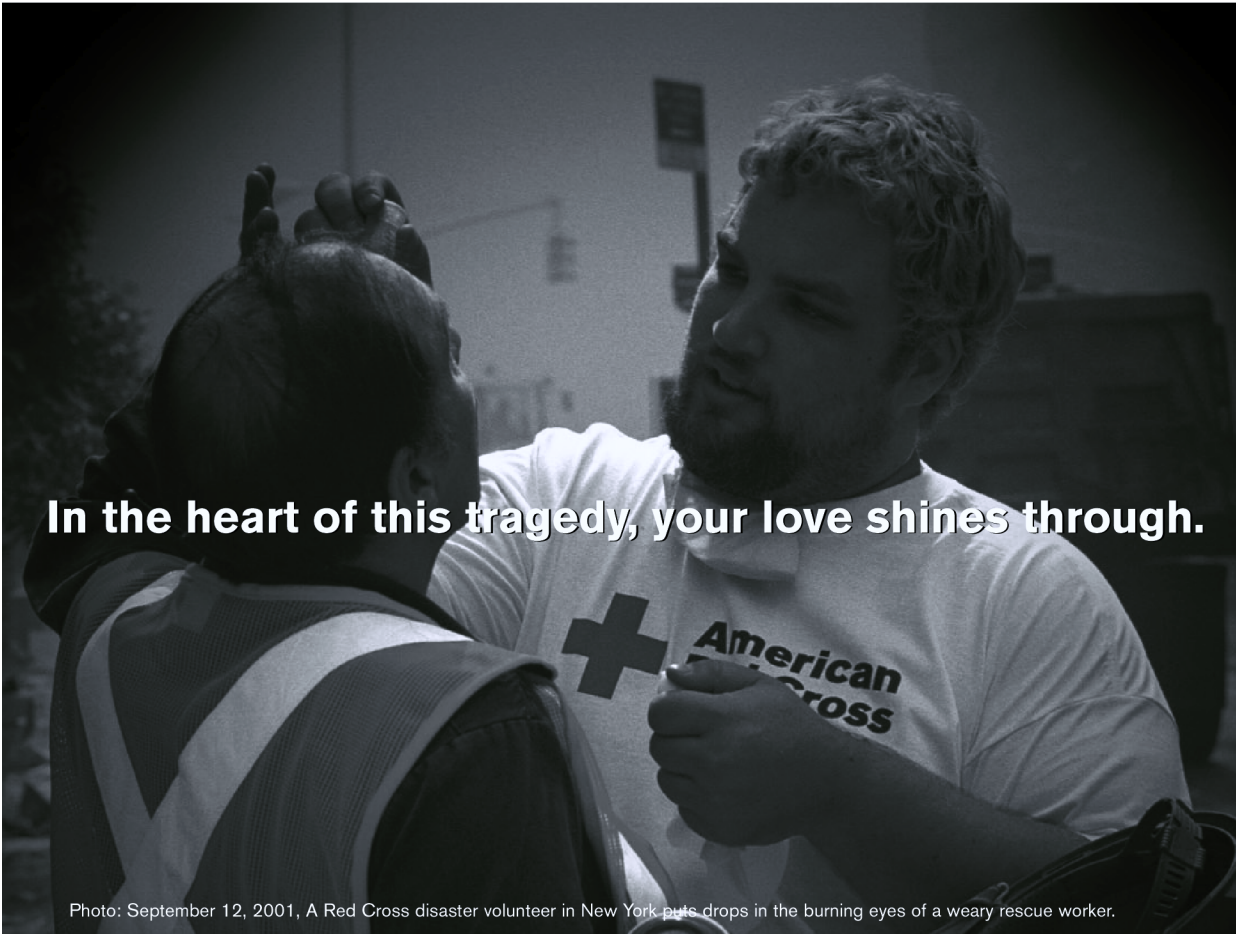
Yes, I said politics. If the world were fair, politics would play no role in the course of your career as a slot technician. As we all know however, the world is not fair and the reality is that politics will play a role in your work circumstances. Your performance

will also be critical, of course, but at least as important will be the way that you get along with your coworkers and your supervisors.

There is a positive side to this concept of office politics, as well as a negative side. Most of us are familiar with the negative side, which is that it so frequently looks like favoritism. On the positive side, however, it lends some sense of structure and job security to the work environment. In the end, however, it doesn't matter whether you like it or hate it, because politics are a fact of work life. Like so many other facts of life, if we fail to deal with it, it will tend to deal with us.

For example, let's say that two individuals are competing for the same position. The position presumably represents advancement. Both candidates want the job but only one can have it.

In this example, the two candidates are not equally qualified. In fact, the two are different in every way. Candidate one, a male, has been on the job only two years but quickly has increased his workplace contribution until he has been recognized as the second most capable worker on the staff. He seems to be quite vocal about the workplace issues that bother him and seems to feel that this demeanor gives him the appearance of caring about his job. The other candidate, a young female, is truly an average performer on the job. However, she has been with the company for



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seven years, is well liked by everyone and has been seen socializing with the supervisor after hours. She even visits his home on the weekends.

On the surface, job performance should be the only significant factor in making the decision and politics should play no role. Since politics is undeniably a part of everyday life (and certainly of office affairs), I see no valid reason why it should be left out of an important decision like this. The woman obviously gets along well with the boss. It seems obvious that this relationship would play a part in her chances to get this promotion. It may not be as readily apparent but upon further reflection, it seems logical that this relationship would lead the supervisor to feel that she would perform the new job more in accordance with the supervisor's wishes. She also gets along well with the co-workers and since leadership is essentially the ability to get people to buy into your plan, she might have a better shot at getting things done. While she falls a bit short in the job performance category, her job-knowledge is still considered competent. Since the new job would be more about supervising people and less about working on equipment, the people skills might prevail.

Getting the job is one thing. Keeping the job is another. If she were to be given the job, she would immediately face a large political problem. She would have to defuse the concept that she was given the job because she is female and that she is friendly with the supervisor. Undoubtedly, there will be unsubstantiated and irresponsible allegations of a sexual relationship and her "sleeping" her way to the

top. This often happens whenever a female is considered for a promotion. I think this sort of political mudslinging is unfortunate. Nonetheless, mudslinging is a fact of political life and how she handles it would be a test of her political abilities if she were to be chosen for the promotion.

If the male candidate were to be given the position, he would be more able to solve technical issues. This is a HUGE factor in performing the essential job of management, which is to facilitate the labor. Under normal circumstances, a manager is handed a task and a labor force to perform that task. How he accomplishes the task is up to him. His job is to get it done.

At that point, he must evaluate the task, sequence the steps required to accomplish it, then divide these steps into job assignments and hand them out to the labor force. This is called formulating an operational plan. It's not rocket science. Although some plans are better than others, most plans, if reasonably conceived, will work. The real trick is to service the labor force by solving the problems that come up; this is what I refer to as facilitating the labor.

There are many aspects to servicing the labor but they all can be broken into two major categories: task-related problems and labor problems. Task related problems include parts shortages and helping the technicians with the technical aspects of the job. Labor problems include motivation, attitude, and interpersonal relationships. It becomes clear that our female candidate will be better at solving the labor problems, while the male candidate will be better at solving the technical problems.

However, the male candidate would face a political problem of his own if he were chosen. His short term of employment would be regarded as insufficient by most of the other workers and the allegation would be that he hadn't "earned" the job, regardless of his stellar performance.

Between the two, I believe that I might choose the female candidate. That decision would be based on her technical sufficiency, her interpersonal skills, and her years of experience and loyalty to the company. The fact that she experiences the same workplace issues as the male candidate and has a greater tendency to accept and deal with them (rather than "voicing her concern") certainly doesn't hurt, either.

It's important to consider the supervisor's point of view on these decisions before throwing around accusations of favoritism. The supervisor faces unique challenges and his job is somewhat more difficult to understand at times. This is not to say that favoritism never enters the picture because it certainly does. However, when a decision does not go the way you expect, it doesn't always indicate a nefarious motive. You must understand that sometimes, there may be good and legitimate reasons for why decisions are made the way that they are, even if you don't agree. Everyone is responsible for workplace moral, and it's up to all of us as individuals to do our parts.

Till next time, keep 'em runnin'!

- Frank Sutter  
fsutter@slot-techs.com



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

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

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



The monitors used in video slots are designed for quick, easy, and safe repair. Students will

learn the theory of operation of all types of monitors and how to repair monitors down to the component level. Of course, monitor safety will also be discussed.

**Randy Fromm's Casino School 1944 Falmouth Dr. El Cajon, CA 92020-2827  
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## Patriotism Shows at G2E



**T**aken from high atop the giant WMS Gaming booth, this image sums up the feeling of the Global Gaming Expo, held a scant three weeks following The Attack of September 11th, 2001. Symbols of patriotism were abundant, with the overall feeling of showgoers reflecting those of the general population, that the United States of America will outwit, outplay and outlast our enemies.



Unidesa Gaming's General Manager, Ángel Gallego commented "Tremendo! Tremendo!" upon their signing of the MIS Euro-alliance agreement the opening day of G2E.



Greg Kobe and Jim Clifton of Kobetron show their firmware verification equipment.





SDG made a nice showing with their unique Diamond Prize Center



Covering a show like G2E does wonders for your appetite.



The AG&E booth before opening time, featuring Wells-Gardner monitors  
Slot Tech Magazine



I was pleased to see this new Bally machine featuring Ray Charles. One of a series of three, all of them will include audio assistance features and a Braille button deck to allow visually impaired players the opportunity to play unaided. At one time, Ray had campaigned to have America the Beautiful become our national anthem. Bally also showed their Popeye collection (below).







**E**ditor's Note: I go to trade shows to see new products like everyone else but I also love to experience the booths themselves. Manufacturers put a lot of time, money and creativity into these lavish displays and I, for one, appreciate their efforts. As you can see from this month's Slot Tech Magazine, I really loved Atronic's booth with its ancient Egyptian motif.

In addition to their latest game titles such as Sphinx II, Castaways and Crazy Fruits, Atronic was showing their slant top cabinet. The cabinet has some nice features including an armrest that is attached to the main door that swings up for unrestricted access, an easily accessible monitor, and a movable coin chute that easily moves out of the way for service access to the hopper. There's even a handy magnet attached to the side of the cabinet to hold the coin chute during service. Convenient drawer slides allow easy access to the coin drop area.



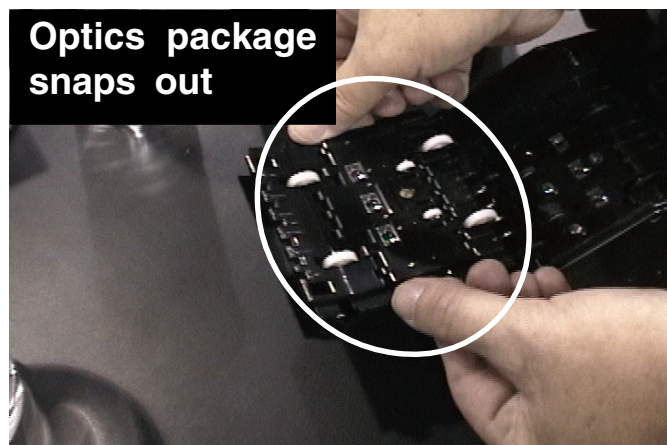
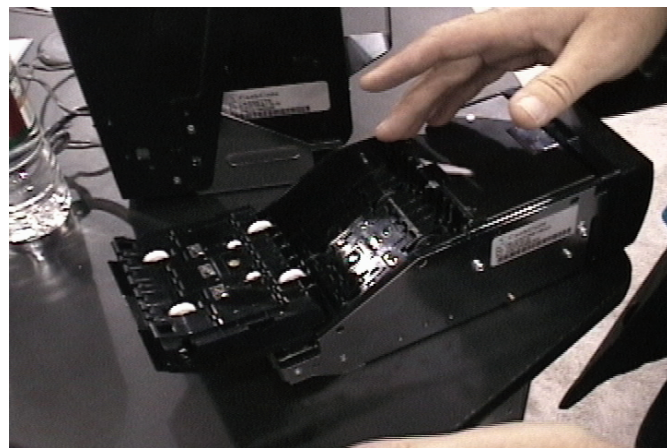
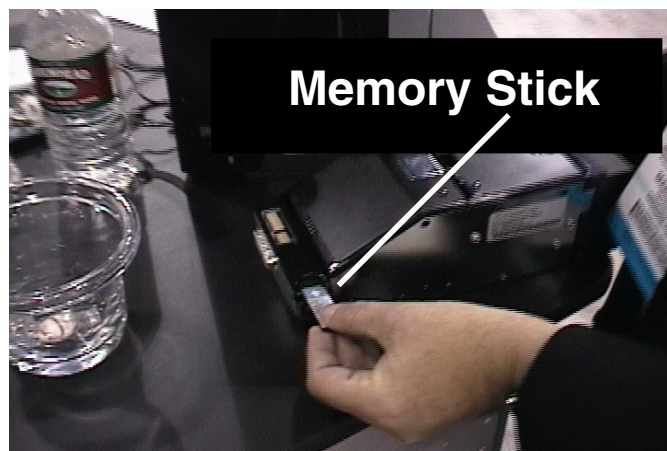
# FUTURE WATCH - THINGS YOU'LL SEE FEATURED

IN FUTURE EDITIONS OF SLOT TECH MAGAZINE

**C**ashCode's Marlon Silver demonstrated their latest universal bill validator. The unit has a number of unique features including a memory stick for programming changes, an easily opened bill path and a snap out optics package. Marlon was in the process of explaining a number of other interesting features such as the automatic bill centering mechanism (not shown) when their vice-president in charge of trade show paranoia dashed over to demand that all recording cease immediately. Regardless, it is an interesting unit, worthy of a full featured review in a future issue of Slot Tech Magazine.



Paul Pechinko with Money Controls' Pay Check ticket printer featuring automatic self-verification.



David Hamilton (l) and Dale Padjen (r) of Kaba High Security Locks showed a solenoid-controlled lock that works in conjunction with the player tracking system.

# VIDEO

The word "video" is a common one in Modern English. It is used as a noun to describe a television segment ("Let's look at the video") or a videocassette ("There's nothing on TV. Let's rent a video") or an MTV feature (Madonna's new video) but in the world of electronics, "video" is an adjective, used to describe a specific type of electronic signal: the video signal.

In a video gaming machine such as a video poker, video slot machine or Keno, the CPU board and its associated circuitry create three outputs that contain image information. They are known as the red, green and blue video outputs. Red, green and blue are the three primary colors of light. By combining red, green and blue in various combina-

tions, we can make any color we want. For example, red and blue combine to make magenta. Green and blue combine to create a color known as cyan, a sort of turquoise color. Red and green combine to create yellow. Of course, all three primary colors combine to create white.

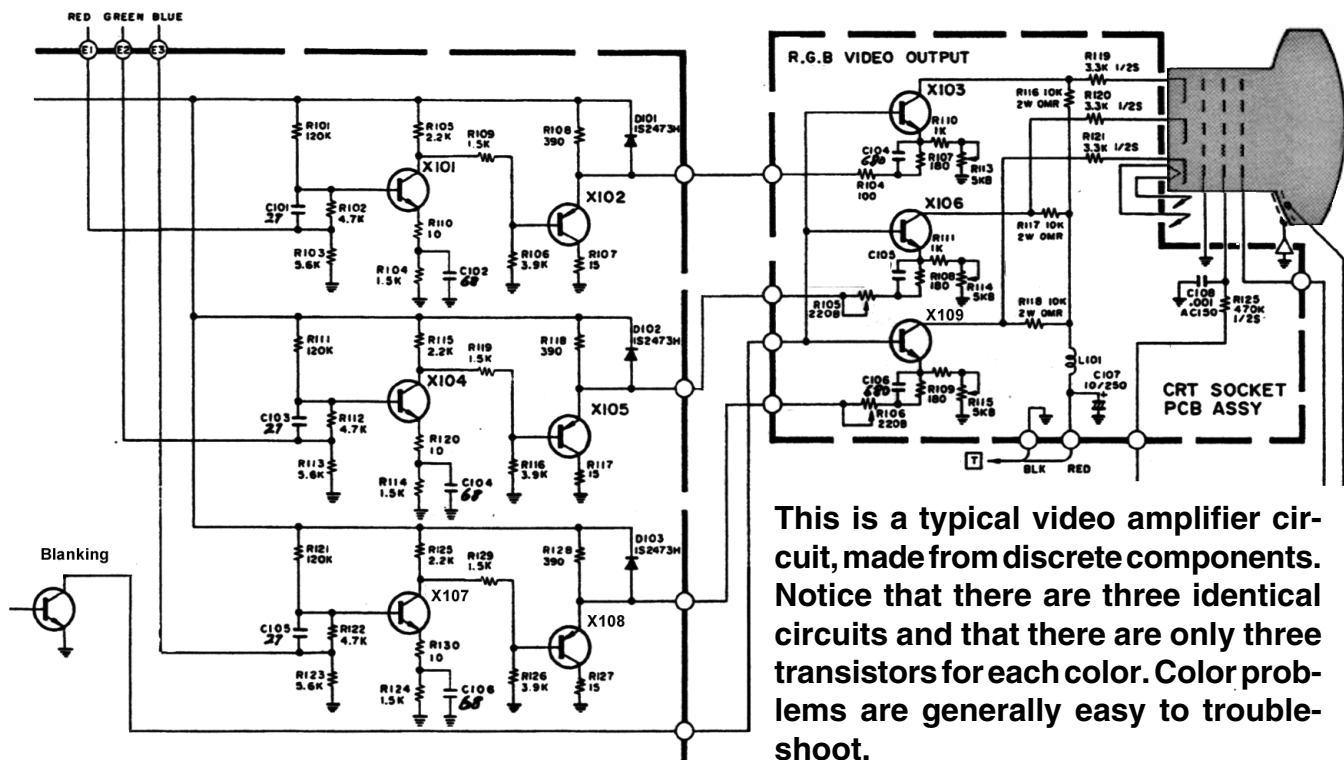
These three video signals are simply changing voltages. The video signals control the video amplifiers in the monitor, which, in turn, regulate how much red, green, and blue will show on the screen. Higher voltages at the monitor's video input connector will make a color very bright while lower voltages will produce correspondingly dimmer colors.

For example, if the game's PCB wants something to appear bright red on the screen (say,

the red heart on a playing card) it would put out around .7 volts to the red video output. This output is connected via the wiring harness and its associated connectors to the red video input of the monitor (duh!). This turns on the red gun in the monitor all the way, creating a bright red color on the CRT.

If the CPU wants something to appear red but not quite so bright, it might put out only .5 volt. .2 volt would create a dim red color. Naturally, zero volts is totally off.

If the CPU wants the color magenta to appear, it will send a voltage out both the red and blue video outputs simultaneously. You get the idea. Flesh tones and all other colors are displayed in precisely the same way. Your television



This is a typical video amplifier circuit, made from discrete components. Notice that there are three identical circuits and that there are only three transistors for each color. Color problems are generally easy to troubleshoot.



set at home works the same way as well.

But the video signals that come from the game's CPU aren't powerful enough to drive the electron guns in the CRT directly. They have to be amplified by the three (you guessed it) "video amplifiers" in the monitor and so we (finally) come to the subject of this month's presentation on gaming monitors – The video amplifiers.

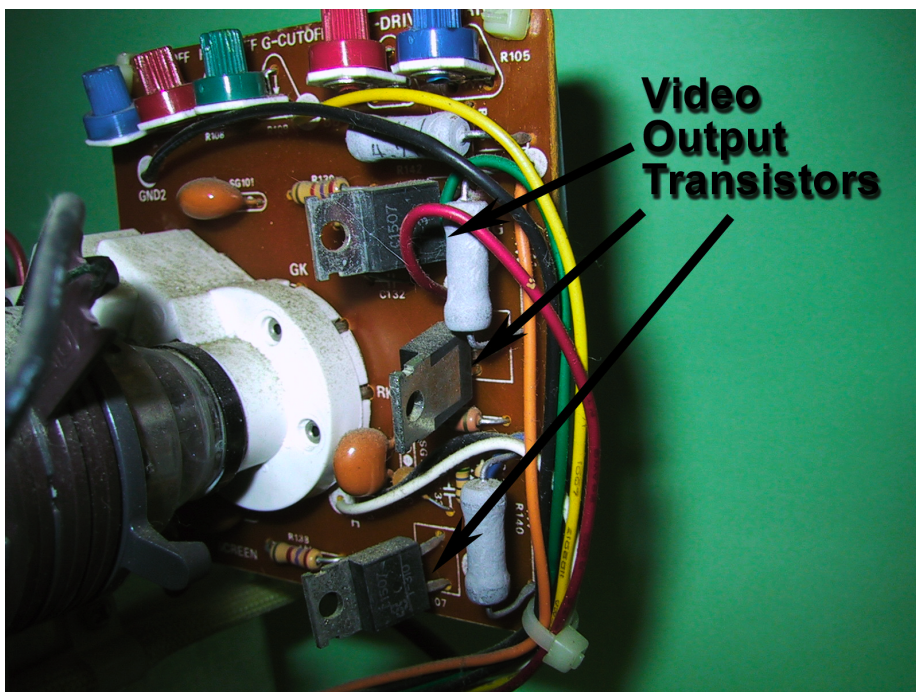
### The Video Amplifiers

There are three identical video amplifiers in a color monitor. The video amplifiers take the low-level video signals that come from the game's PCB, amplify them and send them to the video output stage. It is the video output circuitry that controls the electron guns in the CRT itself.

Let's take a look at some examples of video amplifier circuits, starting with an early design using all discrete components. There are three transistors in each of the three video amplifiers. The three video amplifier sections are identical, so we'll just look at one of them. Let's look at the red amplifier.

The video input is coupled to the base of the first video amplifier transistor, X101. The output of X101 is passed through a 1.5k resistor (R109) to the base of the second video amplifier, X102. X101 and X102 are located on the main printed circuit board assembly. This is the large printed circuit board that sits on the chassis below the picture tube.

After being amplified by X102, the red video signal is passed through a connector and a wire (colored red for convenience in trouble-shooting) to



the red video output transistor, X103 on the "CRT SOCKET PCB." Color monitors have a small printed circuit board, mounted on the end of the neck of the picture tube. On this board are mounted 5 or 6 small potentiometers (the color adjustments) and the three "video output" transistors. There is one video output transistor for each color: red, green, and blue. Most (almost all) monitors use a neck board for the video output transistors and the adjustment potentiometers.

The red video output transistor is connected to the red electron gun through a 3.3k ohm resistor (R119). Of course, the red electron gun is not really red at all. It is called the "red gun" because the electrons it shoots will only strike the red phosphor coating the inside of the picture tube. The three video amplifier circuits that drive the red, green, and blue electron guns are identical, the only difference being the final aiming point of the electron guns they control.

We can use this to our advantage when we troubleshoot a

monitor that has color problems. If we suspect that one of the video amplifiers is bad, we can compare its operation to that of the two video amplifiers that are working properly. For example, suppose your game is missing one of the three colors. Say you're missing the red in your video poker. At first glance, everything appears normal. The colored background is there (It's blue, remember?) and you see the cards but something isn't quite right. One thing you notice is that instead of being red, the hearts and diamonds are black. And, isn't the payable supposed to have a red background? That's black as well. Less obvious is the fact that all of the normally white words and numbers are now that cyan color mentioned previously.

It's now pretty obvious that we're missing red but we don't really know if the problem is in the monitor or not. A problem with the game's computer may be keeping the red video signal from being generated (not too likely) or the connection between the computer and the monitor may be bad (entirely possible, especially where the monitor connectors

slam together at the back of the chassis). There is an easy way to determine if the problem lies with the monitor or elsewhere: Swaptronics! In gaming, it's usually the fastest way to narrow down a problem like this.

Let's get back to our "no red video" problem. Now that we have narrowed it down to the monitor (and even to the red video amplifier section of the monitor) all we have to do is TURN THE MONITOR OFF and test all of the transistors in the red video section. There are only three. Chances are very good that one of them will be bad. If you are missing a color as we are in this example, suspect the input transistor (first video amplifier). If you are working on a game whose symptom is a screen that is filled with a very bright raster (often accompanied by vertical retrace lines) of just one color, go right to the neck board and test the video output transistor associated with that color. Chances are really good that it will have an emitter to collector short, keeping the electron gun fully turned on. If you don't have a schematic and you don't want to trace the colored wire that leads from the second video

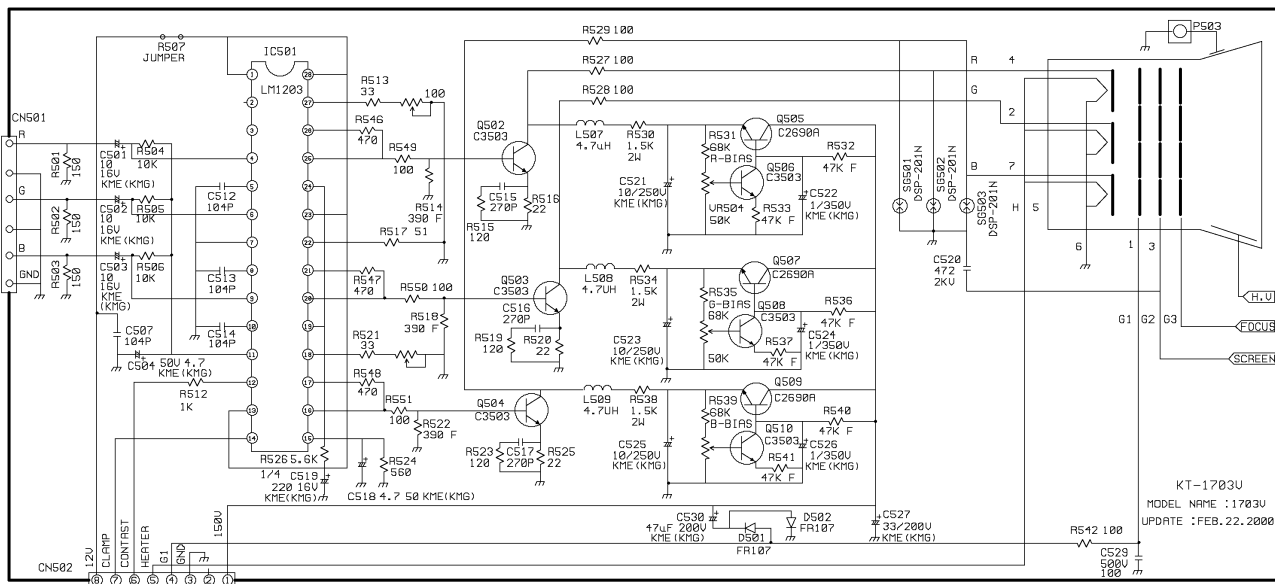
amplifier on the main PCB to the video output transistor on the neck board to determine which transistor controls the color you're interested in, just test all three. They're easy to get to. It's usually faster to go ahead and test all three even when you do have a schematic. If the video output transistor tests good, test the other two transistors in the video amplifier.

## Next Generation Video Amplifiers

Jump ahead about fifteen years and witness the change in video amplifier design with the development of the video amplifier IC. The LM1203 video amplifier is one of the most common video amplifier chips in the world today. Just about everybody that has a computer monitor on their desk has one of these ICs inside it. The LM1203 works in the same way as the video amplifier circuit we looked at previously in that it takes the low-level video signal from the CPU board (or video graphics board) and boosts it up so that it can drive the video output transistors that, in turn, drive the cathodes of the CRT. It has some advantages in that it can operate at a faster speed. The

LM1203 has a higher bandwidth than the video amplifier circuit we just looked at. Interestingly, the use of the IC doesn't really reduce the complexity of the circuit. As you can see, there are still three transistors for each color, in addition to the IC itself.

Troubleshooting this circuit is still possible, even without using an oscilloscope and armed only with the ability to test discrete components. As before, there are three identical circuits in addition to the LM1203. As previously outlined, you can still test and compare the three circuits. If you can't find any bad components in the bad color's circuitry, try replacing the IC. Be aware that, contrary to what might seem logical, you cannot assume that any problem with the LM1203 will necessarily affect all three colors simultaneously. It is entirely possible that a problem with just one color, red, green or blue, could be caused by a defective integrated circuit video amplifier. That having been said, the LM1203 is a rugged workhorse and is not a common failure item in most monitors that incorporate it into their design.





# Plug-Compatible Replacement Monitor for Players Edge® Video Poker Machine

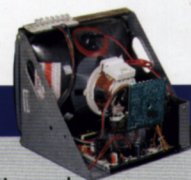


*Sharp Graphics, Vibrant Colors, Economical.*



Good news! You now can get a high quality 14-inch replacement open frame CRT monitor for your \*Players Edge® video poker machine at just a fraction of the cost of a new machine. This replacement monitor offers superior resolution, 0.28mm dot pitch, and vibrant colors that are certain to attract players to your gaming machine. Installation is straight forward (practically just plug-n-play), and it comes with a 1 year parts and labor limited warranty! ♠♥♦

\*Players Edge is a registered trademark of IGT Technology.



## VS14228TD04

### Picture Tube

Screen Size	14" Diagonal
Phosphor	P22
Face-Plate	Non-glare
Dot Pitch	.28mm
Transmission	57%
Convergence Error	0.5mm Max
Power Input	90 - 246 VAC/60Hz

### Sync Signal

H Scan Freq.	15.75Khz nominal (CGA)
V Scan Freq.	60Hz nominal

### Video Input

Input Form	RGB Separate, 0.7 V p-p
Bandwidth	50Mhz (-3db ) typical

Input Connector	15 pin D-Shell connector
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Max. Resolution	640(H)x480(V)/60Hz
Active Display Area	14" Diagonal

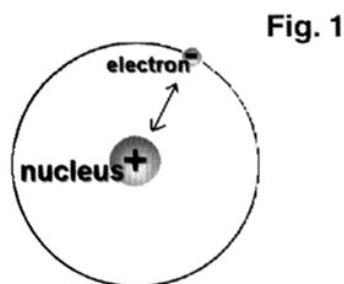


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There is nothing baffling about electronics once you understand a few basics. You do not need any mathematics to be successful at slot machine electronics repair and modern electronics in general. While we cover a lot of "machine specific" repairs in Slot Tech Magazine, it is important to know the basics as well. Let's take a look at the most basic part of electronics. In fact, it's the basic part of any element: the atom.



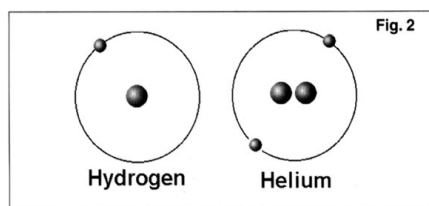
Electrostatic force keeps the electron in orbit around the nucleus because opposite charges attract each other. This is the first law of electrostatics.

The smallest part into which an element can be divided is called the atom. The atom consists of a nucleus and one or more orbiting electrons (fig.1.) The nucleus has a positive charge. The electron has a negative charge.

The electron stays in orbit due to an attraction between the positively charged nucleus and the negatively charged electrons. This is called electrostatic force.

**1st law of electrostatics . . .**  
**Opposite charges attract**  
**Like charges repel**

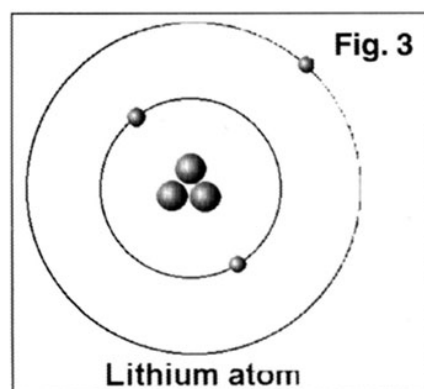
The nucleus is actually made of two types of particles. One type, the proton, has a positive charge. The proton is responsible for the positive charge of the nucleus. The other particle is called the neutron. As the name implies, the neutron is electrically neutral. It has no elec-



trical charge at all.

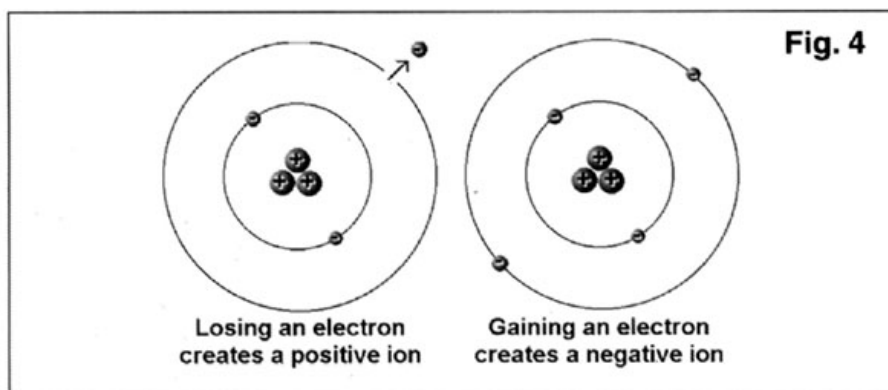
The number of protons in the nucleus determine what the element is (fig.2.) The atom on the left has just one proton. This is hydrogen. The atom on the right has two protons. This is the element Helium. Notice that there are the same number of electrons in orbit as there are protons in the nucleus. This atom is said to be balanced.

The lithium atom is shown in figure 3. Lithium has three



protons in the nucleus. This means we need three electrons in orbit. Each shell is limited to a maximum for the inner shell in two, so the third electron is moved to an outer orbit. The electron that's by itself in an outer orbit is easily pushed out of orbit by heat, light or an applied field (such as a magnetic field.)

When this happens, the atom is no longer balanced. It has a net positive charge because there are now more protons than electrons (fig.4.) We give this unbalanced atom a new name. We now call it an ion. This is a positive lithium ion because there are three protons in the nucleus (remember, the number of protons in the nucleus determines the type of element) for a +3 charge, but only two electrons for a -2 charge. The net charge is  $+3-2=+1$ .





Sometimes the electron in the outer shell can ask a fellow electron to join him in the outer orbit. When this happens, the atom has a net negative charge and we now call it a negative ion. There are three protons for a +3 charge, and four electrons for a -4 charge.  $+3-4=-1$ .

The copper atom is shown in figure 5. The copper atom has 29 protons in the nucleus. The inner shell is limited to just two electrons. The next shell can hold eight, and one after it eighteen. Again, we have a condition where a single electron is left in orbit by itself in the outer shell. When copper is refined into its pure metallic form (such as in a wire), the atoms join together in a metallic bond. In doing so, they lose their grip on the electrons in the outer shell. These electrons are now called free electrons.

It is the movement of these

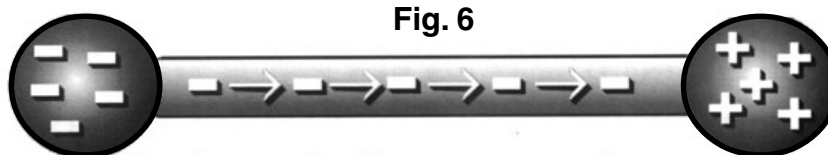


Fig. 6

**Electrons in the copper wire are attracted toward the positive sphere**

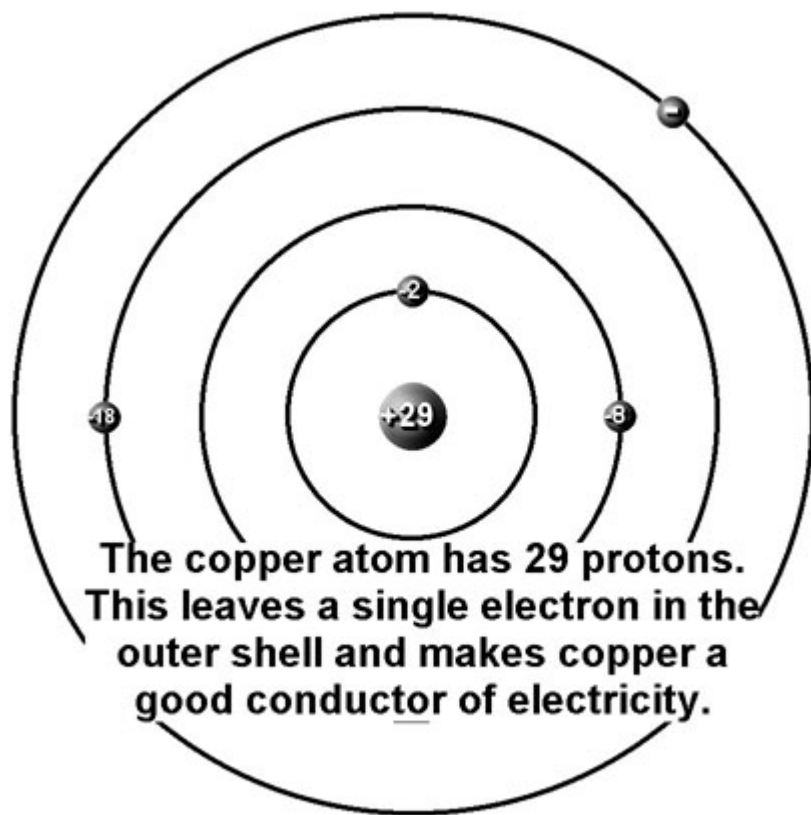
free electrons that we call electric current. We can control the movement of the electrons with “electronics.”

Suppose we place a charged sphere on each end of a piece of copper wire (fig.6.) The sphere on the left has a charge of -5, the sphere on the right has a charge of +5. Another term for a charge is “potential.” Since like charges repel and opposite charges attract, the negative charge on the left will push the free electrons toward the positive charge on the right which attracts them. Soon (almost instantaneously), the charge in both spheres has been neutralized.

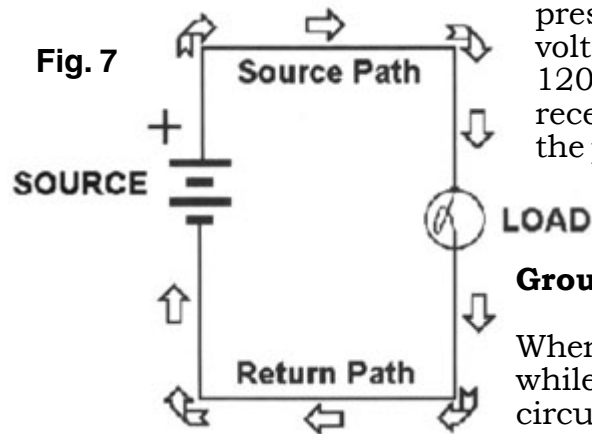
Notice which way the electrons flowed? The flow of electrons is from negative to positive. Engineers refer to this as “electron current.” HOWEVER, it is generally much easier to understand the way electronic circuits work if we think of electric current the same way Benjamin Franklin did. Franklin thought of electricity as some kind of “invisible fluid” that flowed from positive to negative. Although this defies the logic of “electron current,” most people still believe that electric current flows from positive to negative. Modern research seems to bear out Franklin’s hypothesis as well. When we discuss the electronic circuits in games, and when we are tracing the flow of electric current on a schematic diagram, we will use Ben Franklin’s idea of electric current flowing from positive to negative. We call this concept “conventional current.” It is also referred to as “hole flow.”

In this circuit for instance (see figure 7) we have a battery and a lamp connected as a complete circuit. What is really happening in this circuit is that the electrons are forced out of the negative terminal of the battery, through the filament of the lamp, and are attracted to the positive terminal of the battery. It is the friction of the electrons rubbing the inside of the filament that causes the filament to glow.

According to Ben Franklin’s conventional current



ever, current is flowing from positive to negative. You will see the advantage of the concept of conventional current as we look at more complex circuits in future lessons.



## Electronics Terminology

We use a lot of different terms in electronics. Although the names we use may seem strange, the concepts they represent are really quite simple. Take the word “voltage” for example. People use the words “voltage” or “volts” a lot. Your car battery is probably around 12 volts. The power that comes from the wall receptacle is around 120 volts.

Voltage is the term we use in electronics to mean pressure. We measure voltage in volts. Both terms are named for the Italian scientist Alessandro Volta. Volta invented the chemical battery in 1795 (many electronic terms are named for the person that had a hand in the discovery or development of electric phenomena). The terms “charge,” “voltage,” and “potential” are often used interchangeably, although there are subtle differences between them on a purely theoretical level.

Voltage means the same to electricity as pounds per square inch does to water. We

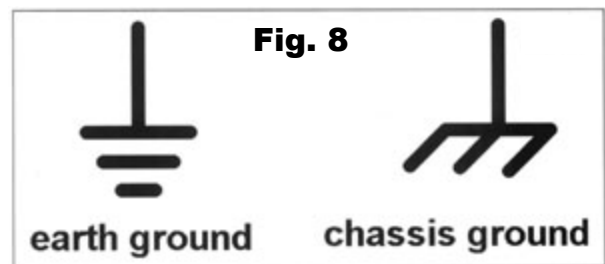
can measure water pressure with a pressure gauge. We can measure voltage with a voltmeter. A 12 volt battery has twice as much pressure as a 6 volt battery. The 120 volts from your wall receptacle has ten times the pressure of the 12 volt battery in your car.

## Ground

When we make voltage tests while repairing electronic circuits, we have to establish one point as a reference point and make all of our voltage test with respect to that point. Remember, voltage is potential difference so we are going to measure the voltage between the point we want to test and our reference point. We call this reference point “ground.” Ground is always the 0 volt reference point in electronics.

The commonly used symbols for ground are shown in figure 8. The chassis ground symbol on the right is used when the ground is not connected to the Earth itself, but when it is a common connection between electronic circuits such as in the chassis of an automobile or the chassis of a videogame monitor. The symbol on the left is for “Earth ground.”

The Earth ground is just that. It’s a connection to the Earth itself through metal rods or water pipes that are buried in the ground. The first commercial use of the Earth ground came with the telegraph, where ground was used as the return path for the telegraph circuit. This meant that they could run a



complete circuit with just one wire, a considerable savings when you’re stringing copper wire all the way across the country.

Most automobiles and trucks have the negative terminal of the battery connected to the chassis. This is called a negative ground system. Any voltages that we measure in a negative ground system will be positive with respect to the ground. Some older vehicles (like the 1962 Datsun pickup truck I used to own) use a positive ground system. In the positive ground system, the positive terminal of the battery is grounded to the chassis of the vehicle. If we were to measure the voltages in the positive ground system, they would be negative with respect to ground. We often use both positive and negative voltages in electronics.

Whenever we have a complete path for electrons to follow and we have a potential difference (pressure) to push them through, we have something called a circuit. The flow of electrons through a circuit is called “current.” Because there are billions and billions of electrons flowing through a circuit, we have a name for a large quantity of electrons. 6.2 billion, billion electrons is called a coulomb (named for Charles Coulomb.)

We measure the flow of electric current in “amperes” or “amps” for short. An ampere is one coulomb/second. The





**A typical carbon-film resistor**

howampere was named for Andre Ampere, a French mathematician.

Resistance is defined as the opposition to the flow of current in an electronic circuit. We measure resistance in "ohms," named for Georg Simon Ohm. The Greek letter "omega" is the symbol for ohms on a schematic drawing (fig.9.)



**Fig. 9**

A material that is a good conductor of electricity has a low resistance. Something that does not conduct well has a high resistance. To obtain a precise amount of resistance, we use a part called a "resistor."

## Resistors

The schematic symbol for a resistor is shown in figure 10. The amount of resistance (in ohms) is usually marked next to the resistor symbol on the schematic diagram.

If you need to buy a replace-



**Fig. 10**

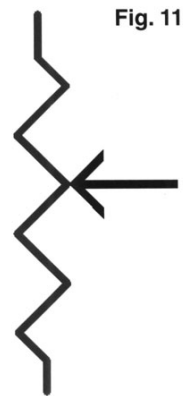
ment resistor for something, you can't just go to the electronics shop and ask the man for a resistor. You have to be more specific. There are some specifications for resistors. The first specification is the resistor's value in ohms. In gaming, we use resistors with values from as little as one tenth of an ohm, to a million ohms or more.

Large power resistors are large enough to have the resistance printed right on them, but smaller resistors use a color code to indicate their value. We'll take a closer look at resistors and the resistor color code in next month's "Slot Tech Electronics 101."

The next resistor specification is called tolerance. Tolerance refers to the percentage of accuracy of the resistor. For instance, 100 ohm, 5% resistor might be somewhere between 95-105 ohms. The tolerance is indicated by the metallic fourth band on the resistor. A gold band indicates a 5% tolerance. A silver band is 10%. Virtually all modern electronics use resistors with a tolerance of 5% or less.

The last resistor specification is the "dissipation" of the resistor. The dissipation is measured in "watts" so it's

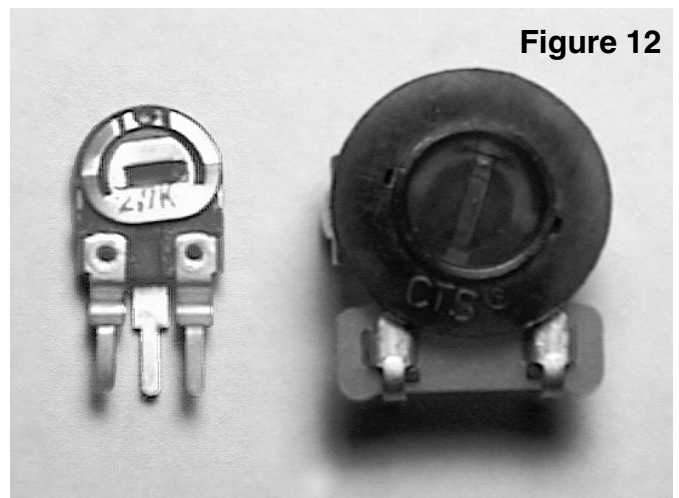
sometimes referred to as the "wattage" of a resistor. It's a rating of the resistor's ability to dissipate heat. Higher wattage resistors (5 watts or more) are generally "ceramic, wirewound" resistors that can get quite hot without burning up.



**Fig. 11**

One useful type of resistor is the "variable resistor." The variable resistor is also called a "potentiometer" (po-ten-shee-ah-met-er) or "pot" for short. We can use the pot as a volume control, a brightness control on a monitor or to adjust the voltage of a power supply. Of course there are countless other uses for pots as well.

Figure 11 shows the schematic symbol for a potentiometer. Figure 12 shows a couple of typical PCB mount potentiometers.



**Figure 12**

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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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