Slot Tech Magazine

Slot Machine Technology for the International Gaming Industry

April 2006

Quick Simple Repairs #12
Get To Know An Atronic Technician
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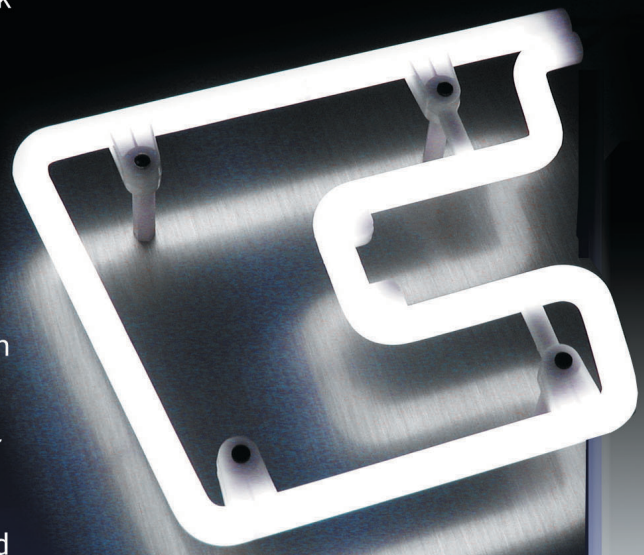

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Slot Tech Editorial

The commonplace, Erasable, Programmable, Read-Only Memory integrated circuit seems to hold some sort of mysterious power over some casinos. Manipulating an EPROM in any way often entails a ritual that rivals that of any of the world's religions.

Consider this scenario: A RAM clear, repair, upgrade or conversion needs to be performed on a machine. The novitiate priest/shaman (the slot tech) begins the ritual by sounding the trumpet/ram's horn/conch shell (radio transceiver). The priest/slot tech now has nothing to do but meditate/stand around doing nothing productive - while he awaits the arrival of the ritual procession bearing THE SACRED CHIPS. THE CHIPS are kept in The Ark of the Gaming Commission (the safe) which itself lies deep in the bowels of the Temple of the Commission. The shaman/slot tech cannot enter this temple for it is the sole realm of the High Priest/Gaming Commissioner and his apostles.

However, THE CHIPS cannot be carried by High Priest. Transporting THE CHIPS requires an armed escort. That's the job of Security and so they form the ritual procession by meeting at the Ark, removing THE SACRED CHIPS, placing them on the Anti-Static Pad of Watchful Protection and bearing them to the location where the ritual healing/repair will be performed. Under the supervision of the High Priest and the watchful eye of Security, THE CHIPS are manipulated by the priest/slot tech in the manner that only he/she knows. When the ritual is complete, THE CHIPS are returned to The Pad and subsequently conveyed back to their resting place in the Ark. Naturally, the entire ritual has been recorded in The Log of CYA, just in case something goes horribly wrong with the ritual.

"Thou Shalt Not Duplicate" or "Go Forth but Do Not Multiply"

I was recently at a casino (in the slot shop, naturally) observing one tech showing another one how to remove and replace an EPROM. He made a point to mention that if a pin is accidentally broken off the EPROM, it would cost $1500.00 for a replacement.

"Huh?" I blinked in surprise. "Can't you just burn another one?"

He replied that not only did they not have a PROM duplicator in the shop, the very existence of a PROM duplicator on the premises was forbidden by, you guessed it, the High Priest of the Gaming Commission, operating under the restrictions laid down in the Book of Regulations (another of the Sacred Texts).

The subject of EPROMs was brought to mind by the simultaneous and unsolicited receipt of an advertisement from eetools for their PROM duplication equipment (see page 37) and an excellent feature article on how to build a giant EPROM eraser, penned by Ted Bevis. I guess my point in all this is that, while I applaud the need for security, this business with EPROM control and, especially, restriction of duplication, is unnecessary voodoo. There are lots of casinos that allow their techs to duplicate EPROMS (including the majority of the "major" casinos, nationwide) without untoward side effects. It is completely legal to make a copy of an EPROM in order to replace one that has become damaged. There is no reason to fear a $1500.00 charge just because you've accidentally broken a pin off a five dollar component.

Randy Fromm

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

Randy Fromm's Slot Tech Magazine

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Get To Know An
Atronic Technician

By Michael Brennan

Their phones ring at 3:00 am, they log tens of thousands of miles on the road, they eat on the run and have receipts popping out of every pocket--they are Atronic field technicians.

These unheralded road warriors spend their time fixing games, hearing complaints, resolving problems, and receiving little recognition in return. So today we're giving these trailer-driving, trouble-shooters their due, by providing a little insight into the life of a slot machine manufacturer technician.

The first technician of the bunch is Justin Beck, a four-and-a-half year veteran from Reno, Nevada. You could call Justin the "outdoorsy type." The second technician we interviewed is Chris Sweeney. Chris is rather new, serving as an Arizona technician for just under a year. He really likes high definition television, and spends most of his free time heading out for food and drinks. Next is Casey Prout, who has been with Atronic for almost three years, holding court as Michigan's Lead Tech. All you need to know about Casey is that he has given his truck a woman's name.

What is the strangest thing that has ever happened to you on a casino floor?

Justin: In our trade you see a lot of weird things, like people falling off of chairs, people screaming over jackpots, drinks spilled into games, cracked monitors from angry customers. But there is a casino in California that allows their workers to actually destroy an old slot machine that is no longer on the floor-- a game that might have been a problem child to them. They get to take out their aggressions on the old thing.

Casey: The strangest and best thing is that I met my wife on a casino floor. It's now ten years and a total of 5 kids later (some hers, some mine, some ours).

What is your least favorite thing to do in a casino? What is your least favorite procedure to perform?

Justin Beck

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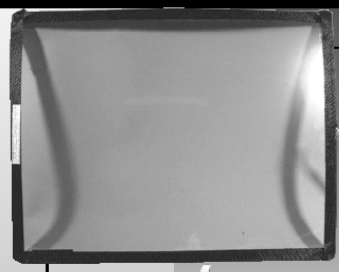

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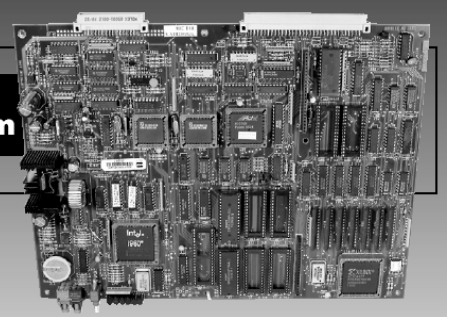
Capacitive Touchscreens



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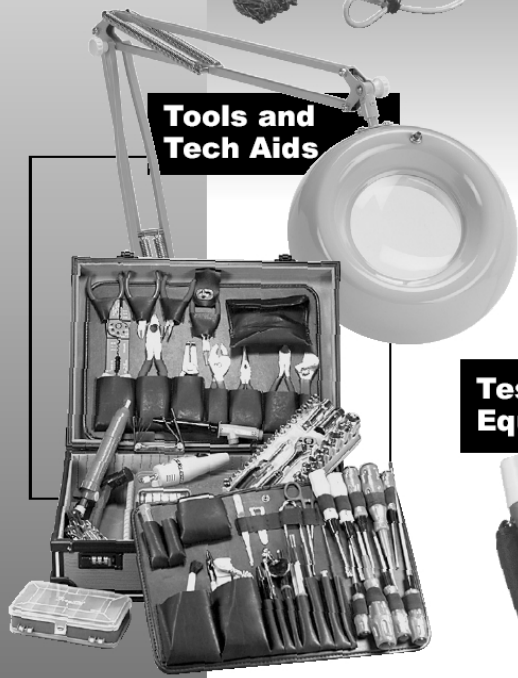

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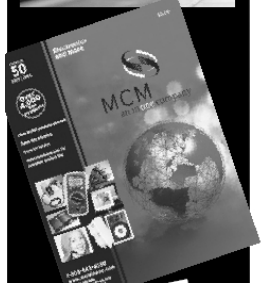

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Chris: My least favorite thing to do is fielding questions like, "Is there a trick to make this game win?" or "That game is paying out too much, that's why you're working on it, huh?" My least favorite procedure is logging software data for each game on a progressive link. There are tons of characters and you have to write extremely small.

Justin: This is tough, I actually like to work on games. But, I would say my least favorite procedure is replacing parts that are difficult to get to, like the back plane board and the TFTs. If there is a problem with either of these hard-to-reach parts, it can make for a long day and possibly some short fuses, and I don't mean the ones in the games.

What is the most common service issue you are called out to perform in a casino?

Casey: It would be something to do with the site PC, either resetting it or installing a new one.

Justin: Readjusting the TFT cables that become loose; I'm beginning to become quite a pro at fixing this. Recently, we have come up with a fix for this issue. We've created a new graphics card bracket that you can replace in one minute. There's more information available in technician document TD AA 06-003.

What service that you get called to perform do you feel could be rather easily performed by casinos themselves?

Justin: Just simple things like loose TFT cables, maybe RAM clear procedures, especially when I've made repeated trips for the same errors. The casino technicians really can do a lot to help out.

Casey: Although it is becoming less of a concern recently, I think casinos were reluctant to RAM clear an e-motion because of their past experiences RAM clearing our older platforms.

What's the best thing about the e-motion cabinet?

Justin: I like how easy they are to work on. The design team really made this cabinet technician friendly. There is a lot a space to access and reach parts.

Chris: It runs efficiently, so there seem to be less late night service calls than from our older platforms, Cashline and Towerline.

Casey: It looks like no other and a lot of casinos say they only open the door to reload paper or change lights.

Since you may be on the road a lot, what's the strangest thing that's happened to you while driving?

Casey: I almost hit a bear, yes a bear, while returning from a service visit two summers ago.

Chris: One time the weather was insane-- winds seemed to be 100mph. I could see dirt and debris sweeping over the road in front of me like waves in the ocean crashing into the beach, but this stuff was nailing the side of my truck! At one point, I saw a ten-foot tree just uproot out of the ground. I felt like I was in "The Wizard of OZ." On the way back, rain was dumping down so much that it completely flooded the

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street. It was late at night and I had to dodge headlights coming at me, since no one knew where the street lines were. I couldn't believe that this much water came down in 30 minutes, and I'm from Seattle!

Justin: The most memorable was when two other techs and I were on 395 North, 20 miles outside of Reno, when about seven mule deer decided to cross the road. They were head to tail in a straight line, and the largest opening between two deer was maybe three feet. Somehow, my coworker managed to squeeze a seven foot wide truck going 65 miles an hour through a three foot opening without hitting a single deer.

As "road warriors," do you know how many miles you drive a year or how many you have accumulated?

Justin: In one year I've traveled up to 80,000 miles. In our Vegas office two vehicles have 140,000 miles each, and a van had 80,000. I've probably put about 215,000 miles in. Throughout, I've only had to change one tire, but I've used tire chains and 4-wheel drive for over one thousand miles. I've been fortunate to have had a lot of good travels that where quite safe.

Casey: I probably average about 50,000 miles a year between Betty and rental cars. I call my truck Betty. When you're on the road this much, you need to name your truck. My wife gets jealous when I talk about Betty, and Betty gets jealous when I talk about any other mode of travel.

Any bad experiences in hotels or other road-weary stories?

Casey: Once, it took three separate hotel rooms to find one to sleep in. The first room had a smoke detector that chirped every couple of minutes, the other featured a dripping AC unit, and the third had a noisy ceiling fan, but I gave up and slept there through it.

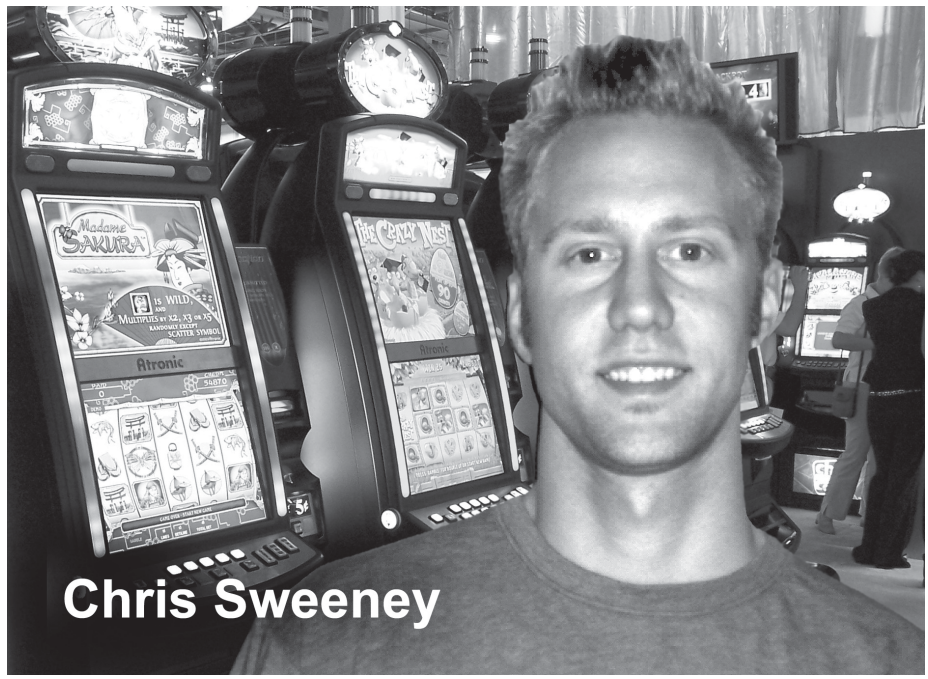
Justin: Before a service trip to California I had switched brands of laundry detergent. When I got there, I had an allergic reaction to the detergent; it made me welt up and itch. This was the kind of itch that, no matter how hard you scratch, it won't go away. It covered me from head to toe. Those were the longest four days of misery I had ever experienced.

What is your favorite random small town you've traveled to and why?

Casey: I think it would be a tie between Spread Eagle, WI, because of the name (yes, I had to buy a t-shirt) and Wagon's Mound, NM, where I ran out of gas while driving from Arizona to Michigan.

Justin: Warm Springs, Oregon. This is a great high desert plateau setting with the Deschutes River running through the valley along with Mule Deer, Chucker, Quail, Steelhead, Rainbows and Browns! This is my kind of paradise. I'm all about the great outdoors and nice walks in the middle of nowhere, not to mention the nicest people you can talk to. I wish I had a good camera for those trips.

Chris: That would have to be



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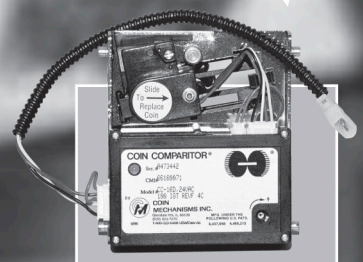
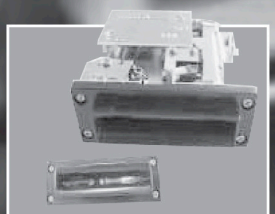


Coin Mechs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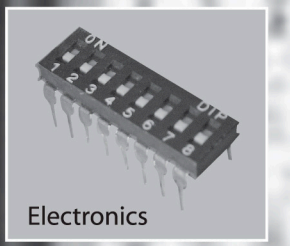
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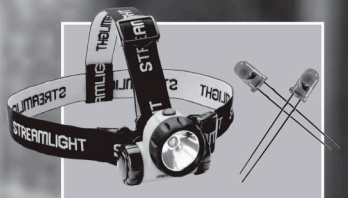

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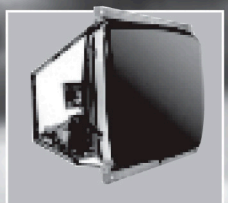
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Have you spent hours trying to fix something, when the solution was very obvious or a simple error? What's the "dumbest" thing you've done?

Chris: Oh yeah, I did some dumb things when I first started. I've put the reset chips in backwards, I've plugged the player tracking cable into the wrong port. I've even changed every board in the game and found out that the problem was a blown fuse. Now, with experience, I tend not to make those little mistakes any more.

Justin: Which time? When working in California, I forgot a security dongle we use on our lap tops that enable us to use a PC setup program. I left it on my desk at the shop in Reno, and my boss at the time had to bring it to me so I could finish my five minute job! There wasn't a pat on the back for that one.

Got any personal records for fast installations?

Justin: A co-worker and I installed 85 games in just over 2 days, with new locks, player tracking, drilling, mounting, setup and testing. I'm getting better every day with e-motion games and I'm ready for a new best.

Casey: At Kewadin, St. Ignace, I had a 12-game install. The casino had the games unloaded, unboxed, bases drilled, machines bolted down and the power ran so that I could install software. The whole thing took about seven hours.

Chris: I just replaced a TFT monitor in a game at a casino. It took me 40 minutes exactly from the time the game was opened until the game was closed again and in service. I'd like anyone to challenge that.

Which casino, in your opinion, has the most well-run slot tech department?

Chris: There are a few here in Arizona like Desert Diamond, Casino Arizona, and Gila River. They're all pretty good.

Justin: Spirit Mountain, Oregon. Super nice group of techs, hardest working in any casino I've been in. Thanks for all the help! They are extremely well trained and very attentive to everything I did. They ask questions and very seldom do I ever have the same problems twice.

Casey: Little River in Manistee, Michigan. I can ask any tech there a question, and get an answer.

What type of help do you appreciate most from slot casino technicians?

Justin: I am a firm believer in less is more when it comes to how many technicians you can have in one place at one time. It helps if someone is efficient at what he is doing, say installing player tracking or changing out locks. It's nice to gun and run if you can.

Chris: The best way (and a lot of casino technicians do this) is to have games that we are going to install prepped before we get going. This means changing locks, installing tracking systems and prepping the bases, if possible. This saves us a lot of time, and we can install everything very efficiently.

Casey: I like when a technician watches what I am doing, asks questions, and then jumps in and helps me finish the job.

How many tools have you lost/gone through over the years?

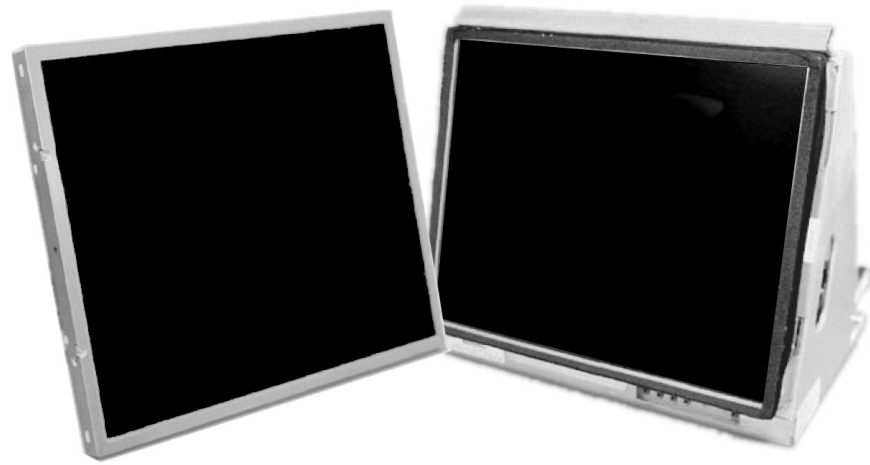
Casey: The only tool I have ever lost is a quarter-inch drive ratchet.

Chris: I haven't worked here for years, but every time I lose a tool, it turns up in the tool bag of somebody I work with. Go figure.

We hope this little Q&A session helped shed some light on what it's like to be an Atronic technician. There are over forty of these technicians spread throughout the world (thirty in the US and Canada alone), and they all strive to serve their customers as best they can. If you want, take the time to get to know your local Atronic technician-- they no doubt have their own interesting (and possibly unprintable) stories to tell. Look forward to future articles like this, including interview sessions with international technicians. Au revoir.

- Michael Brennan
MBrennan@atronic.com

Are LCD display problems driving up your costs?



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Quick Simple Repairs #12

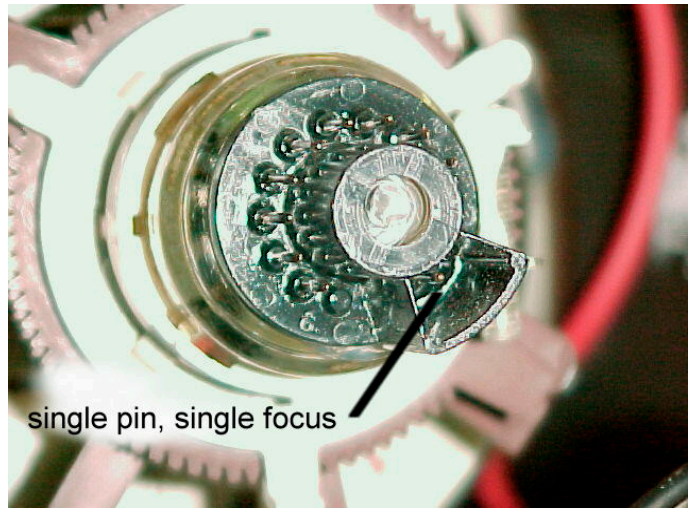
By Pat Porath

WMS Upright Monitor – Blank Screen

While making a round on the gaming floor, I noticed a WMS upright video game that was shut down. Hmmm, what is with this game? I powered it up and the monitor was black. To make sure that the problem WAS in the monitor, it was swapped with another game. Once in a while a RAM clear will bring back a monitor; therefore it would be a software problem. However, in this case it was indeed a problem with the monitor. It was swapped and the problem followed.

By looking at the dust buildup, it looked like it had been a while since it had been put on the bench. Could it be bad caps on the monitor chassis board? Could it be the separate B+ power supply for the chassis board? Maybe it's a bad CRT (picture tube) or a combination of things?

Well, instead of tearing the monitor assembly all apart, I took a different approach. Let's start with something easy. Why not? Things on the floor were pretty slow. With both a single focus and a dual focus power supply in hand, things were started on the monitor. I pulled off the neck board to see if it was a dual or single focus and saw that it was a dual. On the neck of the CRT, there is a spot where there are two pins or one pin. Two pins are for the dual focus while one pin is for single focus. I thought, why not try only replacing the power supply as it is the problem with this specific type of monitor (a Wells-Gardner U3000) some of the time. I used a ground cable and shorted out the second anode of the CRT, pulled off the connectors and removed the four small bolts. Then I installed the "RFI" (ready for installation) B+ and hooked it all back up, connected the anode and such. Now it was time for the real test. Was it or was it not the power supply? After powering up the game my fingers were crossed and then there it was, a beautiful picture on the CRT. Pretty as could be. Another game back online.



Notice in the close up picture where the single pin is located on the CRT neck. One quick look and it is very easy to tell if the tube is a single or dual focus type.

I.G.T. Error Codes

On IGT games, there is a wide variety of error codes that can come up on the display. The majority of the manufacturers of slots use the same basic error codes to tell you where the problem may be in the game. Here is a list of the IGT error codes for an S+. The S2000 games are about the same.

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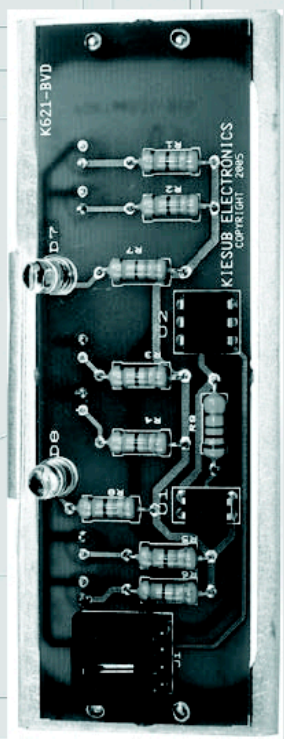

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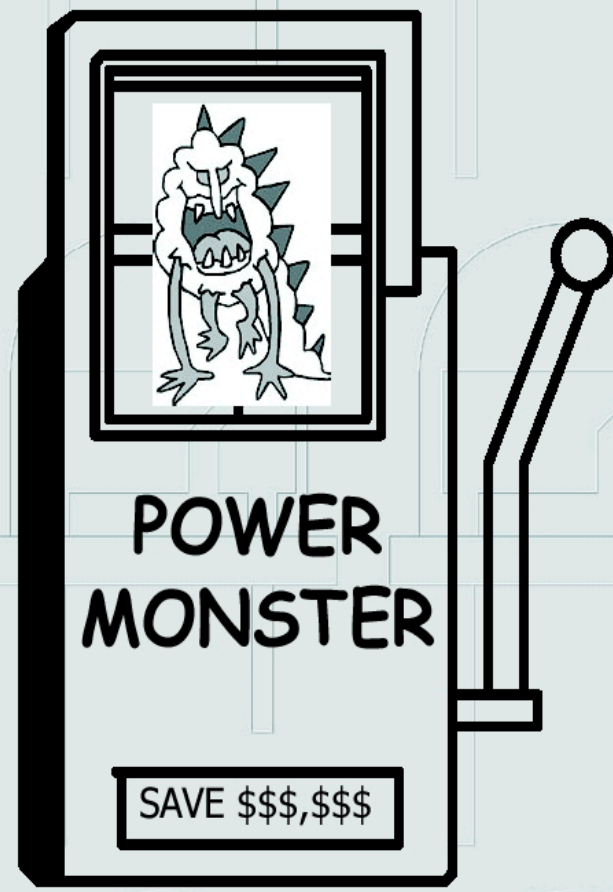

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Code 12-the battery on the main board is low and needs to be replaced
Code 2100-is a coin in tilt
Code 3100-is a coin out tilt; it may be a coin out jam
Code 3200-means an extra coin was paid out of the hopper
Code 3300-is usually an empty hopper
Code 40-general reel tilt
Code 41-reel #1 tilt
Code 42-reel #2 tilt
Code 43-reel #3 tilt
Code 44-reel #4 tilt
Code 45-reel #5 tilt

A note on reel tilt code: If the game is a regular three reel game and you get an error code 44, you may ask "what is the deal here?" If the game has a bonus reel up top, say a multiplier or something like that, the game will see it as the fourth reel. This is also the general idea for Bally reel tilts as well.

Code 61-is a CMOS error (RAM error)
Code 62-EPROM error. The game may need a RAM clear or it may have a bad EPROM
Code 62_1-EPROM data error
Code 64-progressive communication down
Code 65_1-the EPROM may be not be proper for the specific game
Code 65_2-RAM and EPROM data don't match
Code 66-EPROM was changed

Error Codes for Bally Games

Code 20-coin in jam
Code 21-coin in error (or jam)
Code 24-a coin bounced in the optic when it was inserted
Code 30-the hopper may have overpaid
Code 31-coin out jam
Code 32-usually means the hopper is empty
Code 33-a reset was done during a hopper payout
Code 41-reel #1 tilt
Code 42-reel #2 tilt
Code 43-reel #3 tilt
Code 44-reel #4 tilt
Code 45-reel #5 tilt
Code 50-the main slot door is open
Code 54-the drop door may be open
Code 60-a reset was done during a bill transaction
Code 65-the mechanical machine meters may be disconnected
Code 70-a door may have come open during a spin
Code 71-improper reel #1 movement
Code 72-improper reel #2 movement
Code 73-improper reel #3 movement
Code 74-improper reel #4 movement
Code 75-improper reel #5 movement
Code 80-ROM error
Code 81-the battery on the main board is low
Code 82-the door was open when the game was off
Code 83-SafeRAM error
Code 84-RAM error
Code 90-a display error, LED or vacuum fluorescent display error
Code 91-communication error within a progressive

This would be a handy guide to keep nearby, especially when an oddball code does occur on the floor. For example, a slot attendant calls you on a code 61 (RAM error) on an IGT

An older IGT game would come up with a code 43 (reel 3 tilt). It wasn't often but once in a while during the day. After checking into it further, it was found that the reel motor was starting to go bad

game. By knowing what the code means, you will then be ready for the next step: clear the code. To resolve a code 61, there is a combination of things that need to be done. Holding the test button for three seconds, a 61__1 will appear. Close the main door, turn the jackpot reset key and it should clear. The game options would also have to be checked.

On a Bally, if there is a code 71 (reel 1 tilt) simply open and close the main door for a reset. If it doesn't work the first time, is there a reel obstruction? Maybe the reel motor is going bad. If you get called back to the game later on in the day for the same code, there must be something wrong somewhere. If it isn't fixed, you'll get called back to it again and again.

There was an older IGT game that was on the floor and every so often it would come up with a code 43 (reel 3 tilt). It wasn't often but once in a while during the day. After checking into it further it was found that the reel motor was starting to go bad. The motor was pulled and when it was turned by hand it made a funny noise. Hey! They aren't supposed to do that. It was replaced with a spare and we had no more problems.

- Pat Porath
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Build your own EPROM Eraser and SAVE!

By Ted Befus

Wow, what a title. Sure catches the eye doesn't it? Well maybe not, but it's the best I can come up with. Sounds kinda like a commercial.

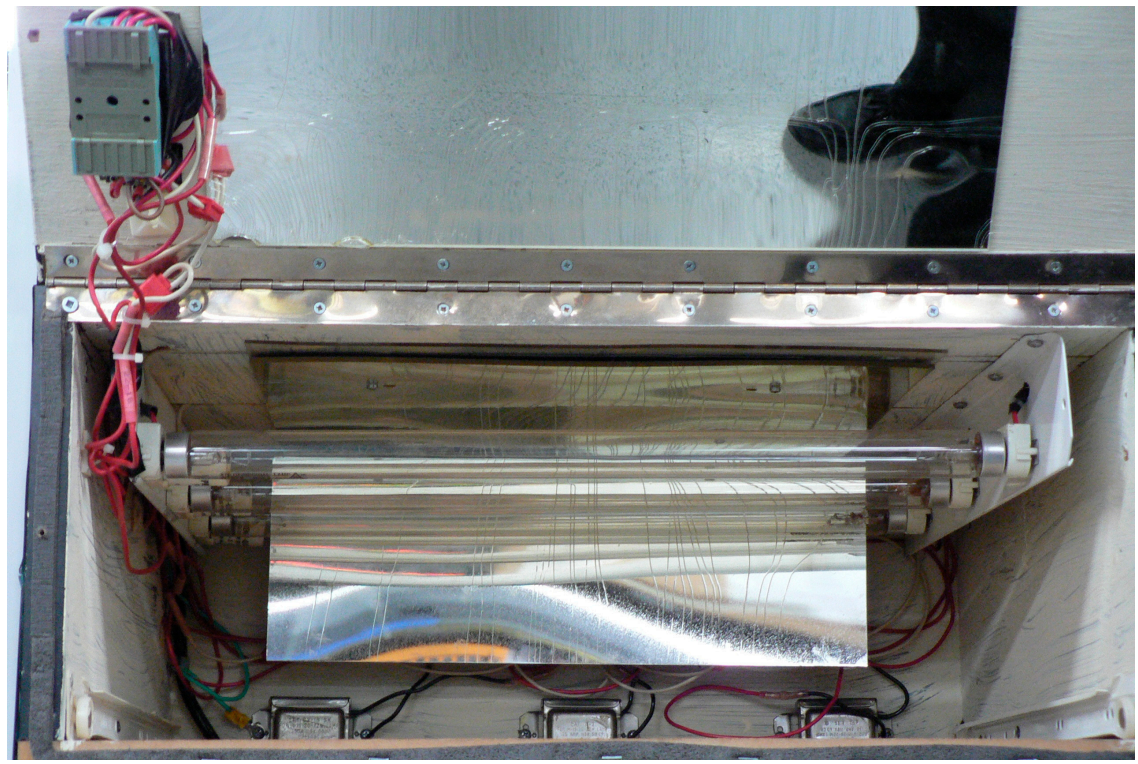
Ok, since this is the first (and maybe last) time that I've ever written for ANY publication, I'd like to take a minute to thank Randy Fromm and Slot Tech magazine for agreeing to look this over (and maybe even publish) this article. It's a great honour to write for a publication like this (note the letter U in the word honour. Can you guess what country I'm from?)

The idea for this article came from a discussion on the Slot Tech Forum (hosted by Pete Bachran. Thanks Pete). It all started innocently enough, with questions regarding EPROM burners and erasers. I piped in with my two cents worth, stating that you could always build your own EPROM eraser, after all that's what we did!

Why build your own, you may ask. The guys in our shop don't like to be the "tools" of manufacturers (unless we have no choice). It's just so satisfying to build something with your own hands.

Prior to this, we had spent quite some time searching the market for an eraser that was both large and AFFORDABLE! It was quite the pain using our little (and I mean LITTLE) eraser that we had purchased when we first opened. When it came time for an EPROM upgrade, we would spend entire shifts toiling over the eraser trying to get enough chips erased so we could run our upgrades. Thank goodness we aren't an exceedingly large casino.

Eventually a few of us sat down and examined what was needed. It was all really quite simple: A chassis large enough for A LOT of EPROMs, some UV bulbs and a timer circuit.



For the chassis, we looked around at our options. In the end, we decided to take an old cannibalized slot base, cut it down to the height we wanted and go from there. The slot base also gave us a retractable shelf that was perfect for rolling in and out of the eraser. The removable tray was covered in anti-static foam to hold the EPROMs.

The best thing we had going for us was that everything we needed was in-house. The ballast and starter combinations were readily available from our parts inventory and the timer is something we like to keep on hand for just such instances as this. We chose to use three, G15T8 UV

bulbs. Each is powered by a 15W ballast/F2 starter combination. The timer is a Potter and Brumfield® CNT 35-76 Programmable Relay/ Counter plugged into a Releco® S3-B base.

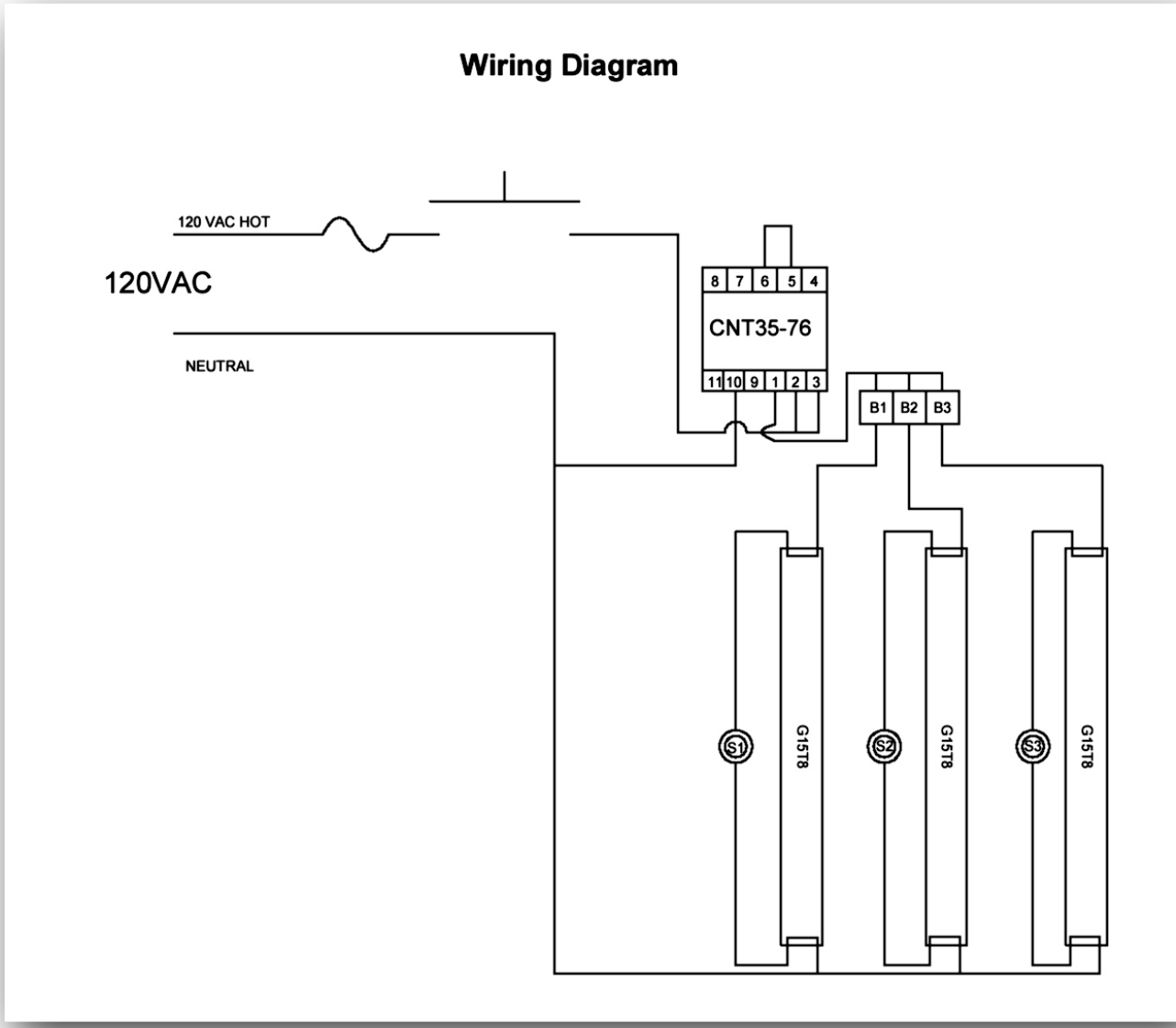
The timer is the heart of the eraser; everything is run off of it. It is easily programmable with several different operating modes and can run on a 120 VAC supply. We thought about using a DC timer/relay combination but opted against it since we didn't want to add more hardware than was necessary.

The inside of the cabinet was first painted with flame retardant paint and then lined with a reflective covered plastic on the sides and top of the cabinet. Our eraser is quite large, measuring 22 inches across, by 18 inches deep and nine inches tall. We evenly spaced the three UV bulbs on the top of the cabinet. The bulbs were placed approximately four inches above the eraser surface. In case of bulb or hardware failure, we opted to make the front cover hinged. In the event that we need to replace anything, we can flip the front panel up for easy access to the inside of the unit. While in use, this cover is screwed shut to prevent any escape of UV radiation.

I'll be the first to admit that the eraser isn't the prettiest thing around. For us, the most important thing at that time was whether or not it worked. It's not too bad considering that it was built in less than a day.

Wiring

Now you're wondering how everything is wired. This diagram is very basic but it will give you the gist of what is going on:



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Wiring Diagram

See? I told you that it was a basic drawing. It really is that simple. However, there are a few things not in this drawing that you may want to include when you build your version of this. We neglected to install a kill switch on the EPROM tray so if you pull out the tray while the eraser is running, you increase the risk of exposure to UV radiation. Some of you may think that it isn't a big deal but we're talking about bulbs that are designed for sterilization and pharmaceutical use. They can do some real damage, especially to eyes. Better safe than sorry.

Also, on this diagram I haven't shown any connection points. You'll need a common connection point from the timer/relay to all the ballasts as well as a common connection for your neutral lines. To keep things simple, use a terminal block. They're easy to use and can be screwed directly to the cabinet of the eraser.

Next, when you look at the relay/timer base you will notice that I have pins 5 and 6 tied together. These pins control the reset function of the timer circuit. Without closure on these pins, the timer is not allowed to start. Simply shorting these pins together means that by using only the power switch I have complete control over the timer. If you want to leave the power on continuously, you can hook up a momentary pushbutton or toggle switch to control the timer.

You'll also notice that I fused the hot side. We used a 1A fast blow. The last thing that you might be looking for is a direct connection to "Earth" ground; I don't show one in the diagram. In our eraser, we have connected the case of each ballast together and tied the three to ground.

I'm not sure how many of you have used one of the CNT timers before. They are quite impressive. The Potter and Brumfield® name is a good one, and for good reason. This timer has 10 different modes. For a list of modes and connections you can go to www.tycoelectronics.com and do a search on

the CN 35-76. You should find list of PDF files with everything you need to know about it. These modes and times are controlled by a series of thumbwheel switches located on the top of the timer. Times can run anywhere from fractions of a second to hours.

I'll give you a brief description of how this is all going to come together: We are going to use the "G" mode on the timer. This mode is a controlled on-off interval, meaning that when power is applied through the power switch, the timer/relay will close the "normally open" contact of the relay (connect pins 1 and 3) and enable the timer. This will supply the ballasts with the 120VAC hot needed to complete the circuit and light the 3 UV lamps. When the timer expires, the relay contact is re-opened, cutting off the power to the ballasts.

After you have your eraser built and operational, the only concern you have is to determine the minimum amount of time necessary to completely erase your devices. We settled on 30 minutes of erasing time. The distance between the devices and the UV bulbs may increase or decrease that time.

I certainly hope that this has covered enough to get you going (or at least make you dangerous). Remember that those UV lights are no joke! However tempting it might be, don't stare into the light!

- Ted Befus
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410557 Aristocrat MAV500 MPU board and the SH7750

By Herschel Peeler

It appears there are at least three versions of Aristocrat MPU boards. I was familiar with the 410461 and 410289. An email from another tech asked me a question about the 410557 and I had to do some research. The question was about the system hanging up during a hand pay. This is the long way around answering the question, but the objective is the educational process not just answering the question. To follow along you will have to have a set of prints for the 410557 board and a data sheet for the SH7750 CPU wouldn't hurt. The article will probably still be of value if you do not.

Sheet 1 of 26 of the 410557 schematic

Here we have a hierarchical drawing of how the rest of the drawings are tied together. We have the MPU, an Hitachi SH7750 with a SH4 instruction set. The SH7750 has an External Data Bus of 64-bits and an Address Bus of 26 bits.

We have all the usual sections we would find in any other MPU board: Dynamic RAM Array, Data Buffers, Address Buffers, EPROM, Expansion Connector, Static RAM, Serial Port to the Bill Acceptor and other Serial Ports, MVP Bus and all the other sections going to the backplane and to the game itself.

We have a PCI bus, as we would expect to find in any modern computer system. On the PCI bus we find the PMC and a Video Card. The PCI Controller is a PLX9054. If you get your face into many home computers, this guy might be familiar to you. All this is tied together by a massive FPGA, Field Programmable Gate Array.

Since this article is about the processor itself, we will go to the data sheet. You can find it on the Hitachi web site without much trouble (Quite unlike the ARM250 version of this board. I had a devil of a time finding information on that CPU).

SH7750, page 61 of the data sheet

The SH7750 is classified as a 32-bit processor.

"But the schematic shows 64 data bits", you may observe.

"Ah," I would answer. "But it is the internal structure that determines the classification." While the pinout may show 64 data lines, the CPU on the inside only processes data 32 bits at a time.

We find mostly the same internal sections we would find in most other processors of this era: Central Processing Unit, Floating Point Processing Unit., a Cache memory between the processors and the other sections, Clock Pulse Generator, Interrupt Controller, Serial Communications Interface, Real Time Clock, Timer Unit, Bus State Controller and Direct Memory Access Controller.

Pinout, page 65 through 74 of the data sheet.

To help you make some sense of the pinout you see on the schematic, here is a quick rundown on what these terms mean:

RDY* - (I) Ready, active Low
RESET* - (I) System Reset, active Low
CS0* – (O) Chip Select outputs to control other operations. Active Low.
CS1* - (O)
CS4* - (O)
CS5* - (O)
CS6* - (O)
BS* - (O) Bus Start, active Low
VSSQ – I/O Ground
RD2* - (O) A Read Strobe for SRAM or RAS* for SDRAM, active Low
VDDQ – I/O Power, 3.3 V
VDD – CPU Power. 1.8 V
VSS – CPU Ground
BACK*/BSREQ* - (O) Bus Request / Bus Acknowledge
BREQ*/BSACK* - (I) Bus Acknowledge / Bus Request
CKE – (O) Clock Enable to SDRAM
WE0* - (O) Write Enable 0* for SRAM or CAS0* for DRAM, data bits 0 - 7
WE1* - (O) Write Enable 1* for SRAM or CAS1* for DRAM, data bits 8 - 15
WE2* - (O) Write Enable 2* for SRAM or CAS2* for DRAM, data bits 16 - 23
WE3* - (O) Write Enable 3* for SRAM or CAS3* for DRAM, data bits 24 - 31
WE4* - (O) Write Enable 4* for SRAM or CAS4* for DRAM, data bits 32 - 39
WE5* - (O) Write Enable 5* for SRAM or CAS5* for DRAM, data bits 40 – 47
WE6* - (O) Write Enable 6* for SRAM or CAS6* for DRAM, data bits 48 - 55
WE7* - (O) Write Enable 7* for SRAM or CAS7* for DRAM, data bits 56 - 63
CKIO - (O) Clock pulse to SDRAM
CKIO2 - (O) Clock pulse to SDRAM
DRAK0 – (O) Acknowledge for DMA Access Request
DRAK1 – (O) Acknowledge for DMA Access Request
CS2* - (O) Chip Select 2* Output strobe, active Low
CS3* - (O) Chip Select 3* Output strobe, active Low
RAS* - (O) Row Address Strobe for DRAM
RD* - (O) Read Strobe* for SRAM or CAS* for DRAM
RD/WR* - (O) Read / Write* for SRAM
RXD – (I) Serial Communication Data Input
DREQ0* - (I) DMA Request Input 0*
DREQ1* - (I) DMA Request Input 1*
RD/WR2* - (O) Read / Write* for memory
MD0 / SCK – (IO) SCI Clock, Mode Control inputs on Reset*
MD1 / TXD2 – (IO) SCI FIFO Data Output, Mode Control inputs on Reset*
MD2 / RXD2 – (I) SCI FIFO Data Input, Mode Control inputs on Reset*
MD3 – Mode Control inputs on Reset*
MD4 – Mode Control inputs on Reset*
MD5 / RAS2* - Mode Control inputs on Reset* and RAS2* for DRAM
MD6 - Mode Control inputs on Reset*
MD7 / TXD – (IO) SCI Data Output, Mode Control inputs on Reset*
MD8 / RTS2 – (IO) Data control for SCI FIFO, Mode Control inputs on Reset*
IRL0* - (I) Interrupt Request Line 0, active Low
IRL1* - (I) Interrupt Request Line 0, active Low
IRL2* - (I) Interrupt Request Line 0, active Low
IRL3* - (I) Interrupt Request Line 0, active Low
NMI – (I) Non-Maskable Interrupt, active High
XTAL2 – (O) RTC Crystal
EXTAL2 – (I) RTC Crystal or frequency input
VDD-RTC – Power for the RTC, 3.3 V
VSS-RTC – Ground for RTC
TCLK – (IO) Timer / RTC Clock
CA – (I)
CTS2* - (IO) Clear to Send for SCI FIFO
SCK2 / MRESET* - SCI FIFO Clock and Manual reset input
DACK0 – (O) DMA Acknowledge
DACK1 – (O) DMA Acknowledge
STATUS0 –
STATUS1 –
ASEBRK* / BRKACK – (IO) Software Break and Brake Acknowledge (H-UDI)
TDO – (O) H-UDI data out
TMS – (I) H-UDI mode
TCK – (I) H-UDI clock
TDI – (I) H-UDI data input
TRST* - (I) H-UDI reset
CKIO2ENB – (I) I/O Clock 2 Enable
VDD-PLL1 – 3.3 V
VDD-PLL2 – 3.3 V
VSS-PLL1 – Ground
VSS-PLL2 – Ground
VDD-CPG – 3.3 V
VSS-CPG – Ground
XTAL – (O) Crystal or Ceramic Resonator drive line
EXTAL – (I) Crystal or Ceramic Resonator input or frequency input

Crystals

The SH7750 has two crystal oscillator inputs. One is for main CPU operation. The other is for the built in RTC (Real Time Clock). RTC will only take a few paragraphs so we'll cover that first.

All games have an RTC that keep track of the time of day and calendar functions. When you set the date and time into a game, this is the circuit you are referencing. The SH7750 has a separate set of crystal and power inputs for the RTC.

The other crystal is the source of timing signals for the CPU and most other circuits. When you hear about a processor having a speed of so many Mega or Giga Hertz, this is what they are talking about. The SH7750 has a clock speed of 200 Megahertz. However, this is not the speed of the CPU. This clock signal is divided down by a factor of eight or so. That speed is divided down further to create the clock signals that the CPU actually runs on. A 200 MHz clock may eventual give one instruction every 10 MHz. This gives us a bus speed of about 100 ns. If memory is slower than that, we cannot read information from SRAM, DRAM and EPROMs properly. The CPU has a problem if we try to run it any faster than the bus and memory speed can operate. We have a number of solutions to deal with this problem but we don't have the space to go into it here. As I said, the data sheet for this CPU alone is over 1,000 pages long in a pdf file.

RTC

The RTC (Real Time Clock) is a chip that has the task of keeping track of time and date in the system. Since this is a common task in all systems, many processors have this feature built into them from day one. The SH7750 is such a processor. This section has its own crystal for timing and runs off of sepa-

rate power from the rest of the CPU. This is usually battery backed-up and stays under power even when the CPU is powered down.

When you set in the time and date on the game, this is where that data goes. Most RTC chips have a small section of RAM in them to store date and other information. In your home computer, this is the CMOS memory you are probably familiar with. Here we have stored configuration information for the system.

When we lose battery power, we usually lose time, calendar and configuration data. Some games have a large capacitor on this power line so the battery can be changed without losing the data if you are quick enough.

When you first install the board, this battery may be removed or disabled and you will have to enable it. If you remove the board from service, remove or disable the battery.

Cache

The CPU can process information faster than memory can deliver it. To deal with this, we have two features of the SH7750. We have a 64-bit data bus that can read data twice the size of the CPU and we have a Cache memory between the CPU and the I/O section. Cache is a high-speed memory that keeps track of the most recently used places the program has gone.

In the structure of a program, we often run in loops that repeat one operation for a number of times before moving on. When we read a program from memory the first time, it is stored in Cache as it moves through the processor. On subsequent passes through the loop, the CPU references Cache memory instead of going out to main (slower) memory. Main Memory may have a speed of 100 ns. Cache may have a speed of 10 ns.

DMA

DMA (Direct Memory Access) is a feature built into most MPUs these days. Normally in a simpler system, the CPU is the only processor on the board and therefore the only device that can reference memory and control operations on the board. In more complex and newer systems, it is possible to have multiple processors in a system or have peripheral devices that are smart enough to talk to memory directly.

Normally the CPU controls information flowing from a storage device to memory. The CPU reads data from the storage device, brings it into the CPU's registers, and then moves from the registers to memory for storage. This is what is going on when we load a program or data in from a CD-ROM. High-speed storage devices like CD-ROM, DVD and disk drives can be built with their own processors included and have the ability to directly address memory. Since only one device can control the system's bus at one time, the CD drive must have a way to request access to the system from the CPU. To accomplish this, we have DMA Requests and Acknowledges.

The CPU starts the operation by telling the CD to read a certain file. The CD will take a while to locate the file so the CPU may go off and do other tasks while it is waiting. When the CD has located the file, it reads it from the disc, writes it into a memory in the CD Drive Controller itself and pulls on a DMA Request line of the CPU. When the CPU sees the DMA request, it stops what it is doing in an organized fashion and gives control over to the CD Drive Controller by sending it an Acknowledge. The CPU then tri-states its Address, Data and Control Lines. This allows the CD Controller to take control of the system bus and feed its data directly to memory.

When the CD Controller is finished, it removes the DMA Request and turns off its bus drivers, allowing the CPU to regain control of the system bus and pick up right where it left off.

Timer Unit

While the RTC keeps track of the calendars, we need a separate timer to track other events that must happen within a certain time frame. This is little more than a counter. We count clock

Figure 1.1 shows an internal block diagram of the SH7750 Series.

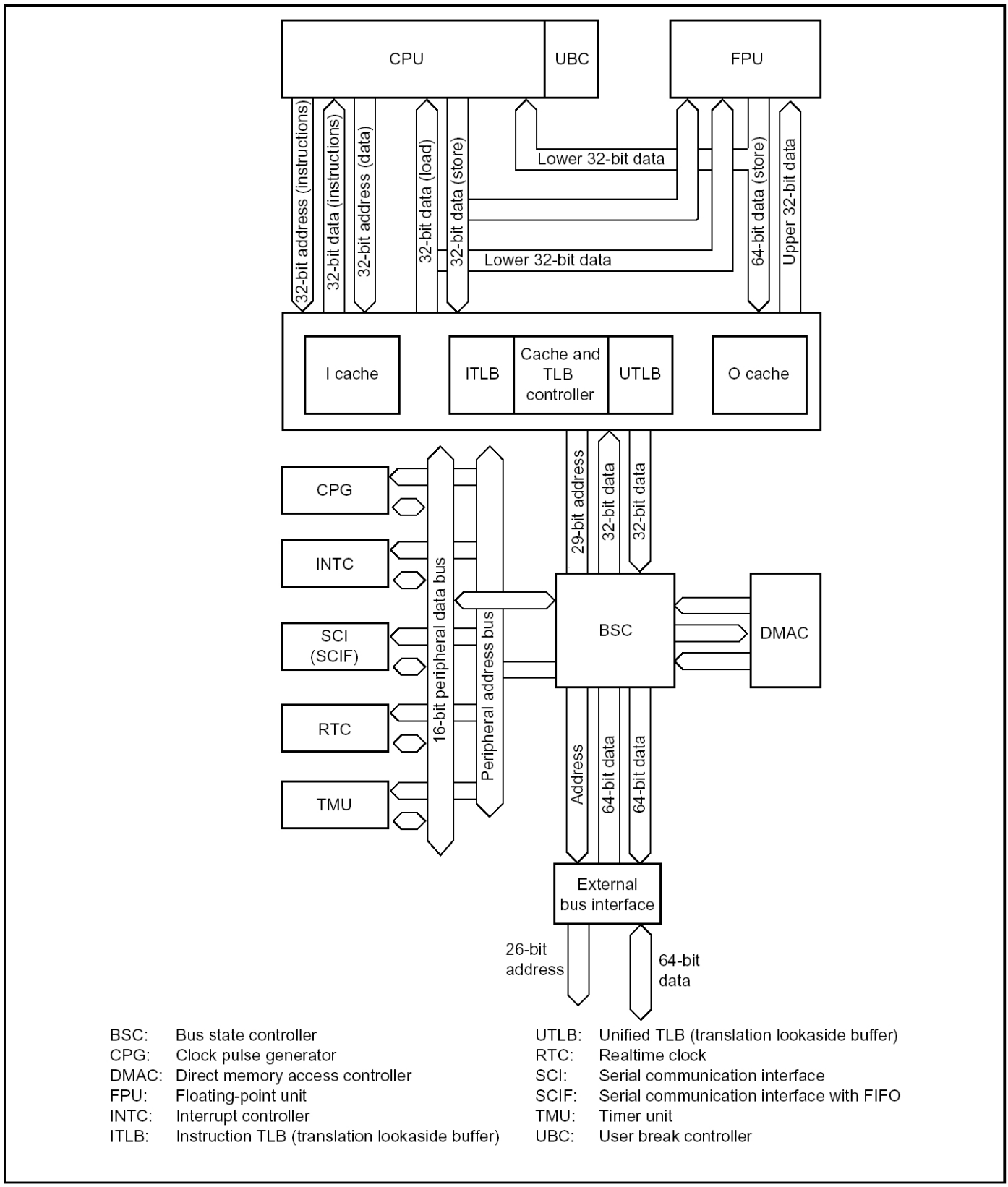

Figure 1.1 Block Diagram of SH7750 Series Functions

pulses derived from the CPU Clock. The CPU sets up a count and tells the timer to start counting down. When the Timer reaches zero, it interrupts the CPU with an alarm. Meanwhile, the CPU is free to go about other duties.

We would use this for determining Coin In and Coin Out timing or for Stuck Coin timing for instance.

Bus State Controller

All operations in the CPU must have some organization. At any given time, we may have any number of things that could happen. The CPU is only capable of performing one operation at a time. The BSC (Bus State Controller) is part of this system that keeps the CPU organized.

We may have more than one interrupt pending, DMA requests pending or a program in execution. It is the BSC that tells the CPU what operation has the highest priority and will be done next.

Interrupts

Many operations may be going on in the MPU at any given time but the CPU can only do one thing at a time. Most of the time, other operations are quite a bit slower than the CPU. The MPU may be generating a sound, displaying a picture and communicating with the Player Tracking system all at the same time. Individually, each of these operations takes only a small piece of the processor's time. The processor will divide its time up and spend a fraction of a second on each operation.

This control is accomplished through Interrupts. The CPU starts a process the programmer knows will take a long time to accomplish. A routine is written in a section of memory to handle the routine this process will require. An Interrupt Vector is set up pointing to this routine. The CPU then goes about setting up other routines that may be in process at that time in the same fashion. When a given process requires attention, it will pull on an Interrupt line. The CPU will finish its present instruction and save the condition it is in by pushing registers associated with that process onto a section of memory called the Stack. The present Program Counter is pushed onto the Stack. The Interrupt is recognized and the Program Counter is loaded with the Vector that points to the routine required to handle the Interrupt. At the end of that routine, we have an Instruction called a Return From Interrupt. This pops the old Program counter off of the Stack and the previous program picks up where it left off before the Interrupt.

NMI

Usual Interrupts can be enabled and disabled by the CPU. During Power Up for example, the tasks the CPU is performing are more important than normal operations and normal operations shouldn't be happening anyway. So the CPU disables interrupts during POST (Power On Self-Test). After POST is complete, the CPU enables interrupts it is expecting to occur as those operations are initiated. It does this by masking out the Interrupt Enable bits of the Status register so they are not set.

NMI is a Non-Maskable Interrupt. This is usually the highest priority Interrupt in the system. Each Interrupt level has a priority assigned to it. If more than one Interrupt were to occur at the same time the one with the highest priority is done first. NMI is reserved for Power Failure in most games. If this condition exists it is the most important thing that can happen in the system and takes priority over other operations.

Two modes: User and Privileged

Normally, the CPU is running in User Mode and switches to Privileged upon receiving an Interrupt. This is important to us when we realize what the Register Structure of the SH7750 is like. This brings us to . . .

Registers

The SH7750 has 16 working registers, R0 to R15. R0 to R7 are banked registers and are switched when the processor changes mode. So we have

two sets of R0 to R7 Registers. One set for running in User Mode and another set for running in Privileged mode. R8 through R15 remain accessible in either mode.

We have a short list of other registers worth mentioning.

SR – Status Register

The Status register is a collection of flip-flops spread throughout the CPU that notes what the conditions are. Are Interrupts enabled? What Interrupts are pending? What was the result of the last operation the ALU performed? These sorts of questions.

Accumulator

The SH7750 is a 32-bit bussed machine but the result of a Multiply operation will result in a 64-bit value. For this reason, we have a 64-bit Accumulator. The ALU can reference as High and Low words. MACH – Accumulator Register, high 32 bits. MACL – Accumulator Register, low 32 bits.

PR – Procedure Register

The Procedure is where the Program Counter is stored when we do a Jump to a new address. Fairly unique to Hitachi CPUs. Most processors store it in RAM.

PC – Program Counter

The Program Counter keeps track of where in Program Memory the CPU is executing. It is usually one count ahead of the currently executing instruction. While one instruction is being executed, the PC points to the next instruction and the CPU is reading that from EPROM. This is called a Pipelined operation. Only the oldest of processors do not do such a thing. We would have to go back to the days of the 8080 to find one that did not do this.

Beyond these we have a bag full of other registers for Memory Management and the Floating-Point Processor and other operations we won't bother to go into.

Program Flow

Every CPU has an Instruction set. This is a collection of operations the CPU is capable of performing. If we compared various processors we would find many similarities among the instruction sets. All of them work by adding, subtracting, comparing, ANDing, ORing, or in one way or another moving data between registers.

For an example let's take a routine we all will likely understand. We all know what things must take place in a hopper coin pay out. Let's see what the microprocessor might do in this.

Hopper Payout

First we recognize that the player has pushed the Cash Out button on the Player Panel. We turn the hopper on. Count coins coming out of the hopper. Increment the hard meter and the soft meter. Decrement the credits displayed. Check to see if we are done. If we are not, we wait for the next coin to come out. If we are, we turn off the hopper. We will use generic instructions that you would find in most any processor. We will give a short description as we might find in a Source Code listing and describe it more in following lines of code:

```
100 Cash Out MOVE, R0 PP
: Read the Player Panel port.
101 Bit Test, R0 00001000
: Test the bit in R0 for Cash Out
102 BNE, Return
: Return if not set
103 MOVE, 01000000 HC
: Turn on the Hopper
104 COUNT MOVE, R0 HIN
: Read the Hopper Input port
105 Bit Test, R0 00000100
: Check for a coin out signal
106 BNE COUNT:
107 MOVE, R0 COMETER
: Read the C Out Meter from RAM
108 OUT, HARDMETERS 00000010
: Increment the Coins Out Meter
109 INC R0
: Increment the C Out value
110 MOVE, COMETER R0
: Update the C Out value in RAM
111 MOVE, R0 CREDITS
: Read the Credits count from RAM
112 DEC R0
: Decrement the Credits value
113 MOVE, CREDITS R0
: Save CREDITS value in RAM
114 BNZ COUNT
: Branch back to Count until done
115 MOVE, 00000000 HC
: Turn the Hopper off.
116 RETURN
: Exit when we are done
```

We would have gotten to this routine by executing a JUMP instruction to the address in EPROM where this routine is stored. When we execute the JUMP, the Program Counter register is temporarily stored in the Procedure Register. When we execute the RETURN, we move the Procedure Register back to the Program Counter and the program execution picks up from where it left off. A similar thing happens when we execute an Interrupt.

Line 100

The Player Panel has an address the processor can reference and read from. It reads this address and moves the data to a register in the processor where it can analyze it. In this case we read address "PP" and put it in register "R0."

Line 101

We do a Bit Test to see if a certain bit is a One. In this case, that bit would be the Cash Out Switch. The CPU feeds the register R0 into one side of the ALU. Feeds the data 0000100 to the other side of the ALU and does an ANDing. If that bit is set in both sides of the ALU the CPU sets the "EQUAL" bit in the Status Register.

Line 102

This is called a Conditional Branch. A Branch is an instruction that alters the path of program flow. A Conditional Branch alters the flow on a condition. In this case Branch if Not Equal. If the Equal bit in the Status Register is not set the Cash Out button is not pressed and we won't do this routine. If it is pressed we do a Cash Out. Since it is pressed in our case, we continue.

Line 103

The Hopper Control port (HC) also has an address the CPU can reference. Setting a certain bit in that address turns on the Hopper.

Line 104

We read the hopper Input port and see if a coin is leaving the hopper. We read the address of the Hopper Input port and put it in R0.

Line 105

Check to see if it is set.

Line 106

If it is not we loop back to line 104. In this way, we wait for a coin to pass out of the hopper. When we see a coin, we move on.

Line 107

We read the Coin Out Meter value stored in RAM.

Line 108

We Increment the Hard Meter by outputting a pulse to the I/O Address of the Hard Meter.

Line 109

We increment the Coins Out value.

Line 110

We store the new Coins Out value back in RAM.

Line 111

We reference RAM to get the present value of the customer's credits.

Line 112

Decrement the Credits value.

Line 113

Store the Credits value back in RAM. The Display routine later will move this value to the display.

Line 114

Branch if Not Zero. Another conditional branch. We check to see if the Credits value we just stored is zero. If it is not, we branch back to COUNT and wait for the next coin. If it is, we continue to the next step.

Line 115

Turn the hopper off by clearing the bit that controls the hopper motor.

Line 116

Return. We go back to the instruction just after the one where the JUMP was that brought us here in the first place.

"On behalf of Table Mountain Casino I just wanted to express our thanks to you and your team. I couldn't have asked for anything better."

Brian Rankin - Slot Technical Manager

On-Site Slot Tech Training
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Randy Fromm's Casino School is a practical, no-nonsense look at how gaming machines work and how to repair them when they don't. **No previous knowledge of electronics is required** to get the most out of the school. The Casino School is geared for those who want to learn how to fix gaming devices without having to learn complex electronic theory or purchase expensive test equipment.

Be prepared for six hours of accelerated learning each day. Class begins at 9:00 am sharp each day and continues until 4:00 pm. The Casino School provides each student with reference materials and troubleshooting guides that will be valuable aids for repairing equipment on location and in the shop.

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THE DIGITAL MULTIMETER

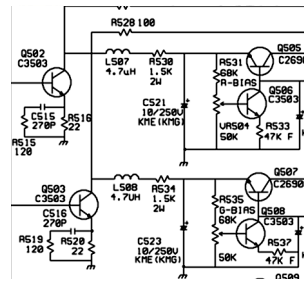
This relatively inexpensive piece of test equipment is easy to operate. Casino School students learn to use the digital multimeter to perform tests and measurements that will pinpoint the cause of a failure down to a single component.

ELECTRONIC COMPONENTS

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

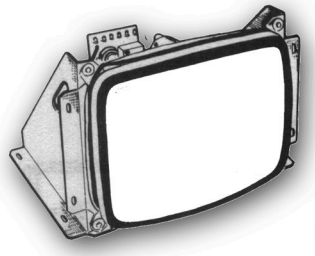
SCHEMATIC DIAGRAMS

Schematic diagrams are the "blueprints" for electronics. Learning to read schematics is easy once you know how the parts work!



POWER SUPPLIES

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



MONITOR REPAIR

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

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

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Needless to say, this is a simplified routine. Normally, we would also have instructions to check coin out timing, check for a stuck coin, check for a good hard meter count and a list of other tasks. But our intention here is to give an example of programming. All microprocessors have similar instructions and work in a similar fashion. Once you learn one microprocessor, most others will be easier to understand.

Getting back to the board and a hang up during hand pays

We would do a similar routine for printing a ticket or a hand pay. When a system hangs up, it is often due to an operation that must be completed before other operations can be accomplished. In a hand pay, we will not start a new game until the hand pay is complete and all the bookkeeping is done. If it is a ticket game, the CPU prints the ticket and waits for confirmation that the ticket has been printed before continuing. If it is a hand pay that requires the Slot Attendant to turn the key switch, the game will not proceed until it sees that the key switch has been turned.

A hang-up often is the result of the program being in a loop looking for confirmation that something of a high priority has not yet happened. Troubleshooting is a question of finding out what the processor is trying to do and what it is looking for.

Cycling power usually does not help. The game will likely come back to doing exactly what it was doing in the first place. It likely will not fix the problem. In some cases it will. It depends on what is being done and why the system hung up.

Clearing RAM might get you out of the jam but in doing so, you just lost all the information that was of so high a priority. Most of the time, clearing RAM just clears the present operation. The problem that caused the hang up is still in the system. Clearing RAM does not fix a problem. It just erases the fact that you had a problem and the bookkeeping that was associated with it.

Determine what operation was in process and why it didn't complete properly.

- Herschel Peeler
hpeeler@slot-techs.com

The Biggest Little Show in Europe

Ireland's Coin-Op Expo - AmEx 2006 - The 27th Irish Amusement & Gaming Trade Exhibition, was held at the Lynch Green Isle Hotel, Dublin on Tuesday 7 and Wednesday 8 March 2006. Free admission, a free seminar programme and online registration all helped to boost attendance, which had fallen off last year, as a result of the introduction of a smoking ban in the workplace.

Some visitors who had not attended recently returned and there were many new visitors to keep exhibitors busy! This was the best attended show in recent years and there was a very positive attitude to the future development of the industry. Visitors from all over Ireland and further afield converged on Dublin for the two most important days in the Irish Amusement & Gaming Trade Calendar, combining business activity and social events, making it an occasion not to be missed.

AmEx 2006 saw the return of international technical guru, Randy Fromm, who conducted a series of seminars under the banner "TechFest Ireland 2006". These were aimed at both technicians and others involved in the repair and maintenance of coin-op equipment. Randy Fromm's seminars included subjects such as the repair and maintenance of monitors and touchscreens, while Money Controls Paul Harris made presentations relating to coin and note acceptors - both including general troubleshooting tips and emergency procedures to keep coin-op equipment operational.

There was a full house of exhibitors with a lot of interest in gaming and many new gaming products were shown, making this an important show from both a gaming and amusement perspective. The variety of equipment shown was excellent, with something to attract the attention of all visitors. Amusement, novelty and redemption games play an important role in the expanding Irish market and jukeboxes, pool tables, touchscreen games, pushers, cranes, spares and accessories were all presented by exhibitors.

In the period since AmEx 2005 many exhibitors have reported an increase in activity in the Irish market, for both amusement and gaming equipment. A growth in demand for pool and jukeboxes has been matched by a higher level of investment in gaming equipment. The opening of new up-market

Leon Deith holds court at AmEx 2006. I worked for his father, Bob Deith, back in 1976.

locations, the refurbishment of others and an increase in demand for equipment from associated sectors, including leisure centres, vending, casinos and betting, has all contributed to the expansion of the market.

The Mary Openshaw Memorial Award For Excellence was inaugurated at AmEx 2004 in memory of the late Mary Openshaw, the renowned journalist who served the international amusement industry for over 35 years. The first recipient was Eduardo Antoja, President of Euromat - The European Gaming & Amusement Federation. The second recipient was Mike Nevin, Managing Director of Namco Europe. The third recipient, announced at AmEx 2006, is Hans Rosensweig, former head of Nova Games, Hamburg and a former President of Euromat.

On the charity front, Joyce Todd organised another successful raffle for Barnardos and show organiser MD Associates made its annual donation to Bru Youth Club. On the social side, the Happy Hour exhibitor party, sponsored by Kimble & Coin-Op News, was its usual success.

AmEx is organised by MD Associates and supported by IAEA - The Irish Amusement Equipment Association (Member Of Euromat).

SOME VIEWS

Stan McKenna, Excel Leisure: "The show was once again successful for us and a good opportunity for us to meet customers and friends. The venue was much improved. The exhibition is a good meeting place and certainly enhances our position in the Irish market. The organisation was very smooth and effective, making it a pleasant experience."

Ray Hazelton, Hazel Electronics: "Excellent show set in a hotel that is transformed and greatly improved. Great atmosphere. Friendly show. A late decision to join the show with my new company. So pleased I exhibited. Wouldn't have wanted to miss the opportunity to meet up again with old friends. Good sales and great fun! Looking forward to next year!"

Right: Derek Lynch, Carnaby Gaming: "We had a marked increase in sales of the Phoenix range and I was delighted with the response to the new Harvest Time game. We had a good response at ICE in London but an even better response at AmEx in Dublin with sales exceeding expectations. We also had discussions with some operators about producing some bespoke games."

Ron Vinson, Amusement Machine Services: "A well organised Amex 2006. This year was the most successful show I have had in the last four years. The Project Coin, Coin Handling and Signage all received unprecedented interest form all sections of the industry in Ireland."

Marian Murphy, Tobyco: "It is our third year to exhibit at the show and we were really delighted with the whole experience. It was professionally run and it was a pleasure to participate. We had great success with all our products, especially The Led Badge, Tattoo Vending Machines and The Maxx Grab Crane. Sales exceeded all expectations."

(l) Paul Brown of MEI and Paul Harris of Money Controls practice their synchronised sitting routine during a break at TechFest.

Evelyn's jumble sale

Money Controls Paul Harris made presentations relating to coin and note acceptors - both including general troubleshooting tips and emergency procedures to keep coin-op equipment operational.

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FutureLogic's USB Printer Tested and Approved by IGT

Glendale, Calif.—March 13, 2006—FutureLogic, Inc., the leading manufacturer of thermal ticket printers for cashless gaming, announced today that IGT, a subsidiary of International Game Technology (NYSE:IGT), has tested and approved FutureLogic's GEN2™ Universal gaming printer for use in its existing and new gaming platforms.

Designed to provide the ease of integration required for the next generation of electronic games, the FutureLogic USB-compatible TITO printers will be launched this spring with IGT's new Trimline™ AVP® games at Red Rock Casino in Las Vegas.

The GEN2 Universal printers anticipate new GSA standards for downloadable games and are compatible with existing platforms as well as the next generation of USB games. The printers include three game ports (RS232, NetPlex, and USB 2.0 Full Speed) and a dedicated promotional printing port to enable the latest trend in casino marketing – promotional couponing.

FutureLogic developed and launched its first TITO printer in collaboration with IGT designers for the introduction of EZ Pay™ in 1999, and proudly maintains its status as default printer supplier for IGT worldwide. As a platinum member of the Gaming Standards Association (GSA), FutureLogic actively participates in the development of USB communication standards and reference designs. The company also works closely with casinos and global game manufacturers to improve efficiencies and enhance player satisfaction.

About FutureLogic
Founded in 1983 and headquartered in Glendale, Calif., FutureLogic designs and builds high-reliability electromechanical assembly solutions for nearly every printing need. As the undisputed leader in super-robust thermal printer technology, FutureLogic is the industry's premier supplier of thermal printers for casino gaming, promotional equipment, kiosk, industrial, electronic voting, gas pumps and medical applications. In July 2004 the company founded FutureLogic Europe Ltd to provide direct sales and engineering support for the growing OEM thermal printer markets in Europe. More information on the company is available at www.futurelogic-inc.com.

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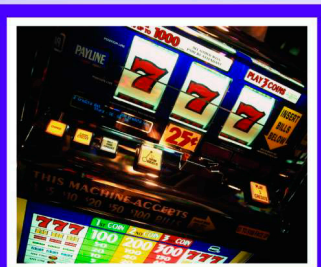
- Universal device support includes the latest NAND Flash Memory, Standard Flash Memory, EPROM, EEPROM, Serial PROM, and Microcontrollers
- Supports Windows 98/Me/2000/NT/XP
- Distribution of 16- and 32- bit data into 8-bit portions
- External START key allows production programming mode.
- Gang Program Mode allows programmers up to 8 units as concurrent programming system. (START ALL key enable to program the programmers simultaneously)
- Supports Windows 98/Me/2000/NT/XP

ProMax-4G	$2,450
ProMax-8G	$4,450



Other products from EE Tools: EPROM Emulator, EPROM Eraser, Single Socket Universal Programmers for USB 2.0 PC-interface (TopMaxII, UniMax, ChipMax2)

EE Tools offers customized programming algorithms at free of charge for gaming industry.

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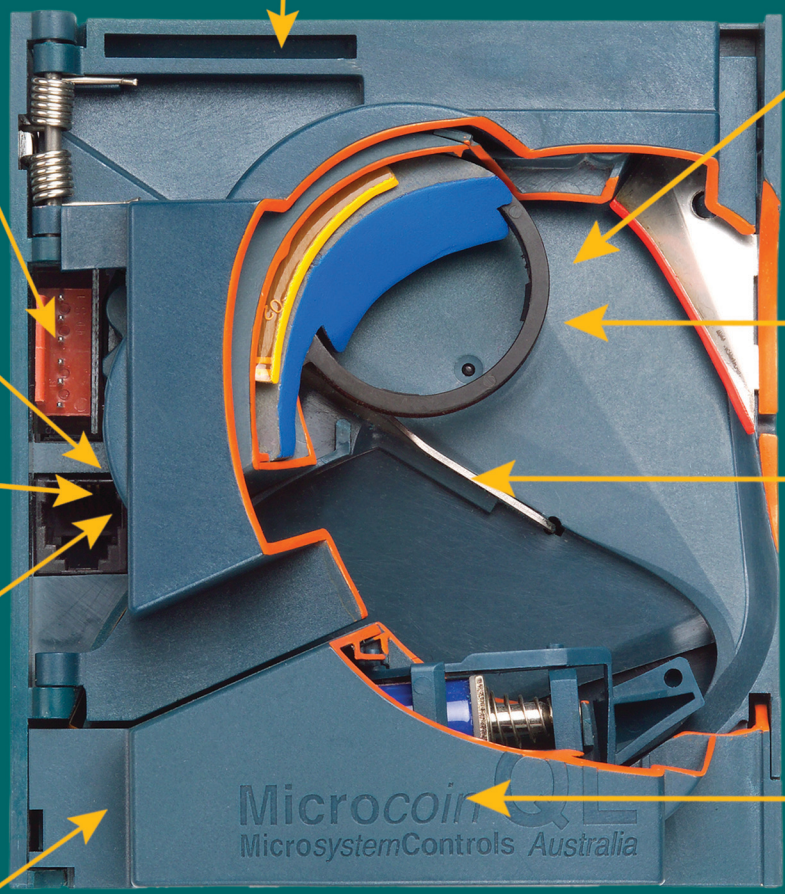

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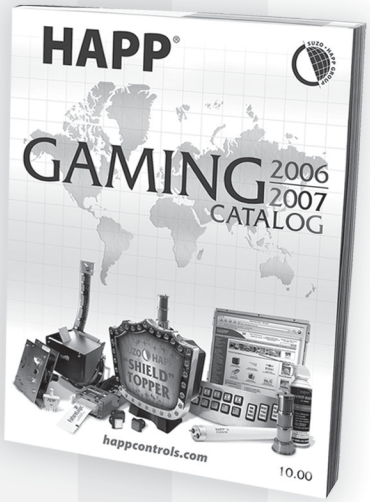

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