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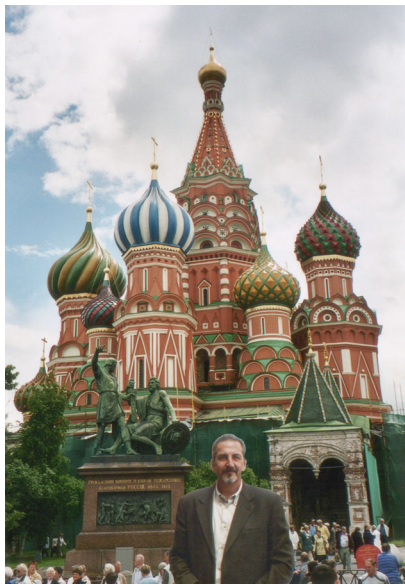
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Cover photographs by Dmytri Lizenko
Metro Jackpot, Kiev, Ukraine

I was fined 100 Rubles (around three bucks) for taking a photograph inside the Metro station. This is the receipt.

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Slot Tech Editorial

Welcome to the special, somewhat sideways edition of Slot Tech Magazine. This month, Slot Tech Magazine whisks you off to Russia for a visit with Russian Gaming Giant Unicum. First stop: The June 17th unveiling of the first WMS Gaming Bluebird machines available in Russia and the CIS. The presentation was made at a Moscow Yacht Club at a western-style barbecue. Being from The West, I felt right at home. From there, it was on to St. Petersburg for a tour of the Unicum factory and a (pre-

sumably) once-in-a-lifetime opportunity to witness the celebrated "White Nights" of the city on the longest days of the year. The travelogue begins on page 30.

Kevin Noble seems to be working his way through the alphabet, backward! He has written about Sigma and Mikohn and IGT and Bally and Atronic and AC Coin. This month, he's sticking to the As with a look at Aristocrat. Kevin's article begins on page four.

Real-world applications are a great way to learn about electronics. This month, Herschel Peeler gives us a detailed look at the Bally hopper controller system, complete with schematic diagrams. It's neat to see the simplicity and elegance of Bally's hopper control system and nobody explains things quite the way Herschel can. This is actually just the first part of a two-part series. Next month, you'll see how to build a simple test fixture for the Bally hopper. Turn to page 12.

Will the fun never end? John Wilson, Slot Tech Magazine's resident slot math guru, puts us into the thick of things when the pressure's on to create a slot bonus game and integrate it into an existing machine. It's a weekend chock-full of pencil chewing, beginning on page 24.

Finally, there is a brand new touchscreen technology on the horizon and Slot Tech Magazine is proud to bring it to you first. It's called Dispersive Signal Technology and . . . Are you ready? Are you sitting down? Well, stand up and jump for joy because this new technology takes the



Slot Tech Magazine publisher Randy Fromm (l) with WMS Gaming's Executive V.P. and Managing Director of International Operations, Seamus McGill at the Moscow introduction of Bluebird.

worry out of touchscreen sensor scratches. That's right. Scratches in touchscreens will no longer cause calibration or operating problems because DST works in a completely different way than existing touchscreens. Read about what our friends at 3M Touch Systems have been working on in their secret laboratories, beginning on page 34.

For those of you that are interested in attending my two-week Casino School, I have planned a class at Sycuan Casino in San Diego, California (July 12 - 23) and one at Chip In's Island Resort and Casino in Harris, Michigan (September 13-24). Read more on Page 13 or go to the website at slot-tech.com for more details.

That's all for this month ('Whew . . . That's enough!'). See you at the casino

Randy Fromm - Publisher
July 2004

Randy Fromm's Slot Tech Magazine

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SUBSCRIPTIONS

Domestic (USA)

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When I was asked if I wanted to drive up to Burlington, prep seven machines with Mikohn, and receive additional training on new Aristocrat Video Slot Machines, I said "yes." How can I pass that up? Accompanying me on my trip this time will be a fellow technician and good friend, Gary Smith. Arriving at the warehouse some 31 1/2 hours later by car, we bumped into old friends David Dalli (who is now part of the new video install crew) and Jerry Pastuovic. If you remember from the March 2003 issue of Slot Tech Magazine, Gary, Jerry and David made the trip to Windsor to help with our "BIG PROJECT." We reminisced for a few minutes but I was eager to dive into our little project. I wanted to start snooping around inside to see what the machine was made of.

Jerry had already grouped our machines together on a workbench in the back of the building and to our surprise, Jerry and his crew of technicians had already installed and wired all the Mikohn hardware including the wiring for the Slot, Drop, and Cashbox doors. Cool.

Page 4

Aristocrat

A Field Trip to Burlington, Ontario

By Kevin Noble

Aristocrat and Glen Styers

This was my first introduction to Aristocrat and not a second later, walking down the aisle with his rolling suitcase, was Glen Styers. He is an energetic, upbeat, happy-go-lucky guy and we never had a dull moment while he was around, including accompanying us to lunch at Jack Astor's. I am sure Minnesota was less lively when Glen was here. Glen is an excellent representative, explaining in detail the steps that are required to perform a RAM clear and showing us how to set the options at the selected values. We had ample time to write everything down

while Glen was going through the machine from top to bottom. We had Glen for only one day, so we had to squeeze all the information out of his head and, at the same time, perform all clears and sets comfortably so we can train our own technicians back home.

Bump In the Road

Jerry, Gary and I were attending this particular training session with Glen when we stumbled onto a problem. We had to first solve why the Game and SMIB board were not talking. Our soft meters and Mikohn meters were not the same, Mikohn was not



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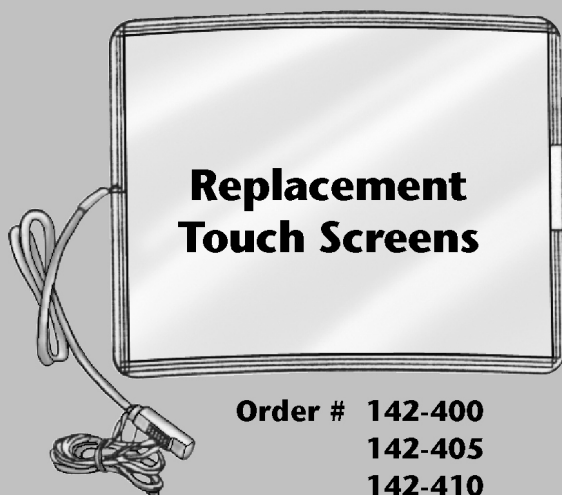
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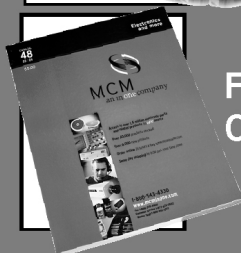
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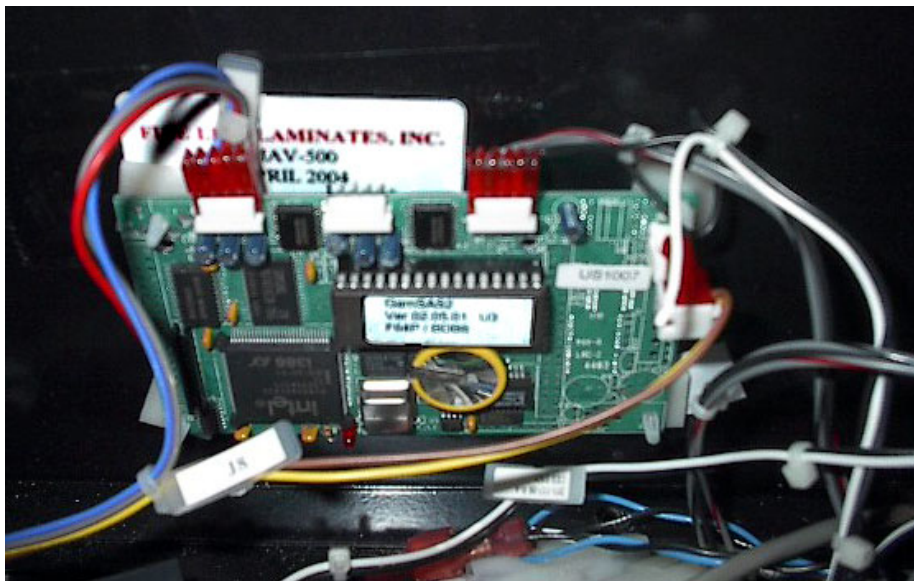
incrementing and it was stuck at 0. We established that the game and SPC 2 board were communicating. To make a long story short, after a few phone calls, we re-pinned the SPC 2 board harness and presto! We were in business and ready for the training.

Training

After completing a million RAM clears on each different manufacturer at our site, it was time to get these machines ready for home. After clearing these machines and re-establishing the proper options, we repeated the process (a number of times) until both Gary and I felt comfortable with our option settings. We needed to verify that all of the machine information was correct on the Slot File, including the correct BV EPROM version, new SMIB version, and now the new "T" version on the IDX. We completed a six-point inspection on each game that included a coin and bill test. We treated each game as if was sitting on our gaming floor, making sure that all systems were go. They can be dropped on bases, wired up and locks installed at home. We cut the prep time on the gaming floor almost in half but the real training starts when the machines hit the floor and are up for the public to use.

RAM Clear Procedure (version 6.01.07)

1. Power machine off
2. Remove the MK6 System EPROM board
3. Replace with MK6 system EPROM board with RAM clear



The SPC2 Board

chips using another MK6 EPROM board.

4. Power on
5. "WARNING" MEMORY WILL BE CLEARED" message appears
6. Press "SERVICE" and "BET 4" together to clear RAM
7. Save any information that was changed before powering off you must start again.
8. Power machine off
9. Replace the original System EPROM board back in machine
10. Power machine on, machine will perform self check
11. Turn Audit key when the machine has completed its self-check.
12. Scroll down to "Operator Set-up/Selection menu and enter (enter button will be "play 7 lines" button)
13. Scroll to "Game Machine Options" menu and enter
14. Highlight "save Machine Options" and enter
15. Exit the menu screens 3 times
16. Press the "Service" button and "WIN" button together to clear static RAM
17. Set SPC ID to 1 (5.9)

RAM CLEARING the SPC 2 Boards

1. Power off the SPC 2 board by removing the connector H8
2. Short pins #6 and pin #7 on inside array of (or right side) holes counting from the bottom going upwards.
3. Power on SPC 2 board, the red LED will begin to flash steady fast
4. Power off the board and remove the short
5. Power on
6. The SPC LED should start to flash at a nice even pace

The SPC 2 Board

I have already mentioned numerous times, this thing called the SPC 2 board mounted behind the award glass in the top box. We learned so much about this small board when troubleshooting our Mikohn/Soft meter problem, that I wanted to pass on what notes I took.

* On the SPC 2 Board, the Mikohn SMIB is connected



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- * GAM SAS2 Ver.02.05.01 (U3) EPROM is used on the SPC 2 board

- * In the Gamma Diagnostic menu (3.17.3) option there should be an asterisk and a rotating bar constantly in motion. This ensures the backplane and the SPC 2 board are talking.

- * On the SPC 2 board, a red LED is constantly flashing. This is indicating the SMIB and the SPC 2 board are also talking

- * The red LED would flash 3 times consistently, pause for a bit, and restart its 3 flashes again. This indicated that we had no communication between SMIB and SPC 2 board.

- * The SPC 2 board is connected into the Backplane board and SMIB.

My Notes:

- * When ordering monitors, ask for the longneck monitors as a replacement. This allows for a little more room in the cabinet.

- * There is a small toggle switch above the monitor that allows you to turn the volume on the game down.

- * The logic door must be open to save any changes to the options.

- * Do not close the logic door while the machine is powering up. This will cause an error code that you cannot clear.

- * You can swap CPU boards between games without losing any information, options, or meters. The E squared is on the main board.

- * If you change the jurisdiction setting in the your options, you must check all



The Coin Hopper

other options because other jurisdictions have preset options.

- * Install the CPU lock on the left side only. This will stop any possible problems from occurring on the System EPROM board.

- * When clearing STATIC RAM, you must set the SPC ID to 1. All the other option setting will remain except for this one.

- * The Validation number is a number that a single numeric value (example a 1 or 2) representing a certain percentage. This can be found on the par sheet or on the game.

- * The play bet button must be set to toggle. This allows you to push the button to start game play. When set as "continuous" you can just lay on the button and it keeps playing.

- * On the PCBA board the left side is U3 and the right side is U2. There are no markings on the board to determine U2 and U3 for inserting the RAM chips.

- * When doing a hopper test, any coins dispensed from the hopper must be returned to the hopper through the IDX. The main door must be closed when you start to reinsert the coins. The IDX recounts the coins number of coins until the exact amount is returned. (Test/Diagnostics mode 4.4)

- * There is a diverter optic that engages and blocks the optic, thus any coins being counted by the IDXs counted as drop when the diverter optic is blocked.

- * In soft tilt modes, the patron is allowed to play through small errors until an attendant is available to clear the problem.

- * A bill test will highlight the value of bill that was inserted and return it back to you.

- * The hopper does not slide straight back but pivots in a clockwise direction.

- * On a coin lockout test, turn the reset key, scroll to test/diagnostics menu, and select 4.3 the coin entry test. Press the change button to turn the

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IDX on and press again to turn it off.

* On the SPC 2 board, the color wiring pin outs from right to left (looking at the SPC 2 board face up) are: black, empty, gray/black, gray/red, and empty. The white wire is left off.

Helpful Hints

*** Top light on candle continuously flashes - bad CPU fan on the main board, change the fan and the error will clear.

*** Game is locked up in hand pay - go into operator setup menu, enter machine options, change printer option to none, scroll down to device drivers and cage printer to none, save options with logic door open, go back to game screen, insert reset key and reset the game, the error will disappear, go back into setup and enable the printer again in both locations, save options and close the game.

*** You keep getting a BACC Mismatch error, open and close the logic door and it will clear the fault. You can also go to the Miscellaneous screen, go to BACC CRC Seed screen, match the CRC Seed, save the option with the logic door open, go back to the main screen, wait for the BV to cycle and close the game.

*** Printer doesn't print or accept bills/vouchers and the printer is good and no other problem can be found. Go to the Miscellaneous screen, go to Printer CRC Seed, match the CRC Seed, save the option, go back to the main screen and wait for the printer

to authenticate, then close the game and do a test voucher or bill.

*** You may run into a problem with the monitors, particularly the touch screen falling off and the monitor blacking out, hopefully those problems were addressed before they were shipped to you. Wells Gardner recommends that 3 caps in the flyback area be changed and they should have corrected the taping procedure holding the touch screen to the monitor. If you run into either of these problems, Wells Gardner warrants them

***If you ever run into a problem and can't get hold of the tech that services you, call 1.800.482.3723. That's the National Service Support Center, staffed 24/7. They can get hold of your service tech or they can patch you through to one of them on duty

Field Trial

Aristocrat has been in the Ontario market for some time now but as far as using the Mikohn Casinolink System is concerned; we will be one of the first Tracks for OLGC to have these on the gaming floor. Under these conditions, the machines will become field trials machines for 30 days. Any physical, auditing, software, or communication problems with the machines must be reported to AGCO for further investigation. If after the 30 days pass and they are approved, other sites will be in the position to add this new manufacturer and

their approved themes on the gaming floor.

Overview

The whole trip was a great learning experience for me. I have met many great people that work in the warehouse, which I rarely get to see maybe couple of times a year. It's nice to hook up once in a while and talk about past experiences or what's on the horizon. The trip was important to me because I almost had a position with Aristocrat a few years back, it was a chance to see the warehouse staff again and to learn about another exciting new manufacturer. But most of all, I have the opportunity to share my experiences with other technicians that will be getting these machine in the future.

I would like to thank Jerry and the other technicians involved in this project for their hard work in pre-staging these machines. Also, thanks to all the contacts (Lucky Thompson) that I have bumped into that are associated with Aristocrat Technologies for their assistance in writing this article. They have been extremely helpful. As for Glen, he was very informative and kept us alert and laughing. I did learn a lot, and I will feel comfortable when I have to rely on the information that I have gathered to train our technicians at our site.

- Kevin Noble
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Bally Hopper Control Board

By Herschel Peeler

test fixture to test the assembly, troubleshooting suggestions, and finally a list of common failures.

AS-03356-0368 Hopper Control Board

The Bally XS-1200 Hopper is the main Bally hopper of choice. You can recognize its origin was Asahi-Seiko. Many of the parts are familiar if you have taken other hoppers apart. One of the things that make this hopper unique is the Hopper Control Board. While the design of the hopper control board has been through many changes, the changes were mostly in the motor driver circuits. In most cases, the design has been microcontroller based. The controller has been either the Motorola 68HC05 or the Microchip PIC16F84. Both have similar functions and pinouts. The PIC16 is more common. The discussion will cover the more complicated version. Once you understand how it works all the others will be easier to understand.

In keeping with the format of previous articles we will cover how the circuit works, what would be required to build a

The one-page version of the schematic may seem a little complicated at first but if you break it down into smaller circuits (by function) it is easier to understand. In this article, I have broken it down into four circuits. The Game Interface Circuits include the major part of the circuits between the game and the PIC16 and the manual control circuits. After that, we will cover the Coin Sensors and Coin Out Circuits. Then, we'll look at the Mixer Circuit and finally, the Hopper Motor circuits.

Game Interface Circuits

Referencing the Game Interface Circuits schematic: Most functions of hopper operation are controlled by the PIC16 microcontroller. Most control lines from the game are only inputs to the microcontroller. They tell the PIC16 what operation to perform and the PIC16 smartly carries out the operation. From the game, we have con-

trol lines Forward Enable (FWD ENA), Reverse Enable\ (REV ENA\), and the Forward / Reverse signal (FWD / REV). The "\ " at the end of the signal names indicates that the signal is "Active Low." When that signal is Low, that operation is enabled. Signal names without the "\ " at the end are Active High. In some schematics a "*" at the end means the same thing. In schematics created with really good software, the signal name has an overscore to indicate active low signals. I use OrCAD because it's free but I don't have overscore capability except on pin names for ICs I can create but I digress. Getting back to the subject...

As the signal names imply, the hopper is capable of going in a forward or reverse direction. We will go into the why and when of this later. All three of these inputs come into a protection circuit. If we follow the Forward Enable line from the connector, it goes into a 180 ohm resistor (R25). The Tranzorb (TSV5) keeps the voltage coming into this pin from going above 5.6 Volts going into the PIC16 (U1). Most of the inputs have this protection circuit on them. These protection circuits help

prevent damage to the hopper when people pull the hopper out or put it in with power on. While the hopper is not intended to be hot swappable, they realize people are going to do it anyway. The hopper will survive it most of the time but the Logic Board may not. It is still a good idea not to pull the hopper out or install it with the power turned on.

The Forward and Reverse signal lines coming from the game go into U3B and U3C. The Bally schematic shows these as AND gates. They are used as Low OR gates (following a scheme known as "negative logic") and are drawn here as they are used. The PIC16 gets its commands to go forward or reverse from game signals or from the two push buttons on the Hopper Control Board itself. These AND gates do the Oring (again, negative logic). U3C will output a Low upon a command from the game or the pushbutton SW2. A Low out goes to an input of the PIC16 telling it to run the hopper motor in reverse. Likewise, a Low out of U3C tells the PIC16 to run the hopper motor forward. If both U3B and U3C are low, the PIC16 runs the Mixer motor (only forward). The PIC16 can tell if the commands are coming from the buttons or the game by looking at the output of U3D. U3D will output a Low if either of the buttons is pressed. If U3D is outputting a High, it knows the commands come from the game.

It is worth noting that the
(Cont. overleaf)

Slot Tech Upcoming Event

Monitor Repair and More!

Slot Tech Magazine Announces Two-Week Technician School

As many of you are aware, Slot Tech Magazine offers a two-week technician training course called (for lack of a better term) the Casino School. It's kind of a "Super TechFest" where we have time to cover everything from basic electronics and troubleshooting to component-level monitor repair. Throw in a good mix of detailed training on coin validators, bill validators, ticket printers and touchscreens and you sort of get the idea. Add the "hands-on" training that is impossible at a three-day TechFest and you have a program can really boost the skills of a beginning to intermediate level slot tech.

Normally, a casino that wants this type of training will reserve a class exclusively for their own technicians. We bring the training right to the casino. The class size is small for the two-week class. In fact, it's limited to just 16 people. But even that number of folks can be tough for a single casino to spare for a two full weeks.

In order to make this training available to more slot techs, Chip In's Island Resort in Harris, Michigan and Sycuan Casino in San Diego, California have both have offered to sponsor the program and allow technicians from other casinos to join them for the two-week class.

So, the program is set and we're on for Slot Tech Magazine's Casino School. To reserve your place in the class at Sycuan Casino in San Diego, California (July 12 – 23) or Chip In's Island Resort and Casino in Harris, Michigan (September 13-24) please go to the website at slot-tech.com, download and return the enrollment form along with your tuition of \$1295.00.

As the class size is exceedingly small, reservations for the class are strictly on a "first-come, first-served" basis. When we receive your tuition, you're in. Purchase orders are welcome and will be invoiced but placement is not guaranteed until tuition is in hand.

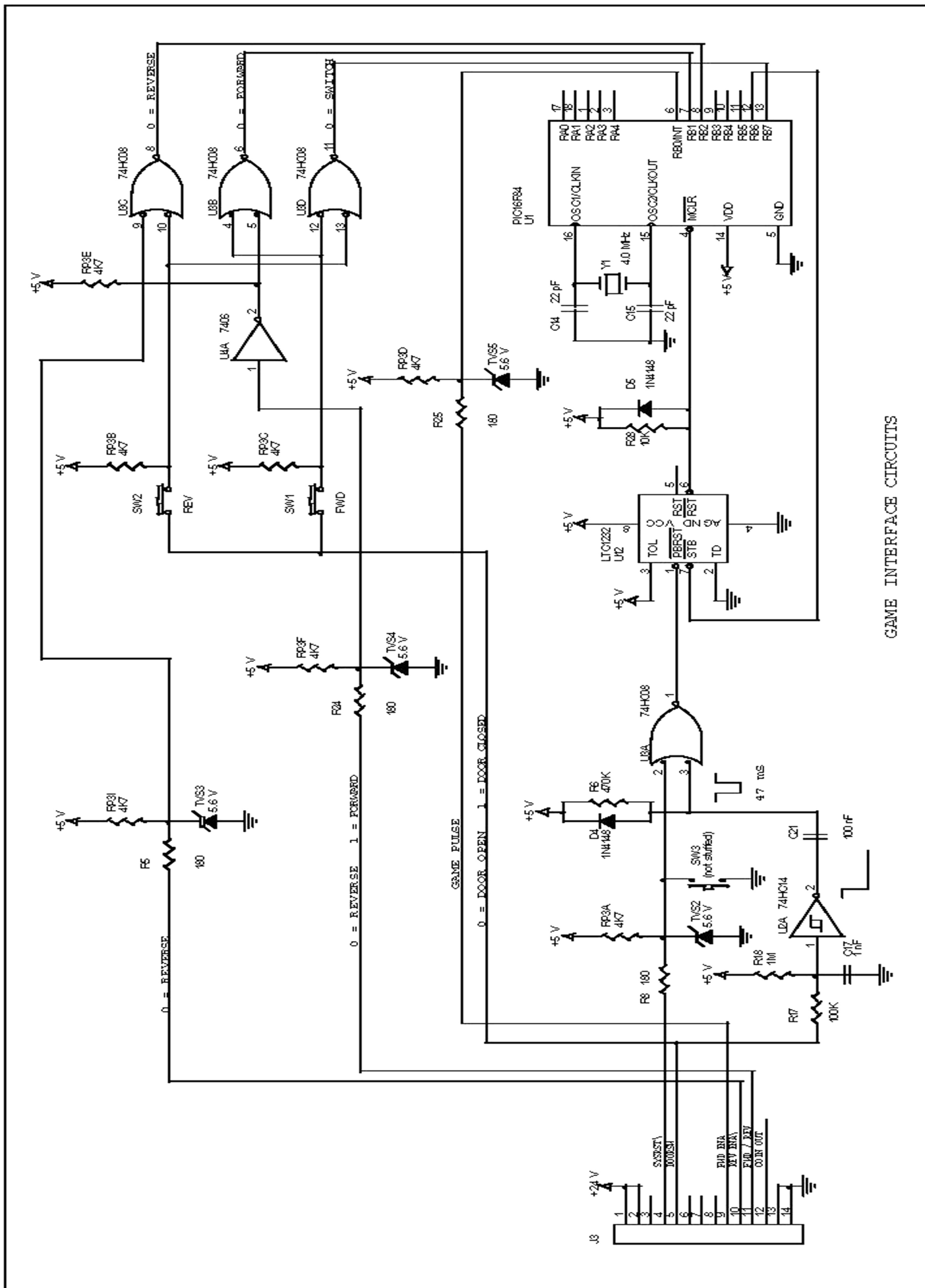
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See you at the Casino School!



Randy Fromm

Randy Fromm



switches are only enabled if the main game door is open. Note the common side of the pushbutton switches. It comes from the connector and is labeled "Door Switch" (DOORSW). The door must be opened before these two pushbutton switches can be used.

The PIC16 is reset under two circumstances. There is a System Reset (SYSRST) line that goes low while the game MPU is going through Reset, as on Power Up. SYSRST goes through another protection circuit as we described before and goes through another AND gate. Again this AND gate is used to OR Lows. The other input comes from U2A, which gets its input from the Door Switch input. When the door is closed, DOORSW

goes high, making U2A pin 2 go Low. The influence of R6 and C21 gives a Low pulse on pin 3 of U3A of about 47 mS starting from this low edge of U2A pin 2. So U3A pin 1 will have a low out during SYSRST or for 47 mS following the door being closed. This Low goes to U12 pin 1. This causes a Low out of pin 6, which is the Reset input to the PIC16 (MCLR, Master Clear).

There is an allowance made for a pushbutton (SW3) that could be a manual Reset but this component is not added to the assembly when it is built. This point comes in handy while troubleshooting.

The LTC1232 (U12) is the Reset Controller for the microcontroller. It gives the

PIC16 a reset pulse on Power Up, U3A pin 1, or from a Watchdog Counter built into the LTC1232 itself.

Let's take a minute and review what a Watchdog Counter is supposed to accomplish. This circuit is basically an oscillator and a counter. On Reset, the counter is cleared and starts counting up. When the counter reaches max count, it pulls on the Reset line of the microcontroller. Ideally this should never happen. A signal should come back from the microcontroller, in this case U1 pin 12, Watchdog Reset. Every so often, the PIC16 should pull this output low, resetting the Watchdog counter, preventing it from reaching full count. As long as the firmware is run-

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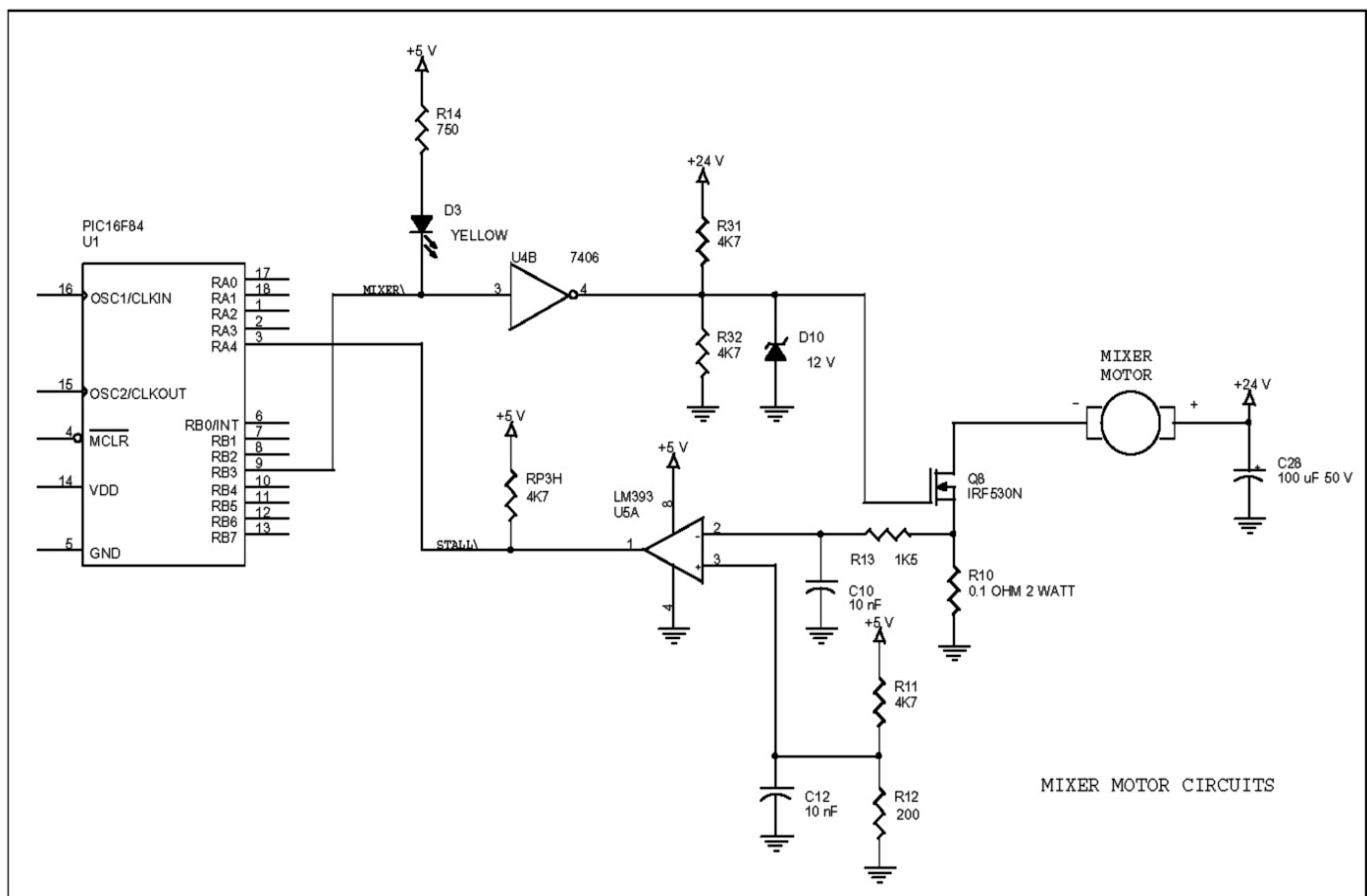
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a circuit associated with it made of two Schmitt Trigger (also known as Schmidt Trigger) Inverters. There is an option to add a capacitor (C6 and C7) between these inverters in order to make it a filter but this capacitor is not stuffed. The Coin Out Sensors are not enabled all the time. Before we can count a coin leaving the hopper, it must first be enabled by a signal from the PIC16 named "Sensor Drive." This signal drives U2D. A High into pin 9 of U2D makes pin 8 Low, enabling the Sensor A optic. This High into pin 9 also goes to Q3, turning it on, which turns on Q2 which also enables the two Sensors as long as +24 V is present. Note: If +24 is dead we can not register coins leaving the hopper.

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Slot Tech Magazine

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5. SIX COIN MEMORIES

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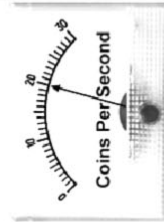
8. COIN JAM RELEASE

To remove bent coins form a comparator often involves a screwdriver and damage. Even half-flap acceptors occasionally require the screwdriver treatment. The X-20 will fully open on your command.



6. 20 COINS PER SECOND

The best players can insert up to 15 coins/sec. Coin comparators with 7-10 coins/sec won't do it for fast fed coins. The X-20's Triple Track technology enables it to measure, track, and credit up to 20 coins/second!



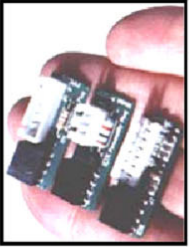
9. DOWNLOAD XACT DATA™

When you have a large number of coin acceptors to reprogram for a new coin, the X-20 Coin Selector provides for perfect programming with Xact Data at the touch of a button, resulting in both time savings and accuracy assurance.



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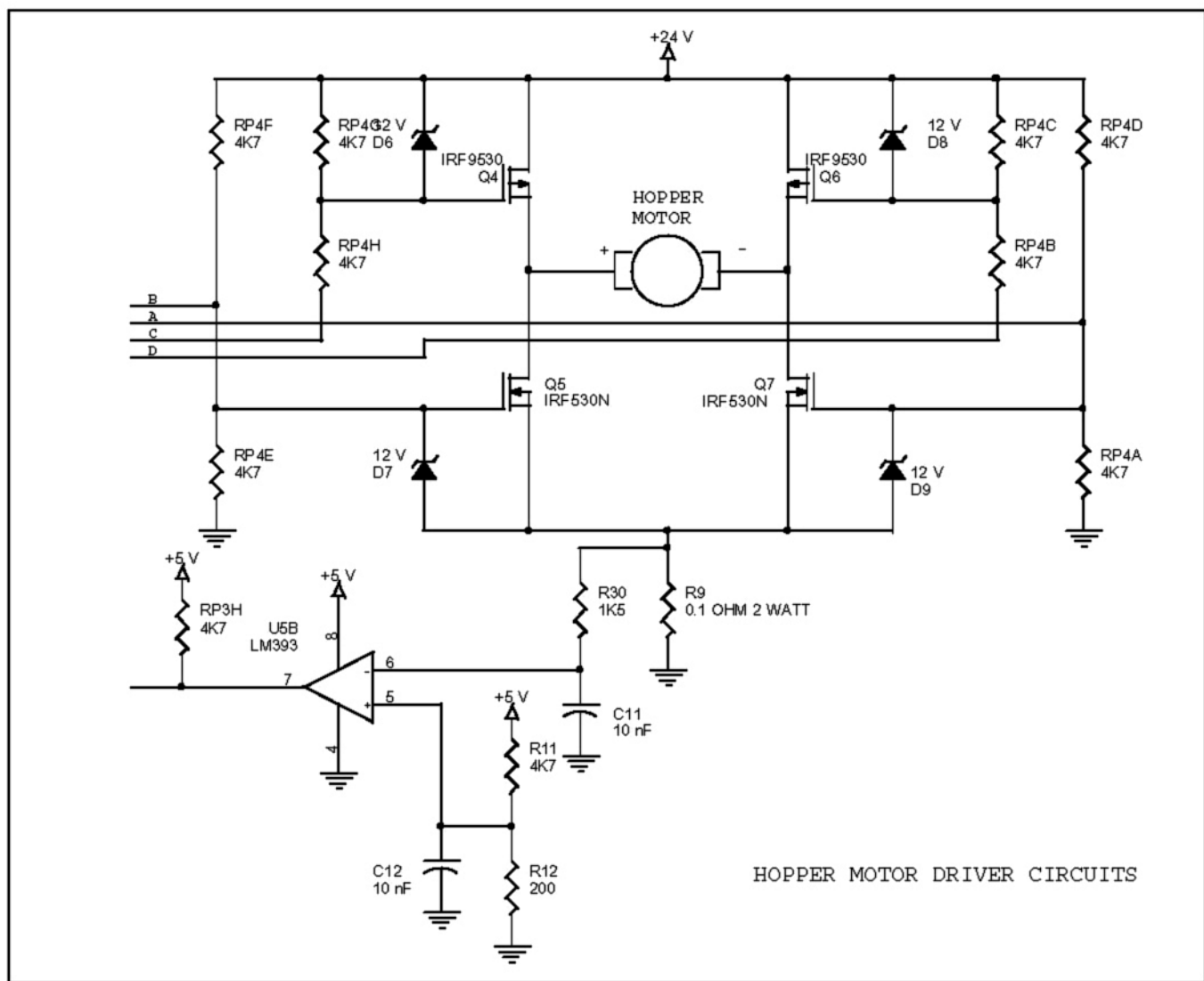
DEAL #2 - THE MORE YOU BUY THE MORE YOU GET!

If your casino purchases new nickel or quarter slot machines from any slot machine OEM and specifies to them that you want our X-20 in your machines we will issue your casino \$20 credit per X-20 to your IDX account that can be used to purchase any of our products. All you have to do is send us a copy of your purchase order to the slot machine OEM specifying our model X-20 for the machines ordered. This credit is to be redeemed for IDX products only. No checks will be issued.



Other X-Mark® Family Products





These “Sensor A” and “Sensor B” signals feed to the PIC16. It is the PIC16 that evaluates these two inputs, and if satisfied all is correct, sends a Coin-Out signal back to the game through Q1.

Mixer Motor Circuits

Referencing the picture entitled Mixer Motor Circuits: An option to the XS-1200 is to add a Mixer section between the Hopper Bowl and the Pinwheel. In this configuration the bottom of the bowl is actually lower than the bottom of the pinwheel.

There are a couple of advantages here: The pressure

against the pinwheel is lessened. In a regular hopper we may have the weight of all the coins pressing against the pinwheel. In the Mixer configuration we only have a few coins in the pinwheel area. The second advantage is that the bowl may be larger and hold more coins.

In normal operation, the area next to the pinwheel holds coins to be immediately fed from the hopper. When this area becomes empty, the PIC16 senses that no more coins are coming out and turns on the Mixer motor, bringing coins up from the bowl and into the pinwheel area.

When the PIC16 wants to turn the Mixer motor on, it outputs a Low out of pin 9, “MIXER\.” This goes to U4B, making the output not-Low. An explanation of the 7406 is worth a minute here. The 7406 is an Inverter with an Open Collector Output. The output is pulled Low, or it is not. The output does not go actively High. It is either Low or it allows external circuitry to pull it High. The 7406 can tolerate an output voltage of 30 Volts. In this case R31 and R32 connect to the +24 Volt line. The point where R31 and R32 connect will either be Low (if the 7406 is outputting a Low) or it will be +12

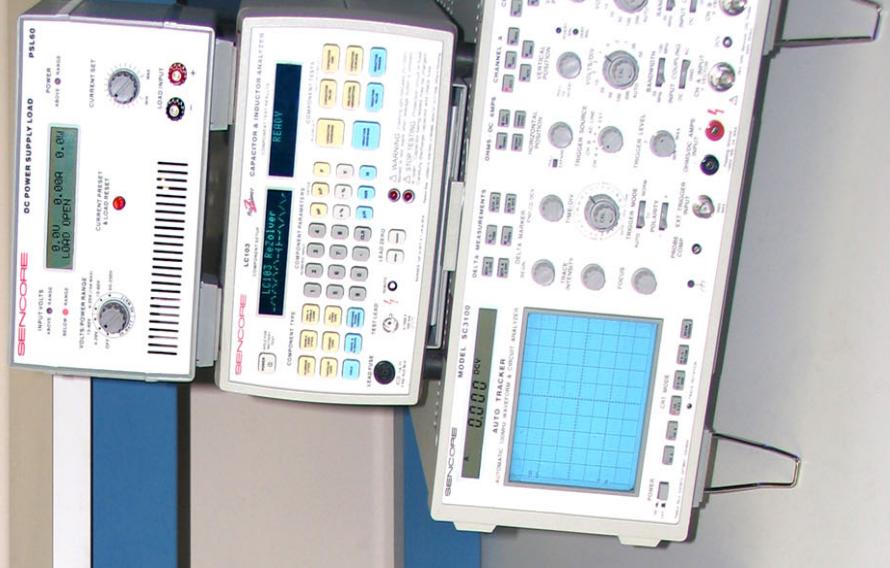
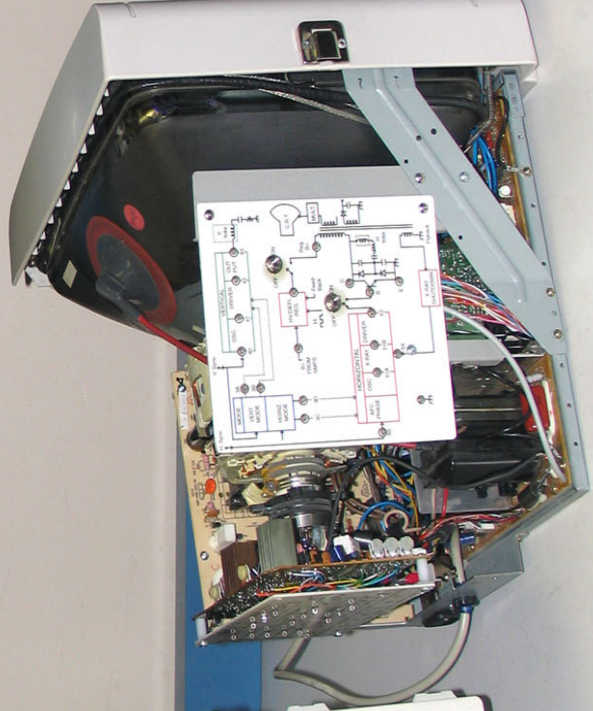
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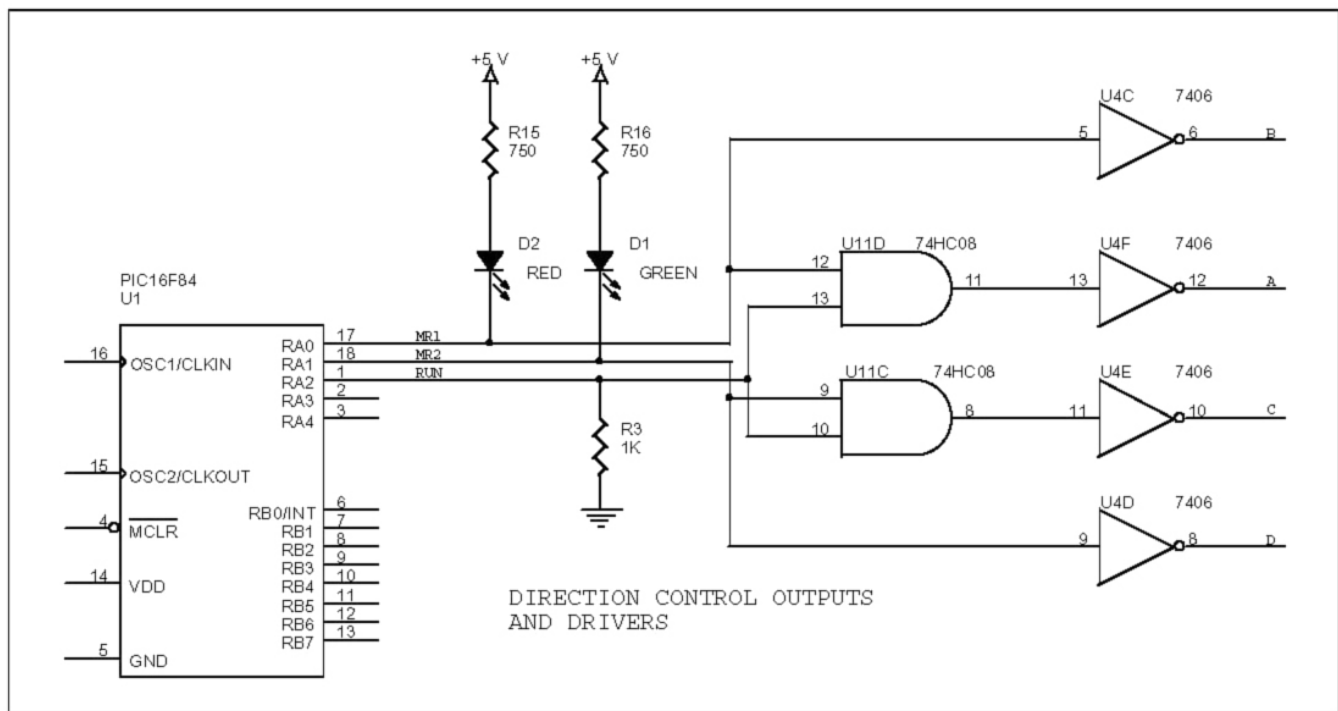
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Volts (limited by D10). The +12 V out turns on Q8, which then drives the Mixer motor.

The circuitry between R10 and U5A is a Motor Current Monitor. As Q8 conducts motor current, this motor current passes through R10. The voltage across R10 will increase with motor current. This voltage level is filtered by C10 and R13 (to avoid short glitches) and is applied to one side of U5A, a Voltage Comparator (See Slot Tech Magazine, June 2004 for more on voltage comparators). When we get a coin jam in the Mixer, the motor stalls and motor current increases.

The other side of U5A comes from a voltage reference set up by R11 and R12. R11 and R12 form a voltage divider whose midpoint is about 0.20 Volts.

Voltage Comparators are simple creatures. When the voltage on the Inverting (“-”) input is lower than the volt-

age on the Non-Inverting (“+”) input the output will be High. When the voltage on “-” is higher than “+” the output goes Low. In our case, when the voltage across R10 exceeds 0.20 Volts the output of U5A goes Low, informing the PIC16 that the Mixer motor has stalled. The PIC16 then turns off the Mixer motor.

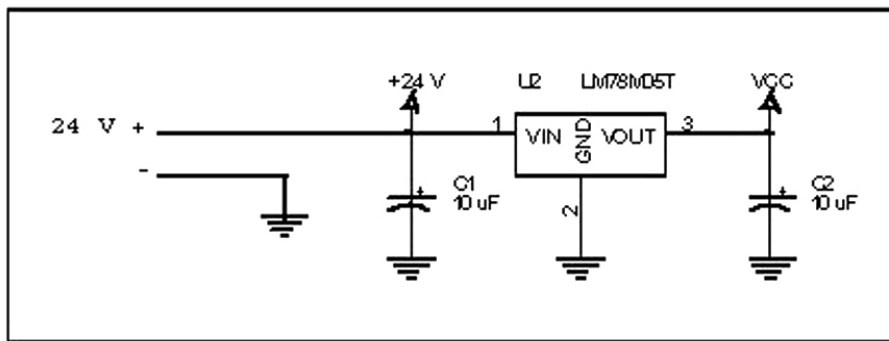
Hopper Motor Circuits

Referencing the two schematics, Direction Control Outputs and Drivers, and Hopper Motor Drive Circuits: The Hopper Motor Drive circuit functions similar to the Mixer Motor Circuit with the exception of being able to drive the Hopper Motor in either direction. To turn the hopper motor off, Q4 and Q6 are turned off. To run forward and dispense coins, Q7 and Q4 are turned on, running current through motor from the negative lead to the positive lead. To run the motor in reverse,

Q5 and Q6 are turned on drawing current through the motor from the positive side to the negative side.

Q4 and Q6 are P-type Enhanced MOSFETs. A 0 V level turns them on and a +12 V level in turns them off. Q5 and Q7 are N-Type Enhanced MOSFETs. A +12 V in turns them on and 0 V in turns them off. The zener diodes keep the voltage on the gates from going higher than +12 V.

The signals to the gates of these transistors come from four of the inverter sections of a 7406 and two AND gates. These in turn are driven from three outputs of the PIC16, “Run,” “MR1” and “MR2.” Two LEDs are on the MR1 and MR2 lines. When MR1 is Low, the Red LED is on indicating that we are going in Reverse. When MR2 is Low, the Green LED is on indicating that we are going Forward. When “Run” is Low, the AND gates



both put out a Low turning off Q4 and Q6.

The circuitry between R9 and U5B monitors the current through the hopper motor in the same way as described for the Mixer motor.

Overall Operation

When the game decides to feed out coins it tells the PIC16 to feed coins. The PIC16 enables the Coin In Optics and starts the Hopper going Forward. As coins pass through the Sensors, the pulses go to the PIC16. If all is correct, the PIC16 tells the game that a coin has left the hopper by sending it a pulse on the Coin-Out line. When the game has counted the correct number of coins leaving the hopper, it tells the PIC16 to turn off the hopper motor.

If we are in the middle of a payout and the area of the pinwheel becomes empty, the PIC16 notes that no coins have left the hopper after a certain number of seconds and turns on the Mixer, bringing coins up into the pinwheel area. If the hopper is in the middle of a payout and can't find coins in the bowl to bring up, it finally resolves

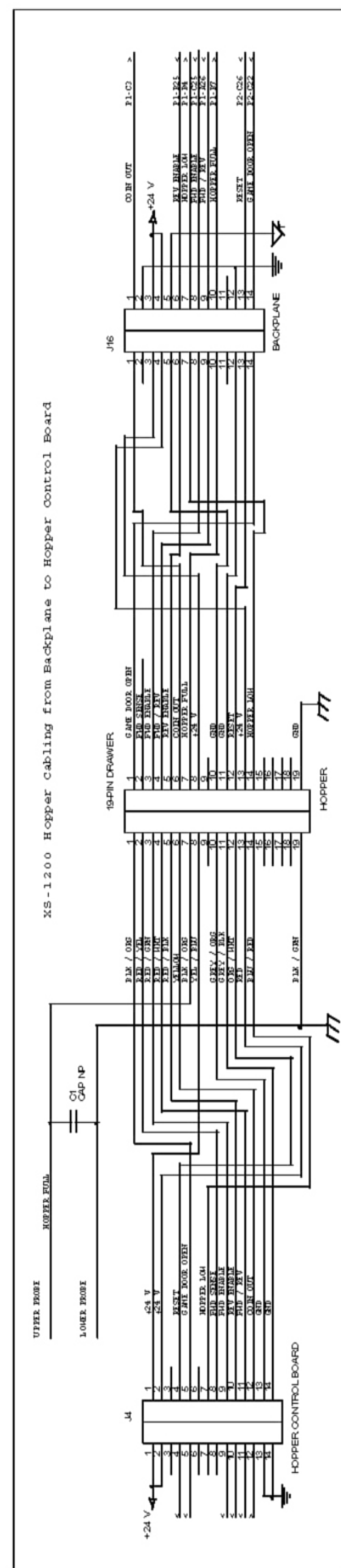
that it has an empty hopper.

If we are in the middle of a payout and the hopper jams up, motor current increases. U5 senses the increase in motor current and the PIC16 stops the hopper motor, sends it into reverse for a few seconds in an attempt to unjam itself, then returns in the forward direction. It will make a few attempts to unjam itself before deciding that it actually has a real hopper jam. The hopper can tell the difference between an empty hopper and a hopper jam. If it becomes jammed, it can clear itself most of the time.

Not otherwise mentioned is the fact that most of the logic circuits run off of +5 Volts and the only voltage applied to the hopper is +24 V. There is a 7805 voltage regulator that drops the +24 V down to +5 V for powering logic circuits. All Inputs and Outputs to the hopper run at +5 V and ground levels.

- **Herschel Peeler**
hpeeler@slot-techs.com

Next month: Part 2 - Building a hopper test fixture.





The Best Laid Plans . . .

By John Wilson

It's late one Friday afternoon when we find you sitting in your office at ABC Gaming. The gaming commission has approved the PAR sheets for the Blazin' 7s games and the game is being well received by casinos. The first numbers from the field trial came in yesterday and it's quite clear that the players like the game, too! After a long project, you're planning to ride the wave from this game for some time. Kicking back and resting your feet up on the desk, it's a perfect chance to catch up on your reading with some back issues of Slot Tech Magazine. Next week promises to be a walk in the park!

Just as you settle in to your quiet reading, the silence is broken by a telephone call from the V.P. of Bonus Game Development. There's a project underway to come up with a new bonus game. XYZ

Gaming's Million-Dollar-Bonus is starting to get some serious play and there's some concern that our numbers may take a slide. Unless a comparable bonus game can be launched within this quarter, the summer shareholders' meeting could be bleak.

Larry, your counterpart in the Bonus Game Division is in charge of developing the bonus game and has decided that it would make a nice fit with your new Blazin' 7s. Management has decided that it's going to be placed on the 25-cent platform and has formulated a range of bonus payouts. The top award is going to be 1,000,000 coins for a \$250,000 jackpot. The lowest award will be 10 coins and every bonus game will award at least that amount.

Black Friday?

You have developed a nice game with the Blazin' 7s mix of high hit frequency and generous payout percentage. While it's an obvious choice for expansion with a bonus game, integrating a bonus game with a 1,000,000 top award is going to be a challenge. Projects like this are what makes or breaks a career. To make matters worse, there's a senior management meet-

ing scheduled on Monday morning to introduce the bonus game and to determine how it is going to interface with the base game. It's going to be a long, long weekend!

While Larry starts working on the graphical display for the new bonus game and developing the electronic interface to the base game hardware, you sit and ponder the dilemma that you're now in. While you are certain that you can come up with the math to make the bonus game work, you're not so sure that you can maintain a reasonable hit frequency. Calculating some rough figures, it appears that the hit frequency is going to drop to 1% or less! The payout percentage shouldn't be much of a problem but keeping both figures at a reasonable level could be just about impossible.

The first thing that you try to do is to decide how you are going to trigger the bonus game. It could be a mystery trigger, starting randomly after every 1,000 games. On the other hand, maybe certain combinations like a red seven, double bar and blank will start the bonus game? That would certainly make the bonus game appear to happen at random, even though

Combination	Bonus Round	Coins Played	Pay
Bonus Bonus Bonus	13	3	20
Bonus Bonus Bonus	14	3	10

there was a definite combination that had to come up to start the game. The average player wouldn't catch on to this trick and it wouldn't matter even if they did. A sequential trigger would also work. Perhaps if the player gets five winning combinations in a row then the bonus round will start. What about adding another symbol to the game that triggers the bonus round? It would mean creating new reel strips, but the payout glass will have to be changed to reflect the bonus game anyway, and the PAR sheets will have to be redone to show the bonus game payout too. "The bonus game payout!" you ponder. Starting the bonus game won't be too much of a problem. The real problem appears to be how the bonus game payout can be shown on the PAR sheet.

After a few minutes of careful thought, you determine that since there is a definite way that you will trigger the bonus game, the bonus game can be shown on the PAR sheet. You start thinking about the lowest paying combination of 10 coins, and picture a part of the PAR sheet:

answer you come up with raises even more questions. How many coins will be required to trigger the bonus game? The Blazin'7s is a multiplier game, meaning that all possible winning combinations are paid for one, two or three coins. Will the bonus game be a buy-a-pay? That will mean that the entire game goes back to the drawing board. There are only two days in the weekend and just when you were planning to spend some time watching the tapes you bought on video monitor repair....

It would be possible to make a combination pay for the bonus game. You remember

the Fireball game by Bally a few years ago that did something like this. Two fireballs paid 15 credits on the 1st coin, 30 credits on the 2nd, and the 3rd coin would pay out either 50, 100 or 150 coins. The Fireball game is a 3-coin multiplier, yet the bonus payment worked almost like a buy-a-pay. There was a definite reward for playing the 3rd coin and you didn't know how much until the bonus hit. Yes, that concept would work here! It would actually be very similar to the proposed bonus game, but on a much smaller scale. The payouts would start at 10 and go to 1,000,000. The only difference is the amount that is paid. However, to get a 1,000,000 coin payout, the bonus game will be triggered only every 100,000 games or so. Nobody is going to go for that.

As you try to come up with a way to increase the hit frequency of both the bonus

	1st COIN	2nd COIN	3rd COIN
3 FIREBALLS	800	1600	2400
3 7s	80	160	240
3 BARS	40	80	120
ANY THREE	25	50	75
ANY TWO	15	30	45
ANY ONE	5	10	15

Hmm, it seems that every
Slot Tech Magazine



game and the overall game itself, you receive an email from Larry. He has just received a fax from the V.P. of Bonus Game Development with a rough layout of the bonus game. The range of payouts has been suggested as shown in the fax below:

This makes the project a little bit more complicated. Sure, Larry is the one that has to determine how the awards are going to be displayed and how the graphics will appear but you have to come up with all of the math and make it work. You start to think that Larry is going to have a pretty

The Grass Is Always Greener

Larry sits at his desk, envious of you. After all, you just have to add the bonus game into the Blazin' 7s. Larry has to come up with the bonus game itself. He pictures a large topper for the slot machine complete with lights, bright graphics and great sounds, terminating in a small wire that simply plugs into the Blazin' 7s base game. He wonders if it's too late to transfer to the Base Game Development division . . .

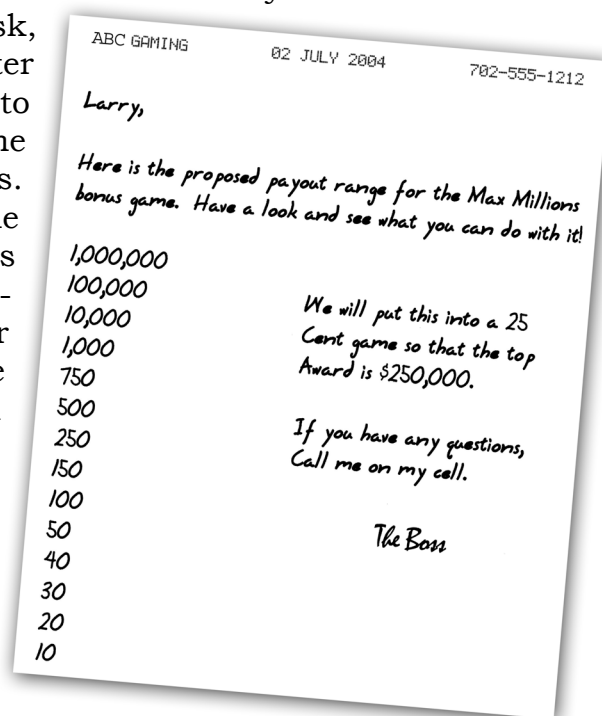
Larry tries to organize his thoughts and see what he has to come up with for Monday's meeting.

He already knows what the various payouts will be, with 14 separate payments possible. The player has to win something each time. Larry doesn't care how the bonus game is triggered or how frequently but he does have a nagging feeling that he probably should.

The final look of the bonus game isn't a real concern for Monday's meeting, either. It could be done on a video monitor or LCD display, or it

light weekend and wonder if it's too late to transfer to the Bonus Game division. However . . .

could be a separate topper with each of the 14 awards shown, illuminated by a backlight or circled with LEDs. For the development, he could simply have 14 white light bulbs with hand-written sticky notes below each one,



showing the award amount. The details can be developed later. What, then, does he need to do for Monday?

His job appears fairly simple. There's the physical electronic interface that takes a signal from the base game and starts the bonus game. He decides what the award is, and signals the base game what to pay. That really couldn't be simpler. He's sure that he can even access the random-number generator from the base game to determine the outcome of the bonus game. "The output of the bonus game," he thinks, "is the real hurdle. How do you determine what the player will win?"



The easiest method is to have the slot machine pick a random number from 1 to 14. If it picks the number one, the player is awarded 10 credits. The number two would award 20 credits, etc. If 14 is picked, then 1,000,000 credits are paid. He picks up the telephone and calls you, certain that you're also going to be working late tonight.

There Is No "I" in "Team"

You and Larry trade ideas and it becomes clear that you are both working in opposite directions.

In order for you to interface your Blazin' 7s game, you need Larry to give you all of the details of how his game plays and pays. In order for Larry to interface his bonus game with your base game, you have to tell him how the bonus game will play and pay in your base game. The solution seems so simple. It's the other guy's responsibility.

You and Larry try to determine what each of your specialties is and what you each need to do to make a seamless integration of the two games. You soon determine that a bonus game really is a separate game from the base game. To the player it looks like one big game but the bonus game really doesn't depend upon the base game at all. It is told when to start and later tells the base game how much the player won. The base game just tells the bonus game when to start and waits to hear how much

the player has won. It becomes increasingly clear that the hardware interface isn't the problem. It's the software and the math that is going to be difficult. (Isn't it always?)

Pretty soon, you have both realized that although the two games are distinct, they really need to be designed the same way. Larry's idea of picking one of the payout possibilities at random won't work. You explain that a 1 in 14 chance of winning a million coins means that the bonus game can only happen every gazillion games or so, and that's just not frequently enough.

"How do you determine the payouts in your Blazin' 7s game, then?" asks Larry.

"Simple. I determine the probabilities and create a PAR sheet to show how frequently each one comes up. There may be only 10 different paying combinations in the base game, but the jackpot occurs much less frequently than mixed bars." you explain.

"What we need to do, is come up with a sort of PAR sheet for your bonus game, Larry. Determine how frequently we can award the million, and how frequently we'll pay 10. The bonus game develops its own cycle, so to speak and ... and ... and that removes all of the bonus game math from my end!"

"Exactly!" replies Larry. "I make the bonus game with a 10,000 game cycle. One of

these is the million credits and 7,500 of these are 10 credits. I mix the intermediate payouts around, determine the probabilities and come up with a reasonable . . ."

"Hit frequency and payout!" you exclaim.

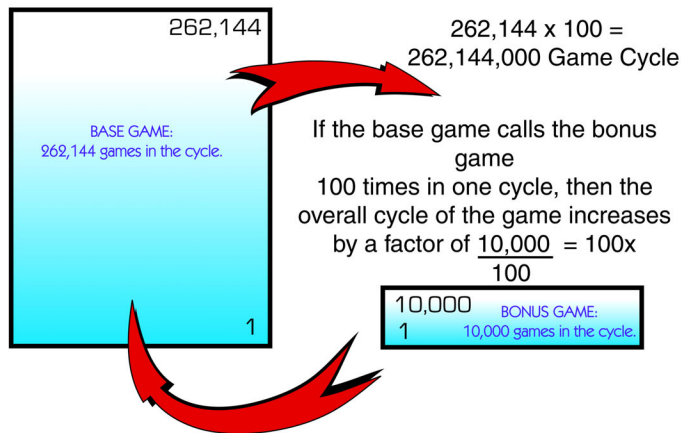
Life Give You Lemons? Make Lemonade

It now becomes clear what has to happen. Larry comes up with his bonus game. He can make as many combinations as required in order to come up with a reasonable payout. The top award of 1,000,000 will be infrequent, perhaps only 1 in 20,000 games. The 100,000 might be the same. Toss in a couple of 1,000 credit pays, maybe 3 for 750, a dozen or so at 100,

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\$10,000
\$1,000
\$750
\$500
\$250
\$150
\$100
\$50
\$40
\$30
\$20
\$10

The MAX MILLIONS* bonus glass, showing the proposed payout for a \$1 base game.

* Max Millions is a trademark of ICS.



a whole bunch of 200, more 100, tons of 50, and a lot of 10. Add up each of the possibilities and you come up with an average payout. You make a bonus game with 10,000 different outcomes.

That's just like the base game and the cycle. Out of 262,144 possible combinations, two of these are the jackpot, eight are Blazin' 7s, maybe 20 are red 7s, 200 are mixed 7s, etc. Out of all of the combinations, you get an average payout that you can work with. The bonus game will do the same. Perhaps after 10,000 games, the average payout will be 200. Sure, the top award of 1,000,000 credits is way above the average. We'll need a bunch below average to bring the average down to 200. The payouts of 150, 100, 75, 50, 40, 30, 20 and 10 will all lower the average. Make more of these, fewer of

the larger ones. The result is that after a cycle of 10,000 games, the average paid out from each bonus game is 200.

You like this idea. However, you decide to initiate the bonus game, all that you have to do is put the average payout into the PAR sheet and it will all work out. You can picture the new PAR sheet:

Monday's going to be a good day after all!

Same Bat-Time Same Bat-Channel

Next month, we'll meet you and Larry in the boardroom. We'll listen to your explanation of how you came up with the payout schedule, how the two games fit together and how you can have a bonus game pay out \$250,000 on a quarter slot machine while maintaining both a generous payout percentage and a reasonable hit frequency.

However, there's bound to be a twist from the meeting, sending you scrambling to integrate the changes wanted by management. Sounds a lot like your job, doesn't it?

- John Wilson
jwilson@slot-techs.com



Reel 1	Reel 2	Reel 3	Coins	Pay	Hits	Coin Out
BONUS	BONUS	BONUS	3-3	200		

Slot Tech Press Release

BALLY GAMING AND SYSTEMS ANNOUNCES TOP 20 REEL-SPINNING SLOTS Celebrates 40th Anniversary of the Modern Slot Machine



The year was 1964 and Bally Gaming, the world's foremost manufacturer of reel-spinning slot machines, catapulted slot-machine technology into the modern age with the introduction of the "Money Honey," the world's first electro-mechanical slot machine.

No longer relying solely on springs, gears and levers, the Money Honey was the first gaming device to use small electric motors to spin the reels, a breakthrough that signaled the birth of the modern slot machine. The development of this new technology forever changed the landscape of casino operations, heralding a new era of slot-machine dominance on the casino floor.

Forty years later, Bally Gaming and Systems is celebrating the birth of the modern slot machine by naming its top 20 reel-spinning slots of all time. From its flagship Blazing 7s(r) to the latest in seductive Playboy slots, these games run the gamut of styles and themes, thus appealing to a wide range of slot players; from budget-minded to high rollers.

Bally Gaming therefore proudly presents its top 10 current hits and top 10 all-time classics. It's a list of games vitally important to a casino's bottom line because reel-spinners produce more revenue than any other segment of casino operations.

Other benefits of reel-spinning slots include lower capital costs, longer shelf life and easier maintenance. Indeed, as more and more slot players from coast to coast vote with their gaming dollars, the casino industry is watching intently as the current video-gaming craze gives way to a resurgence of reel-spinning popularity.

As part of this landmark event, Bally Gaming is giving qualified gaming industry professionals a chance to win a luxury trip for two to the gaming capital of Europe: Monte Carlo, Monaco. To enter, casino professionals should log on to www.ballygaming.com and vote for their favorite all-time Bally classic reel-spinning slot and all-time current Bally slot product. In doing so, they will automatically be entered into the contest. The results of the voting will be announced during the upcoming Global Gaming Expo (G2E) in Las Vegas in October.

Bally Gaming and Systems can be found at www.ballygaming.com.

- Top 10 Bally Classics
 - 24-Karat Wild™
 - Black Gold Magnificent 777s™
 - Blazing 7s
 - Blazing 7s Double™
 - Double Wild Rose™
 - Black&White Double Jackpot™
 - Silver & Gold™
 - Triple blazing 7s Double Jackpot™
 - Double Dragon™
 - Diamond Line Blazing 7s™

- Top 10 Current Hits
 - Bonus Frenzy™
 - Bonus Times 5 Line™
 - In The Money™
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Bluebird Takes Wing in Russia

Gaming Giant Unicum to Distribute in Russia and CIS

Under threatening skies that failed to deliver their promise of a late Spring rain, Unicum Group of Companies, the leading distributor of slot machines and equipment for the gaming industry in Russia, announced the debut of the new Bluebird slot machine from WMS Gaming in Russia and the CIS countries. The official sales of Bluebird started on June 17th with the presentation of the Bluebird machines to Russian operators. Slot Tech Magazine attended the event, which was coordinated by Unicum, the exclusive distributor of WMS products in Russia and Ukraine, and US-based WMS Gaming.



"We started the international market just four years ago," said Sabastián Salat, Managing Director for Barcelona-based WMS Gaming International, S.L. "We prefer to work with distributors. I think this market, being so big, really needs a distributor here," he continued, referring to Unicum. "For us, it's an ideal solution."

The new Bluebird games were introduced to slot operators, along with the WMS's classics, WMS 550 platform and games. Forty-three slots were used in the presentation to show the advantages of the new games and machines. More than three hundred guests attended the party, held at a Moscow yacht club in an American picnic style with

barbecue and country music. Entertainment was non-stop and included a Dixieland jazz band and even a visit from Elvis.

"WMS Gaming designs unique games; their advantage is a variety of merry bonuses and attractive gaming mathematics," explained Yury Larichev, Unicum's vice-

Five new games were shown for the platform. "Robin Hood's Treasure" and "Wild Wilderness" have already been translated into Russian with more titles scheduled for "localization" in 2004-2005. As part of the festive occasion, a selection of carnival-like activities and games was held, each coordinated with the theme of the games. For example, target shooting with an authentic crossbow was tied - naturally - to "Robin Hood's Treasure." Winners were awarded numbered plastic chits and at the end of the event, drawings were held for prizes, including 16 installations of Unicum's new "Systems in Progress" casino management and real-time monitoring system for slot machines. Slot Tech Magazine subscribers will read more about this new system in next month's issue, along with a visit to the Unicum factory in Saint Petersburg.



(left) Sabastián Salat, Managing Director for WMS Gaming International, S.L. (based in Barcelona) and Yury Larichev, Vice President and Chief Operating Officer for Unicum Group were all smiles at the well-received presentation of WMS Gaming's Bluebird system to the Russian and CIS market.





Russian operators take their first peek inside the Bluebird

president. "WMS brand is well known in Russia by its 550 slots. The new Bluebird platform is the most modern gaming solution in the industry today. I am sure players and our customers will be touched by its eye-catching graphics, stylish and ergonomic cabinet design and [well-conceived slot] math."

The first Bluebird machines are already installed in a number of Moscow casinos including the most popular Golden Palace, Europa and Cristall.

About Unicum

Unicum Group of Companies distributes and develops slot machines, equipment and technological solutions for the gaming and entertainment markets. Headquartered in Moscow, Russia, offices in Saint Petersburg, Riga and Kiev. Unicum can be found on the Internet at www.unicum.ru/english

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web. www.unicum.ru



Over 300 Russian operators attended the Moscow event, sponsored by WMS Gaming and Unicum



A selection of carnival-like activities and games was held, each coordinated with the theme of the games. For example, target shooting with an authentic crossbow was tied to "Robin Hood's Treasure."

Gamesman Brand Products by Coin Mechanisms Inc.

Gamesman Casino Range Push Button Products

Coin Mechanisms Inc. announces the release of the Gamesman Brand of Casino Range Push Button products. The Casino Range of Push Buttons is comprised of the GPB 350, the GPB 510, 520, 540 and the GPB 560 & 570. All of the Casino Range Push Buttons feature:



GPB 560



- Unique “snap-fit” of the button into the panel, eliminating the need for a locking nut.

- Patented “twist-on” switch and light source assembly allows orientation of the switch through 360°, plus makes servicing fast and easy.

- Connection to the switch and lamp is made via a single connector - a standard 7-way 0.1” pitch IDC or crimp connector can be used.

- The switch unit comes pre-assembled to the button, reducing assembly time on the production line.

- Illumination comes from a 5mm wedge based lamp or the unique Gamesman LED solution.

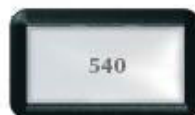
- Also available with 0.110” terminals and single mating connector.



For more information, visit www.coinmech.com.



GPB 350



Breaking News

Happ Controls Acquired by Pfingsten Partners

Happ Controls has announced that it has been acquired by Deerfield, IL based Pfingsten Partners, L.L.C. The company will retain the Happ Controls name and Frank Happ, founder, will remain with the company as Vice Chairman and significant minority shareholder.

"I am proud of our past accomplishments of transforming the business from a startup company to a regional wholesaler to a leading international manufacturer and distributor," said Frank Happ. "The continued growth of the business requires additional capital to support future expansion, both internally and through additional acquisitions. I am excited about our future. It has never been brighter."

Tom Happ, Vice President of Sales and Marketing, will become the company president, effective immediately.

"Happ Controls has a consistently strong growth record in each of its markets. The company's growth has been driven by product development and customer service. We intend to capitalize on these strengths to continue the company's history of success," said Jim Norton, Managing Director of Pfingsten Partners. "We will support the company's growth in domestic markets and expand into international markets."

For further information, contact:
Tom Happ
President
Happ Controls
tel.847-593-6161 ext. 107
tom.happ@happcontrols.com

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Dispersive Signal Technology

A Revolutionary New Touch Technology from 3M

Dispersive Signal Technology provides a new, innovative technology choice for gaming applications. Setting new standards for the touch industry, this patented technology delivers exceptional optics, extreme durability, and stylus support combined with great accuracy and fast touch response.

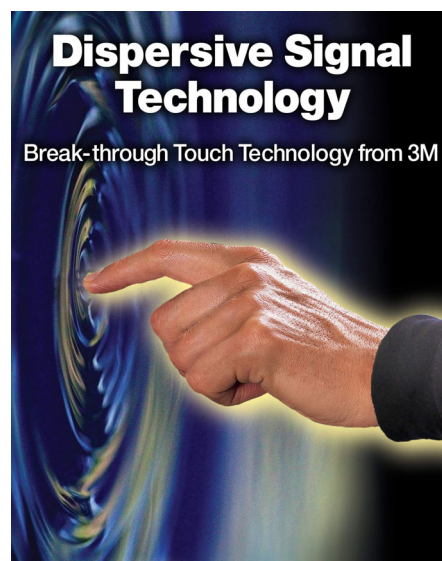
Dispersive Signal Technology works on the premise of measuring the mechanical energy (vibrations) within a glass substrate that is created when someone touches the surface of the glass. Sensors, generally placed on the backside of the glass, convert the vibrational energy into electrical signals. Using advanced proprietary signal processing algorithms, the Dispersive Signal Technology system determines the location of the touch, taking into account the profile of the vibration, glass dispersion effects, and other characteristics of the substrate. Although never before applied to touch applications, a related methodology has been used for over ten years as an evaluation technique in structural analysis circles.

The Difference is "Through" the Substrate

Where other touch technologies distribute a field across the front surface of the touch screen and rely on a touch to interrupt the field, Dispersive Signal Technology waits passively for a signal created by a touch. This fundamentally different approach means that contaminants, such as dirt, grease, and solids, can accumulate on the surface and around the edge of the screen without a significant effect on the performance of the touch screen. It also scales readily, using similar electronics for all sizes of glass. Furthermore, *surface damage such as scratches or gouges generally will not affect performance*, making Dispersive Signal Technology ideal for gaming applications.

Exceptional Optics, Contaminant Resistance, and Much More

Since the substrate is pure glass with no metallic coatings, ridge reflectors, or optoelectronic components, Dispersive Signal Technology provides exceptional optical clarity and light transmis-



sion, and can be sealed to prevent contaminants from entering the touch screen enclosure, protecting the display and other internal components. Vikuiti™ Light Control or Solar

Reflecting Films can be applied to the glass to keep sensitive on-screen data private from prying eyes, or to block external light in high sunlight applications.

Stylus Support

Since Dispersive Signal Technology measures the vibration created by a touch, nearly any object - finger, prosthetic device, pen, credit card, most gloves - can be used to activate the touch screen. This is particularly useful in retail and restaurant applications where the user may use different types of objects to operate the touch screen. Dispersive Signal Technology also provides enhanced palm rejection - a user can rest their hand or

other objects on the touch screen during use without activating the touch screen unless they tap the surface. This unique capability is universally beneficial, but particularly useful for bartop gaming where users tend to rest the edge their palm against the surface of the touch screen. Enhanced palm rejection is one of many break-through capabilities 3M plans to deliver with Dispersive Signal Technology to innovatively change the touch screen industry.

Sophisticated, Yet Fast

Although Dispersive Signal Technology uses intricate, proprietary software algorithms, its touch response time rivals the fastest in the industry. In retail, POS, and entertainment applications, where users are particularly adept and quick, the faster the response of the touch screen, the more transactions occur per hour increasing productivity or profitability, and customer satisfaction.

The Innovation Continues

The fundamentally different

approach of Dispersive Signal Technology promises to further expand the opportunities to use touch screen technology. It brings together the unique combination of exceptional optics with stylus support and contaminant resistance, never before seen in the touch industry. Adopters of Dispersive Signal Technology will not only benefit from all the capabilities they've come to expect with other touch technologies, they will realize new benefits from advanced features such as enhanced palm rejection - the first of what will be a stream of innovative break-throughs that 3M provides with Dispersive Signal Technology.

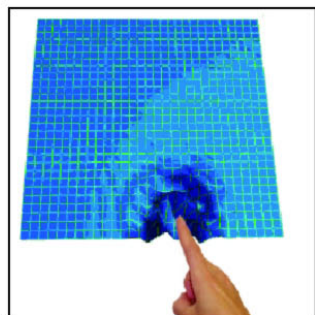
Dispersion Explained

Dispersion is the phenomenon that the velocity of a bending wave propagating through solid material is dependent upon that wave's frequency. A vibration caused by a touch generates a number of bending waves within the substrate, all at different frequencies. Because of dispersion, these bending waves propagate out to the edges of the glass at different speeds rather than in a unified wave

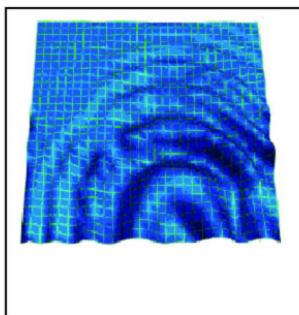
front. The sensors at the edges sense the high frequency waves first - the lower frequency waves arrive later, with the sensors receiving a formation of waves that resemble nothing like the original pulse. This smearing effect is compounded by the reflections off the internal surfaces of the glass substrate. The net result is a seemingly chaotic mass of waves all interfering with one another throughout the substrate.

3M has successfully harnessed this technology by developing a set of proprietary algorithms that accounts for the dispersion effect, gleaning from the mass of chaos a clear, precise touch location. These algorithms are the result of extensive R&D effort providing a highly accurate and sensitive solution. No other touch technology works quite this way.

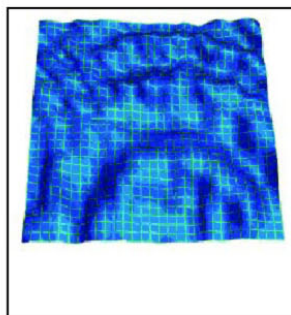
For more information on 3M touch products, contact:
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3M Optical Systems Division
300 Griffin Brook Park Drive
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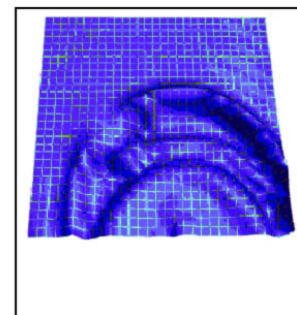
Initial Touch Down



Progressing Dispersion
with the Beginning of
Reflection Effects



Highly Complex Dispersion
Pattern with Reflections



Post-Algorithm Pattern

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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
Slot Tech Magazine is
published monthly by:**

Slot Tech Magazine

1944 Falmouth Dr.

El Cajon, CA 92020-2827

tel.619.593.6131

fax.619.593.6132

e-mail editor@slot-techs.com

Subscription rates:

Domestic (USA)

1 year - \$60.00

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2002

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2003

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2004

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