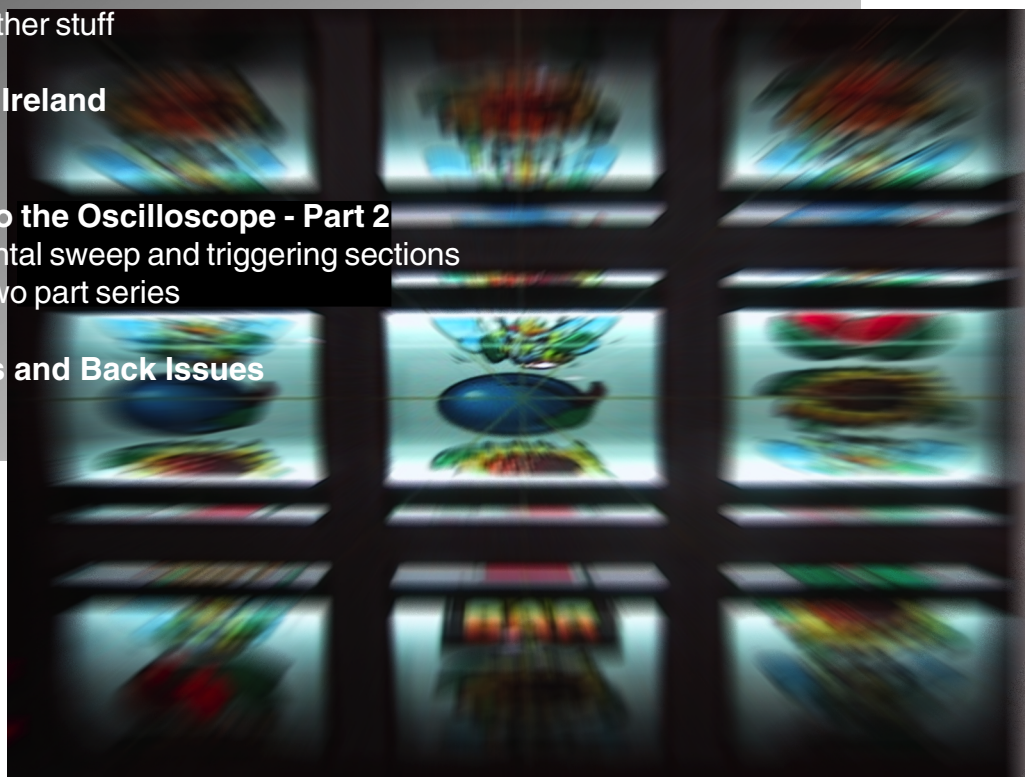
Inside Slot Tech Magazine

April, 2002



Slot Tech Magazine
is an official publication of G2E

Hey Randy,

I have been itching to write something new for the mag but I am still a clerk and really only work on the files and PAR sheets. I hope to be moving into a utility tech position within the next few months.

On another note, one of the guys in the e-shop here, Adam Garza is going to be attending TechFest in a week or so at a campus here in Las Vegas. Is this your TechFest? He said he didn't know anything about Slot Tech Magazine sponsoring it.

Scott Reynolds
Slot Clerk
Boulder Station
(O)702-432-7558
(F)702-432-7930
scott.reynolds@stationcasinos.com

Dear Scott,

You are not the first to bring this so-called "TechFest" to my attention and I am just appalled by it. The answer to your question is NO! Slot Tech Magazine has nothing whatsoever to do with the technical training session you mentioned. The company that is sponsoring the training is using the reputation and good will of "TechFest" to promote their own products and services. To make matters worse, they have all but duplicated the format and content of Slot Tech Magazine's popular TechFest program.

The saddest part of all is that this is a company with whom I have had a wonderful working relationship for more than two decades and I feel betrayed. I am at a loss to understand why they would do such a thing. I have attempted to interview the head honcho of this company but he has refused. I went to see him. I wanted his answers to a number of questions about why he was doing what he was doing but as soon as I poised my pen over my reporter's notebook for an on-the-record interview, he threatened to walk off.

All I can say is that if you (or any of our Slot Tech Magazine readers) hear of such training programs in the future, please look carefully at whom is sponsoring the program. If it isn't Slot Tech Magazine, it's not TechFest.

And speaking of TechFest, you may rest assured that Slot Tech Magazine will continue bringing you the best technical training that the gaming industry has to offer. TechFest III is planned for August 14th - 16th, 2002. Once again, the TechFest will be held in Las Vegas. It should be nice and toasty so bring your weenies and come on down.

That's all for now. See you at the casino.

Randy Fromm

Randy Fromm

Randy Fromm's
Slot Tech Magazine

Editor
Randy Fromm

Technical Writers
Dion Anderson
Pete Bachran
Bart Holden
Ken Locke
Gordon Lowe
Kevin Noble
Herschel W. Peeler
Scott Reynolds

Advertising Manager
Dennis Sable

Slot Tech Magazine is published monthly by
Slot Tech Magazine
1944 Falmouth Dr.
El Cajon, CA 92020-2827
tel.619.593.6131
fax.619.593.6132
e-mail
editor@slot-techs.com
Visit the website at
slot-techs.com

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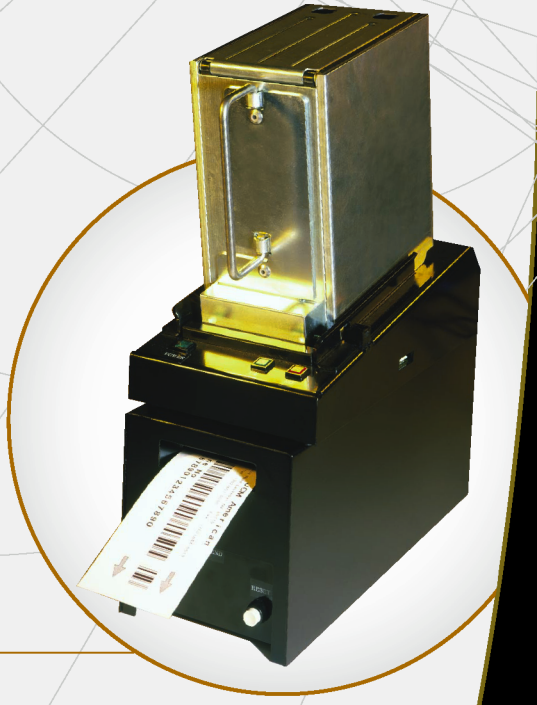

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J4 Virus Disables Bill Validator

By Bart Holden

Last month I received a list of games that had not accepted bills for a few weeks from my tech manager. I was easily breezing through the list noting the problem with each slot machine. Most of the games were on the list for reasons other than the bill acceptor ranging from Ram errors to bad power supplies. I had an S2000 upright Tabasco game on my list. This game was up for play but the bill acceptor was down. This is an extremely popular game on the Gulf Coast and was a priority on the list. A few slot technicians had been in the game over the two-week period trying to fix it.

As always, I entered the game as if I was the first to approach it. I learned this valuable lesson a few years ago after taking a former slot technician's word about having eliminated an I/O board as being faulty. A few hours later, I changed the IO board and the game was operational. I automatically committed this rule to memory. I examined the Machine Entry Log and learned that the game had a wiring problem around the same time that the bill validator failure had appeared.

I cycled the power to the bill validator and listened intently to determine the symptom. The validator was cycling about halfway through. There was no grinding or sluggish sound. In fact, it sounded as if it were well on its way to readying up when it suddenly stopped. As with most bill validator failures, I began by changing the head and transport. This did not lead to any improvement. I then tried a test cash box in the game and it still didn't work. I inspected all of the harnesses at the bill validator end. Everything seemed to be intact.

Next, I changed out the I/O boards and the CPU board without affecting the problem. I removed the reels and swapped out the game power supply. The bill validator still only completed half a cycle.

Frustrated, I opened the game to my left to compare the wiring between the two. I verified one by one, the connectors on the motherboard. Everything was as it should be. I could tell that the main bundle of harnesses had been removed and replaced at some point. The tie wraps used were larger than the ones that had originally been put in at the factory and the harness looked a little more like a rat's nest than it should have. I removed the tie wraps and began following the wires looking for a pinched, cut, or shorted wire. I performed a continuity check on the bill validator harness. Again, everything checked out fine.

After a few more minutes of comparative trouble shooting, I noticed an extra harness, part number 60754003-A, connected to the Reel Lamp Controller 1 Board, part number 769-241-00. This board is located on the back wall next to the handle mechanism in games with back lit reels. Only three connections were utilized in the working game while there were four plugged in on the faulty game. I disconnected the extra harness that was plugged into J4.

After consulting the technical manual, I learned that J4 is an optional connector. The harness that was connected to J4 traced back to the motherboard. As I expected, it was connected to J10, the bill acceptor connection. The harness from J10 has multiple wires running from a few of the pins. One wire runs directly to the bill acceptor while the other went to the eight-pin connector that was inadvertently connected to J4 of the Reel Lamp Controller 1 board. This mistake had applied 13 volts dc to several of the bill validator signals. They included the net transmit data J10 pin 10, the net receive data J10 pin 8, the M reset J10 pin 7, and the 13 volts at J10 pin 1. This caused the bill validator to abruptly stop cycling when power was applied.

The eight-pin connector had originally been tied securely to the main harness just behind and under reel two. When the harness had been removed, the harness was the perfect length and fit to plug into J4. It certainly looked as if it belonged there. Only the slot machine knew that it wasn't correct.

Although the bill acceptor cycled properly, it failed to ready up when the door was closed. I checked to ensure that the validator was enabled and it was. I then went into the Netplex configuration section in diagnostics and found that the validator was not installed. By simply pressing the spin button, the slot machine reinstalled the bill validator and it was once again accepting bills.

- Bart Holden
bholden@slot-techs.com
Title by Adrian Smith

Problem Solving

By Kevin Noble

Before attempting to service a device, you must first develop confidence and understanding of problem solving and how this concept applies to overall troubleshooting and repair. Think of servicing a device as having three phases:

- Analyzing the problem
- Problem solving
- Decision making

You must proceed in the logical manner; otherwise, mistakes, accidents, wasted time, and expenses may result. For example, many technicians upon discovery of a blown fuse, will simply replace the fuse, only to have it blow again. Instead, the technician should first determine the source of the problem and correct it before replacing the fuse.

Analyzing the Problem

This is the first step in servicing a device. It involves critical scrutiny and analysis of the problem. It allows the technician to gain insight into an unacceptable condition. It is defined simply as looking at the overall condition of the device in order to determine whether a problem exists or not. Begin this step by asking questions and making observations as follows:

- Discuss the problem
- Compare the problem with past experiences
- Consider the possibility that there is no problem
- Identify the existing state of operation
- Make an overall observation of the situation

Problem Solving

This is the second step and is completed when it has been determined through analysis that a problem exists that needs further investigation. The first step in this process is getting organized. Begin by setting yourself up with the necessary schematics, specifications, service manuals, tools and equipment. Do not shortchange this step by wasting a lot of time attempting to repair the problem, when reading the technical manual of the device could have easily solved the problem. Once you're organized, begin by asking the following questions:

- Describe the problem or condition
- Compare the problem with a known good one
- Describe all the differences such as symptoms, noises, or smells
- Compare which components are good, and which are not
- Analyze the differences through testing.

Decision Making

Decision-making can be defined by examining various solutions or repair alternatives and selecting the best options. For example could the problem be repaired, replaced, or could it be substituted depending on the operating condition? The technician might consider that an upgrade is needed, RAM clear performed, or that the part needs replacing depending on which option is more cost effective for the company and if the likelihood of future breakdowns is reduced. When deciding what alternative to implement, consider all the advantages and disadvantages for each alternative along with planning. The planning should take into account future changes, expected life, operating conditions, and future upgrades. For example, it might not be wise to replace the IDX EPROM version with a new version when you suspect the entire floor might soon be obsolete and replaced anyway.

Remember to always follow the three steps, analyzing the problem, problem solving, and decision making. Following these basic stages and understanding the importance of these sequences is essential to becoming a skilled technician along with experience.

The Individual Technician

When you are faced with a situation on the floor, many factors come into play in my opinion. The working knowledge of the device, the steps used to troubleshoot and the following other intangibles mentioned below:

- On-the-job experience
- Drive and determination
- Observation
- Cheat sheets
- Technical Log
- Experimentation
- Training

On-The-Job Experience

This cannot be learned overnight but in time, all the simple things that were hard at first, become second nature. This is what I usually call the "menu." This is a menu that, over time, you develop with the steps of what are the first things you will look at. Over time, the "menu" expands.

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Drive and Determination

This cannot be taught or learned. This is about the individual's own desires to become the best that he/she can be. There is a great deal of information from the manufactures, through the internet and from your fellow technicians. I personality find it rewarding being able to motivate myself everyday because of the departmental responsibility.

Observation

This is usually left up to the individual. By observing how things work routinely and determining the proper steps to repair the abnormality. Sometimes the smallest of details allow the technician to chase a lead that ends up being the problem. I have seen many times, just the slightest wear patterns and/or squeals that others have overlooked, have allowed me to repair and solve the problem.

Cheat Sheets

These are small laminated sheets of options, settings, and error codes that I have designed to allow me to reference things that I need right on the spot. These have always been lifesavers and time savers.

The Tech Log

This is one of the greatest tools that I have used, documenting difficult problems that I have come across (the ones that scramble your mind). Logging machine problems that you have never seen before allows you, the technician to reference your own material. I have always said if it happened once, it will happen again. There have been many times that I run into a problem on the floor where I recall seeing the problem before but have forgotten what I had done to repair it. These are the problems that don't happen every day but once in a blue moon. I have a quick reference book that allows me to look up the manufacturer and game type, the problem that I encountered, steps done to troubleshoot the problem, and finally the solution to the problem.

Experimenting

Being able to sit down at a simulator or game and allowing you to interchange parts and devices to see what happens is another way to learn valuable lessons. I don't know how many times, when troubleshooting a problem, I have found different outcomes to different situations. I would never have learned the smaller things involved leading up to solving the overall problem. You can always say "that part causes this to happen, so just replace the component, the optic, or add this spacer" and the problems are solved without changing the complete device, board, or mechanical part.

Training

You can take all the slot courses in the world about slot machines, but gaining first hand knowledge on the floor is the real test. I was lucky. When I started, I had the chance to follow some good technicians. They had the ability to teach and the ability to be patient. One technician in particular was Nancy Powel. She installed confidence in me, allowing me to dig into some problems but was always there to explain why. When I ran into some roadblocks, she was never too far away to look over my shoulder and start to steer me back in the right direction. I never heard any negative comments coming from her. She always provided positive feedback. I feel today that without her guidance, I would never be the technician that I am with the drive and determination to succeed and solve any problem that I face. I have used this basic situation and applied it to the technicians that work with me on my shift.

Teamwork

Surrounding yourself with technicians who like to learn, contribute, and expand their own knowledge makes troubleshooting fun and exciting. Solving difficult problems with different ideas helps everyone to learn. Gary Smith, Reggie Wood and Alex Trillanes are just three of the technicians with whom I work that make the tasks more enjoyable for me. I allow them to take part in troubleshooting the problems with me. Together, they gain valuable experience and self-confidence to solve the difficult problems just like Nancy did with me. This group of guys never counts how many more things they did then the other but look at the overall picture that we all completed together. Discovering the strengths of each individual and applying their skills to different situations. The best thing about these technicians is that you never have to tell them what needs to be done.

Overview

In today's world, troubleshooting is a lost art. I have run across many technicians that are there for the pay and, when a difficult problem arises and they cannot solve it within the first five minutes, they give up. When you are faced with a situation when you are the last hope of fixing something, you quickly develop many other avenues on how to solve the solution. If you do not solve the problem one way, there are many other roads from which to choose. Many times I have been stumped and have seemingly exhausted all my options but I take a short, five minute break and think about other options I might have overlooked, or new avenues to try and eventually, the problem gets solved and entered into my tech log. The shortest way between two points is a straight line; usually my luck is like Barry Sanders touchdown. A lot of dipsying and doodling to gain 2 yards. This is where you get to learn all about the little pieces of equipment to make up the entire machine.

- Kevin Noble
knoble@slot-techs.com

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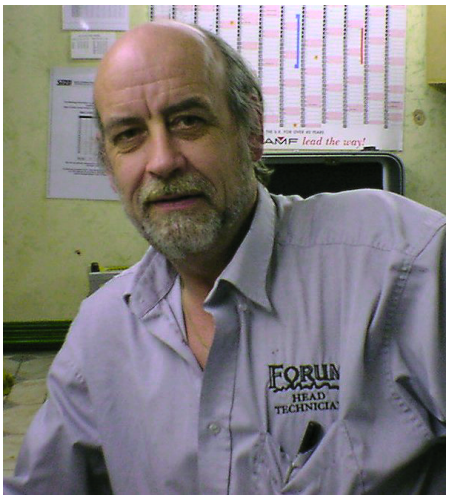
A Plumber's Guide to Fruit Machines

By Gordon Lowe



Why a plumbers guide you may ask your self? Haven't you ever noticed how many people employed in this business have other trades, so why not a plumber? (Do not forget all the pipes and jubilee clips inside those fruit machines)

This series of articles is intended as a guide to all aspects of fruit machine repair and maintenance, aimed at both the newcomer to this trade and those who may wish to expand their present knowledge.

Fruit Machines, one armed bandits, boxes or 1001 other names are more correctly known as AWPs (Amusement With Prizes) are in a continual state of advancement with technology expanding at an unprecedented rate. For this reason, no article on this subject will ever be up to date. There are however, many basic principles that have remained the same in the last 20 or so years and it is suspected for some time to come; if you can get these off to a fine art then any future advancements can be dealt with as and when they arise.

With the intention of making this series of articles into a quick reference guide, I have broken the basics down into sections of Coin Handling, Power Supplies etc.; these are then dissected further, for example Coin Handling is then split into Coin Acceptance and Coin Payout systems that hopefully will make it easier to locate an area of interest.

You may find the section on electronic validators heavy going, and because of the quantity of information, I would advise referring to the relevant validators types as the requirement arises; this section is not intended to be read and fully understood in one go.

Manufacturers are usually found to be very helpful should a problem arise with one of their machines, and for the cost of a telephone call do not hesitate to contact them. They know their own product better than anyone and providing you are in the trade, contacting their technical departments can be a mine of useful information.

There are many people in the repair side of this trade who will keep their knowledge to themselves but there are many more who will only too willingly pass on to you their years of experience. Do not hesitate to ask. One of the best ways to learn is "hands on." Just try to do as little damage as possible along the way; it will happen! Anyone who tells you that they have never made a costly mistake is one of a minority.

This is an industry where given the ability, knowledge and more importantly, the interest, you can go far. Capable engineers are few and far between and it is hoped that this series of articles in Slot Tech Magazine will help along the way. Good Luck.

Safety First

1. Ensure the mains supply lead is intact, without damage, and that the 13 amp plug is fitted with a 3 amp fuse.

2. Has the machine been electrically safety tested in the past 12 months? If not, and it never fails to surprise me how often this is the situation, arrangements should be made to have the machine 'Portable Appliance Tested' before operating. This is a legal requirement that has been instigated to ensure that all electrical equipment is correctly Earthed and cannot pose a danger to both the public and employees.

Equipment to do this test yourself is readily available, known as a PAT Tester but note that it must be suitable for 'IT' equipment (Information Technology or business equipment like computers, electronic typewriters etc.). Ordinary PAT testers can supply very high voltages which can result in damage to the machines electronics.

The regulations require that this test is carried out by "a competent person"..... my only comments here are that if you are not competent then

you should not be working on this type of machine. Study the manual supplied with the tester and comply fully with all instructions and you cannot go far wrong. If in doubt seek the advise of a qualified electrician.

BE AWARE of mains electricity. It can kill. Do not become complacent.

If you are based in a workshop, arrange to have all your electrical power supplied via a RCCB (Residual Current Circuit Breaker). This will lessen the risk of electrical shock being fatal as the supply will cut off within microseconds should you touch a 'live' wire or component.

Don't let all these warnings put you off. Voltages within AWPs are transformed to safe levels. It does however, arrive in the first place at 240 volts and must be treated with the respect it deserves.

3. Familiarise yourself with the manual supplied with the machine you are working on, test routines in particular. All the information you may want is there.

What You Will Need

4. Purchase a Digital Multimeter, the best you can afford. £30-£50 will buy a unit fully capable of doing all that you will require of it. Learn how to use it, in particular the measuring of voltages and the testing of diodes, transistors and other semiconductors. This will become indispensable when attempting to locate and repair faults.

5. Get yourself a few decent tools to start off with. You will soon accumulate more as you progress. Cheap tools give poor results. (Amen to THAT - ed.)

Initially suggested: Set of screwdrivers (including a terminal driver) a pair of fine side cutters, needle nose pliers, and most important of all, a good soldering iron and solder sucker (for removing components).

If funds allow or you can convince your employer of the necessity, buy a soldering station which will set you back around £60-£100 and fit it with a fine (needle point) tip. It will pay for itself after a few simple repairs!

When soldering remember, practice makes perfect. Later, buy yourself a set of nut runners, a gas soldering iron, (indispensable when working on site) crimping pliers, a pocket torch, and so on, ad infinitum. You will also need a case to carry everything in. Now is the time to ask for that wage increase!

6. Keep records on the work that you do on individual machines. They will soon become an indispensable reference guide when recurring faults occur on a particular part. I choose to use a personal computer with a database installed. This enables me to quickly pull up a particular machine and view what work has been done in the past. It also enables me to view say, all the repairs done to a type of power supply to see if I have had the same fault before, it don't half make life easier!

A simple card index can do the same job, albeit slower, it is without the complications that computers can bring. It's all down to what you can afford (or what your employer is prepared to spend) and what you prefer.

And now onto the more specific details:

Coin Handling - Coin Acceptance

The first priority with any gaming machine is to accept currency of some description, in our case the £1, 50p, 20p & 10p coins are the main denominations we must cater for; introduction of the £2 coin and it's viability in fruit machines has yet to be shown, not forgetting the 5p coin, though most of us would like to! (Tokens will be dealt with later)

So what we are left with is the requirement to handle at least 6 different coins of differing values, and what better way to do it than with an electronic validator, or to the less initiated, the coin mech. (Let's use the correct terms, it makes us sound far more knowledgeable, even if we are not)

There are numerous manufacturers of electronic

validators, all with a warranted reputation for supplying equipment to the amusement machine manufacturers with both reliability and high security. The tendency with most of the UK manufacturers of AWPs appears to have stayed with one of two of the main suppliers of validators, that is, Mars Electronics International and Coin Controls International. Such validators as Microcoin or NRI are no less reliable but tend to be used more in novelty/ vending machines or bingo installations.

At this point it is worth noting that nearly all new AWPs coming onto the market are fitted with one of two validators which comply with the BACTA standards and as such, will operate in either binary or parallel operation. (Further details on Binary operation in Section 1.k) These are the Coin Controls C435A and the Mars Cashflow 115. As you will see, the connections and features of the two different validators are similar in a lot of respects. This goes a long way in creating an industry standard; from the point of view of the engineer this simplifies the amount of information necessary to hold in our memory (and if you believe that you will believe anything). For this reason, you will find that I have gone onto much more detail on these particular validators, along with the Mars MS/ME100 series which I believe will be around for some time to come.

The electronic validator identifies a coin by comparing it with parameters programmed within the unit. It will compare the thickness, diameter and the material. Should the coin fall within these limits, a valid signal is sent and what is called the "gate" will open, allowing the coin to proceed into the separator. Should the coin not be within the pre-set parameters)this can be due to a worn or damaged coin) the gate will remain inoperative and the coin will continue on the reject path. This basic principle applies to all the manufacturers with little variation.

To be continued next month

- Gordon Lowe
glowe@slot-techs.com

Not With My Cat, You Don't!

(Or I couldn't think of snappy title for a piece on CVTs)

By Ken Locke

So you show up at the shop one morning to find all these IGT weenies hanging around. They yack into their cell phones in their spiffy corporate polo shirts and khakis and drinking all the shop's coffee. Turns out they're installing this new fangled ticket thing.

They start throwing around words like 'validation' and 'controller front-end.' Great, just when you got your brain around null signals and NETPLEX auto-configuration, they start speaking a brand new language.

And, scattered about an already cluttered work area are pallets of new equipment. Among the boxes is a new gizmo that needs to be added to your gaming lexicon, the Clerk Validation Terminal Plus (CVT).

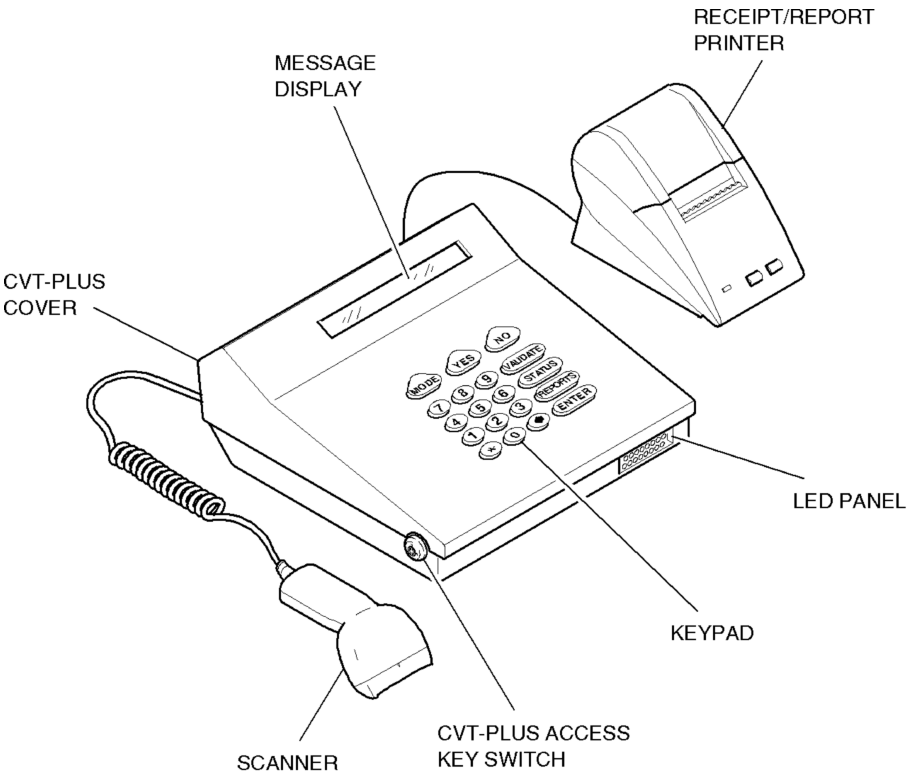
Right, wrong or indifferent, TITO systems seem to be here to stay and the CVT Plus is an integral component to the EZ Pay system. Its not a complex unit, but it chances are it will be added to your responsibilities once it's installed.

This device interprets information sent from the gaming device, stores these data and then sends them further to the central server. In this respect it's really not much different than any data collection unit out there, but there's a lot more going on.

A CVT is considered a cluster control (CC) much like an LCOM or CCOM and many times the terms CVT and CC are used interchangeably. Just remember, it's a box that controls a bunch of other boxes. Up to 50 slot machines can be attached to a single CVT however, it's a not a bad idea to keep it down to around 35 to 45 to allow for expansion on your floor later on.

As its name implies, an operator could validate or redeem tickets at this unit but usually only in the event of a server failure.

So how does a CVT fit into your universe? Each one controls a bank or loop of up to 50 machines as previously mentioned. These machines are daisy-chained together



using plastic fiber optic cable much like a WAP game. They are plugged into the fiber ports located on the machine's Power Distribution Module. Some of you who are getting new IGT machines but do not yet have a ticket system, may have noticed some black fiber cables sitting in the hopper or drop bucket when you first install.

Why fiber? It's secure. Unlike traditional metal conductive wiring, fiber optics work on light. As such, there is no inductive loss to pick off data. Unlike a typical player tracking system, ticket systems don't just gather data, they actually send "money" information to the machine and instruct it to apply credits or cash.

A quick word about fiber. Any run less than 100 feet, use plastic. It's cheaper and tougher. After that, switch to a glass fiber. Its more delicate and expensive, but you won't get any signal degradation. Glass is good up to about 654 feet.

The "home runs" from the beginning and ending machine on the loop are plugged into the back of the CVT. You will notice one end is blue and the other is gray (black if you're using glass). As a rule of thumb, blue denotes receive (Rx) and gray or black indicates transmit (Tx). If you ever forget, just remember to put the blinky wire in the non-blinky hole and the non-blinky wire into the blinky hole.

Your machines don't necessarily have to be powered up to verify continuity, just plugged in. The communication board located in the Power Distribution Module has an LED that should indicate a strong, random flicker if the communication loop is complete with the CVT. This board is powered by a +5VDC originating from an auxiliary power supply inside the PDM. It, in turn, gets its power from hot unswitched AC coming from the wall.

So, back to your CVT. If we wanted to, we could stop there with just slot machines and CVT. Depending on the CVT firmware and machine configuration, this could be either EZ Pay Lite (used in small casinos of less than 50 machines) or EZ Route, which is used by route operators in convenience stores and the like. With the addition of a full-scale EZ Pay system however, a shielded twisted pair would be plugged into the unit leading off to the central system, but that's another article.

Although it appears to be made by Fischer-Price(, this little box can do some pretty cool stuff. Through the large button panel and liquid crystal display we can validate tickets, run reports, check RAM batteries and run a fiber loop test. For a list of all the features and capabilities, download its PSR from the IGT website.

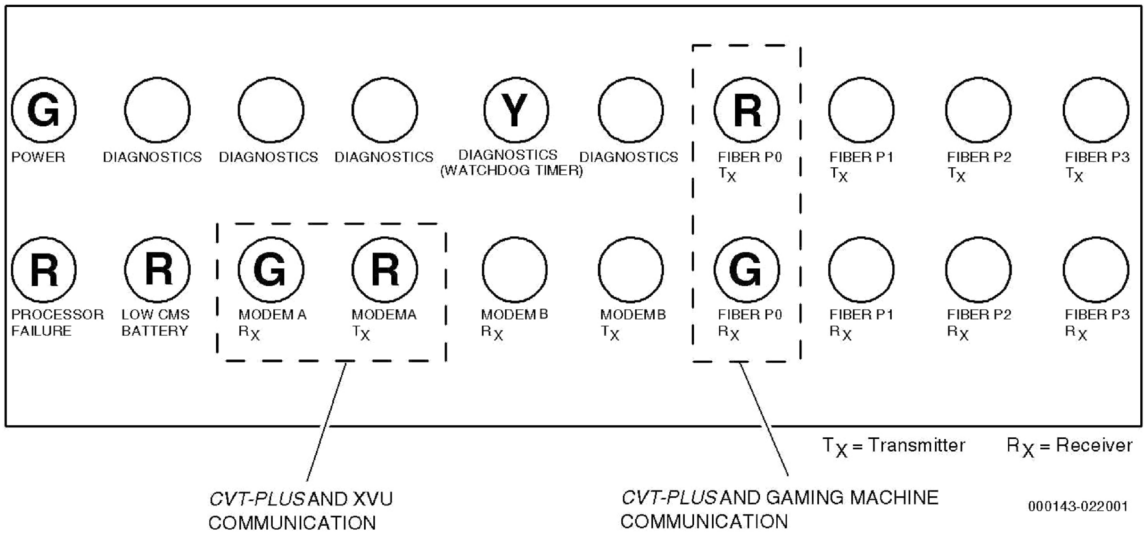
It utilizes a thermal printer for reports and has a sporty little bar code scanner. An LED array on the front will indicate "at-a-glance" diagnostics and communication functions. More on those in a minute.

Inside, the ubiquitous i960 microprocessor controls the main processor board. As you will recall, this is the same high-octane Intel chip that powers our slot machine's processor. A forty-pin EPROM contains the instruction sets and a 2 Meg piggyback board contains the ever-changing validation information. Both the main board and its daughter have their own RAM battery. Both are 3-volt lithium cells with a shelf life of about 2-5 years. They can be replaced interchangeably, but removal will cost you your settings, or worse, all your ticket data. Run a gross meters report prior to changing out these batteries. If you're hooked up to a server, that's even better.

BT 2 is a 3.6 V lithium battery that powers TellTale functions in the CVT. When power is completely removed from the unit, this will monitor security events.

A cold start switch located near the 2Meg board allows a quick reset when it needs a little smack in the head. A closer look reveals a series of jumpers. JP1, JP2 and JP3 all need to be jumped to pins 1 and 2 for EZ Pay operations. It's not a good idea to mess with these as they may remove power from RAM and may very well clear all your data (just in case you felt like playing a little).

Finally, a communications board converts serial data



The LEDs are going to be your best friend in diagnosing communication problems on the floor.

into RS 232. This will be routed through a DB25 shielded four-wire and sent off to the server. There it will mix and mingle with data from other CVTs to create cross-validation. In other words, without a server, only those tickets generated in a particular loop would be used in the same loop. With it, other machine loops can accept tickets from anywhere on the floor (loop, loop, loop, didn't I do this bit last month?)

The LEDs are going to be your best friend in diagnosing communication problems on the floor.

If you take a look at the front, you will notice some LEDs. In the upper right, a green light indicates that the unit has power. Well, how about a big giant "DUH!!" If you see any lights, you've got power. A steadily blinking yellow watchdog LED will tell you that the voltage levels within the unit are within tolerance. A red LED in the lower left will indicate a processor failure of some kind, possibly a bent pin or improper installation of the boot prom.

The Modem Rx (green) and Tx (red) should be a steady flicker to show that the CVT is communicating with the host server. Fiber P0 Rx and Tx should also flicker representing a good link between the CVT and its associated machines. At a glance, one should be able to tell how an EZ Pay floor is working.

Like slots, CVTs have there own unique key chips and higher security functions. At the present time, stuff like this is usually reserved for IGT or the duly blessed subsidiaries like SODAK and Hi Tech. You can still learn the procedure however, from the PSR. You just normally can't have access to the chip itself.

A word to the wise: Store these in a central area away from the floor for easier access. Many properties have taken to plunking them in the drop box or worse yet, laying them on their side in a slant top squashed in by the hopper. Troubleshooting is fairly low with the CVT. Aside from broken fiber from a ham-fisted floor attendant, they are pretty solid.

The only thing missing from the Clerk Validation Terminal Plus is an on/off switch. When I was so bold as to ask why, the response was "Umm, why would you need one?" 'Nuff said.

Ken Locke is a Technical Trainer with the Gaming Systems Department of International Game Technology in Reno, NV. He has traveled to gaming jurisdictions throughout the world to train casino personnel on nearly all aspects of slot operations. Currently, he works on the new EZ Pay Ticket-In Ticket-Out installation team. Contact him at Ken.Locke@igt.com

Introducing CashCode's Multi-width Bill Validator

The CashCode Front-Loading banknote validator (FL) validates multi-width currencies, and stacks banknotes into a secure cassette. The FL has many versatile features, such as a removable bill validator head, removable sensor modules (sense-a-click(tm)), a removable power supply and communication interface module, and a removable, lockable, cassette. Other benefits include a flash stick memory, modular design, an optical sensor array (OSA), inductive sensors, dielectric sensors, an interchangeable communication/interface, minimal cost of ownership and flexibility of bezel options.

The MFL is a multi-width version of the FL and uses a patented self-centering banknote transport guide, which perfectly aligns bills of various widths when inserted at any angle.

The self-centering feature of the MFL is a multi-width mechanism that validates multi-width currencies (variable width: 62mm-82mm). The unit can validate multiple international currencies while using the same bill validator. Originally designed for the Gaming market where front-loading machines are the preferred industry choice, the unit was also designed to accommodate the Euro and other currencies with multi-width banknotes. The MFL includes a large bill table to accommodate many bill denominations and can include currency from more than a single country.

The MFL may also be used in industries other than the Gaming market. The transportation market and the retail industry are prime examples of this, where it is necessary to validate bills of different denominations and sizes.

Patented Technology

The MFL features new and patented sensor technologies, an auto-centering mechanism, as well as new, patented, mechanical designs in the bill-stacking device which reduce the force required to stack a bill and extends the life of stacker components.

The FL communicates with the host machine using a variety of methods. Because of its modular design, different interfaces and protocols are available for communication purposes.

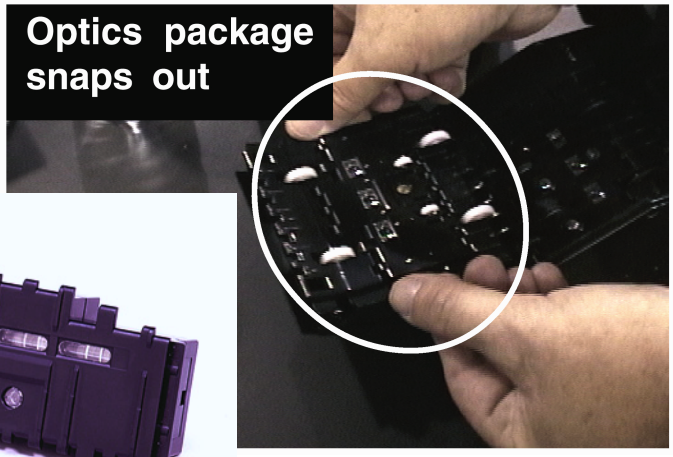
Optical Sensors

Optical sensors are mostly reflective technology, but also consist of passive technology through the bill. Very modular in design, a number of different sensors are offered in the MFL depending upon the application.

In addition to the regular sensors used for bill validation, modules can be fitted with a barcode reader for bar-coded coupons.

Removable "Sensor Pak" (Patented)

The FL features embedded sensor technology in a removable "Sensor Pak", designed to handle multiple international currencies. Five transmitters and one receiver make up each optical sensor, with multiple sensors per pack.



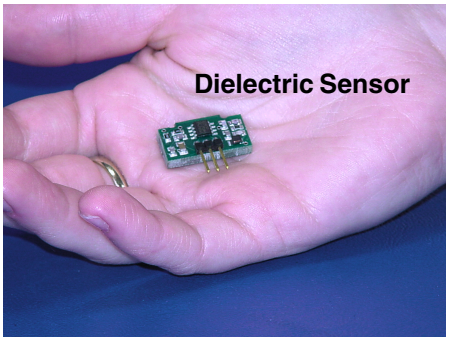
The removable Sensor Paks

High-Security Optical Recognition Technology

The FL's high-security optical recognition sensors maximize detection of counterfeits and verification of bona fide banknotes. These sensors are auto-calibrating and auto-tuning. The sensors simultaneously scan both sides of a banknote through the validation process.

New Inductive Sensor Technology (Patented)

The FL's new, patented, inductive sensor increases the sensitivity in the banknote recognition process.



New Dielectric Sensor Technology (Patented)

A new, patented, dielectric sensor is part of the FL validator. The dielectric sensor verifies the actual bill density, the legitimacy of security threads, the material the bill is made from and any applicable watermarks inherent in a note's paper design. If tape has been applied to the bill for fraudulent purposes, or if a watermark is not present, these differences can be detected using this state-of-the-art sensor. The dielectric sensor is easily adaptable to handle international currencies and reject counterfeits.

Magnetic Sensors

Included in this unit are CashCode's own patented magnetic sensors, which accurately focus the magnetic field. The FL has a more intensely focused magnetic field than in older validator models.

Flash Stick Memory

A high-tech feature of the FL series is the flash stick memory. The flash stick memory can be programmed with ease for updates due to currency change, or due to a change in the protocol being used. It is easily inserted in the validator and downloaded to another memory within the device. Designed with simplicity in mind, currency software can be upgraded quickly and efficiently.

Anti-counterfeiting

The FL features an anti-stringing cross-sensor, which defeats any known stringing attempt by sensing additions or alterations to a banknote. The FL was recently able to reject banknotes that were fraudulently manufactured in Australia. These fraudulent bills were constructed by cutting various banknotes into strips, and then reassembling the strips to make an additional banknote. The FL was able to detect the alteration in banknote material by using the dielectric sensor—instead of just optical or magnetic sensors.

Serviceability/Modularity

The modularity of the FL validator enables the user to do a number of things he or she was unable to do before in terms of serviceability. The device has been designed so that between opening the

door, removing modules and replacing modules, the FL can be back in service within sixty seconds. This is accomplished by snap-in and snap-out modules. Both sensor modules can be easily removed and replaced within seconds.

The head is removable from the frame of the FL, by a simple actuation of the lever—and can be removed within seconds. If there is a problem with the stacking motor, power supply or communications interface, these are also of modular design. The entire circuit board can be removed within its housing, just seconds after removing the banknote cassette.

The FL features a built-in self-test using flash code, located on the face of the validator. Should the validator malfunction, the test can be actuated by inserting a banknote, blocking the first sensor in the validator and then removing the banknote or other material. Once this is achieved, an LED on the front will start to flash a number of times. By noting the number of flashes and comparing it to a chart provided in the user's guide, a service technician can quickly determine how to fix the problem and put the validator back into service very quickly.

The FL and MFL's modular design means OEMs no longer have to stock the whole device, making the unit quite cost-effective. With a common frame and head, the OEM can switch the rest of the modules to make up the

desired configuration. The unit can easily be switched from 12 to 24 v., RS232 to CCNet, to optoisolated—many possibilities are available.

Cassettes

A number of different configurations for the banknote cassette are offered in the FL. Two cassette sizes are available, with a 600 and 1000 banknote capacity. Other features include a handle, no handle or a foldable handle, allowing for different space requirements within the game machine. The cassette features a patented design by CashCode, which allows a banknote to be stacked without having the stacker motor move the entire mass of stacked notes. This cuts down on the current required to operate the unit and extends the length of time before MTBF. It also extends the life on the stacker motor and electronics.

Rather than pushing the banknote against the entire stacker bills to move it away from the side rails, the rails are actually moved back at the same time, thus stacking the banknote. The banknote cassette is also offered with no locks, one lock, two locks or a third lock—which can be added to the frame. The FL offers the highest security for any banknote cassette in the industry.

Protocol

CashCode has developed its own protocol: CCNet, which is a multi-drop type RS232 communications. CCNET accommodates multiple countries, multiple denominations, barcodes within the validator as well as smart-card readers, bill-to-bill dispensers and other devices.

Security

The frame of the FL or MFL can be configured for two security switches. One security switch is activated when the lock on the frame is rotated between a locked or unlocked position, while the other switch is actuated when the banknote cassette is removed from the frame. An option exists for the addition of a memory device to contain statistics within the banknote cassette.

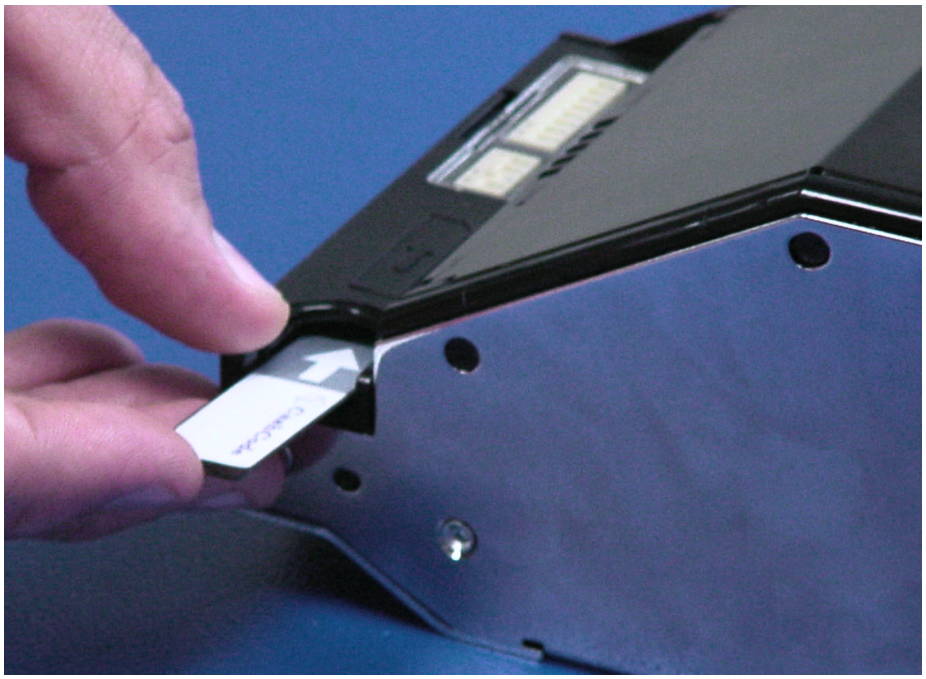
Transport Mechanisms/ Auto-Centering Device

The most important feature of the MFL is its automatic centering device. A benefit of this device is very accurate tracking on a given spot of the banknote. Because of the unit's ability to accurately center the banknote, the MFL has a very high acceptance rate for the industry. At the same time, the MFL has a one hundred percent rejection rate of all known fake banknotes.

The transport mechanism for the validator features rollers and no belts. Maintenance is very low, as the rollers have a minimum lifespan of five years. Due to the FL's no-touch validation technology, the banknote never makes contact with the sensor. This greatly reduces the cleaning cycle and keeps the validator in peak operating condition.

Clamshell Design

The FL's clamshell design allows the service technician to quickly clear any jam in the bill path, thus reducing the time required to get the validator back into operation



The flash stick memory can be programmed for updates due to currency change or a change in the protocol being used.

should a jam occur. The actual banknote pathway is a very straightforward design and allows for very rapid movement of the banknote. The FL completes the validation and stacking cycle in less than three seconds, which includes the centering process in the multi-width design. The cycle is less than two seconds in the fixed-width design (FL).

Easy Serviceability

Slot techs might prefer servicing the FL over any other device due to its modular design. This enables the slot tech to get the job done on location-in less than one minute! For the serious OEM and service center, CashCode has developed a PC-based service test fixture. This enables the repair tech to narrow down which module is at fault, and to pinpoint to a component level the actual fault in any of the modules.

How MFL Works

While the banknote is being transported forward, it tends to "float" because the rollers used are not round or circular, but triangular. As the banknote floats back down to the roller, the two side rails, which do the centering, bump and push the bill toward the center. Shortly after, the bill contacts the roller again and is moved forward.

FL Cassette vs.Others

Unlike other products on the market, the CashCode banknote cassette features an easy-release mechanism. By a simple push of a lever, the banknote cassette is released when it is in the unlocked position. The cassette allows for high security cam locks to be installed, common to the Gaming industry. There is a different MTBF on the overall device, on the stacking mechanism, and on the cassette.

Bezel

The FL and MFL offer a variety of bezels: a plain one, one with a two-line digital display, and one featuring a smart-card reader with a two-line digital display and an infrared communication port. The FL is a very versatile validator, as it can include a smart-card reader/writer, a barcode reader, and the possibility of a second comport to be used for connection to an external modem, in the case of the banking industry, or to send barcode information to a casino back room, for example.

The bezel features attractive runway lights, to attract the customer to insert a banknote into the entranceway. An interesting aspect of the two-line digital display, is the option for the OEM to customize the display message. This allows for the option to show different languages, for example.

New for the MFL, is the ability to validate banknotes from more than one country. This may come into some serious play in the future along borderline cities. For example, in Canada and in the US, where two different widths of banknotes are used, casinos will now be able to have machines that can accept either currency while using only one validator.

CashCode's bezel design accepts some common competitors' and third party's bezels, which can be used on the MFL model. This saves time and expense for the OEM. However, the OEM would be wise to use the CashCode bezel, as many improvements in design have been engineered.

Infrared Communications

One feature of the smart-card bezel is its infrared communications. This useful feature allows interrogation and programming of the device, without opening it or making physical connections to the validator. This may be done using an infrared transceiver from a handheld, such as a Palm.

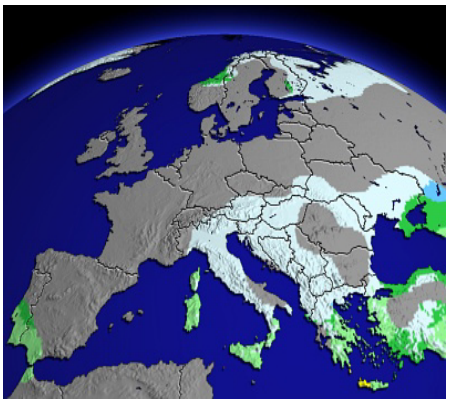
Size

The overall physical size of the FL and MFL, as well as the actual mounting envelope required for the unit, is comparable to most competitors' products for the Gaming industry. As a result, the OEM can easily use the CashCode product in a previously designed machine.

For further information on the FL or MFL, contact:
CashCode
553 Basaltic Road
Concord, Ontario, Canada.
L4K 4W8
tel: 905-303-8874
tel: 800-584-2633
Fax:905-303-8875

International View

By Martin Dempsey



Movement At Last On New Irish Gaming Act

It is now expected that a Bill will be published later this year in relation to changes to the Gaming & Lotteries Act, as part of the Irish Government's current legislative programme.

The Law Division of the Department of Justice has been asked to draft a Bill in relation to the recommendations of the Review Group, which has been approved by the Government. The policy document, which was issued as a result of the review is now being processed by the Law Division. The legislation is now in a queue and indications are that it will be published in the second half of this year.

With an election due, probably in May, those involved in the industry will anxiously await its outcome. It is hoped that the new Bill will propose a number of changes to the 1956 legislation, bringing it in line with legislation in force in many other EU states.

Amusement & Gaming Expo For Kiev, Ukraine

Amusement & Gaming Expo 2002 will be held from 2 to 5 October 2002 at the National Exhibition Centre - ExpoCentre, Kiev, Ukraine. The total area of the exhibition will be 4,500 sqm in 5 pavilions.

The event will include MUSIC EXPO - 2 pavilions (2,000 sqm) of Light & Sound Equipment; BILLIARD EXPO - 1 pavilion (500 sqm) of Billiard Equipment.; PARK EXPO - 1 pavilion (100 sqm for stands and open area for attractions - total 1,000 sqm) of Park Equipment; GAME EXPO - 1 pavilion (1,000 sqm) of Casino, Amusement Equipment, Slot Machines, Bowling etc.

The organisers are the Federation Of Billiard Sports, Park Association, Federation Of Bowling Sports and Association of Gambling Business, Music Association; Maximum Consulting Ltd., the Administration of the City Of Kiev, The Ministries Of Culture & Art Of Ukraine and the State Committee Of Sports.

The exhibition project consists of separate specialised exhibitions which are taking part in the same place and on the same dates. Total number of exhibitors will be 150 companies from 20 countries. Total number of visitors is expected to be 20 000.

For further information please contact Maxim Dobroskok, Maximum Consulting Ltd., 03124, Kiev, Blv. Lepse, 8, Ukraine. Phone: + 380 44 488 49 72. Fax: + 380 44 488 75 18.
Email mexpo@nbi.com.ua

Euromat Supports "Fundamentals Of Gaming" 2 Day Intensive Course

Organised by the European Gaming Management Institute, the course will be held at the Brussels Hotel Meridien, the 18 and 19 April 2002. Euromat has granted its full support to the course, and contributes two senior speakers, Eduardo Antoja and Dirk Lindenbergh.

The programme is a comprehensive review of all the essential matters in gaming and an ideal starting point to further progress in industry knowledge. Full details are available at the EuroGMI website http://www.eurogmi.com

Commenting on the course, the President of EUROMAT, Eduardo Antoja, said: "EUROMAT is glad to participate and support an event of this kind. The gaming industry has its own specific concepts and knowledge base. Up to now, both long-standing professionals in the industry and young graduates joining it were obliged to learn by trial and error, or by acquiring the know-how from their experienced colleagues in an unstructured way. There is a clear need in Europe for specific training programmes on gaming, and we think that this 2 day course fills a void."

For additional information, please email info@eurogmi.com or call EuroGMI at +32 2 7340504.

TCS Recognise Slot Developments With New Structure

As the slot business within TCS grows, with new product development becoming a key priority, the management team have announced the decision to transfer Andrew Beddoe from TCS Funtime to TCS Group, with specific responsibility for TCS slots, Cyberview and other ancillary slot products. Andrew will report directly to Sales Director Peter Lingard.

This has therefore left an opening within TCS Funtime, the Leeds-based new and used amusement and gaming machine company, which has been filled by Derek Hepple. Derek joins TCS Funtime as National Sales Manager after 4 years as Sales Manager with Northumbria Leisure, preceded by 8 years as General Sales Manager for the Kunick Group. Derek will be supporting Stephen Robins, Sales Director.

Eurocoin Wins Chipco Sales Award

Chipco, the leading US-based manufacturer of casino chips and plaques, has named

Eurocoin Sales Director Colin Veitch (l) with John Kendall of Chipco. Chipco has named Eurocoin as its Distributor of the Year.

Eurocoin as its Distributor of the Year. It is the first time that Chipco has made such an award and the presentation during this year's ICE was in recognition of the outstanding contribution made by Eurocoin to the company's total sales success.

Eurocoin has distributed the Chipco casino currency range in Europe and North Africa for eight years under exclusive licence and has worked with hundreds of casinos to develop customised full colour racks of chips and plaques.

Security has always been a key selling point of the Chipco range as the designs are deep-dyed into the material of the chip, offering benefits over decals, and the high-impact and design flexibility of the Chipco products has made them firm favourites.

"Sales from our network of seventeen resellers are increasing year on year and currently represent around 40% of our total revenue" said John Kendall, Chipco's President. "During 2001, Eurocoin generated approximately 50% of our overall distributor sales - a major achievement for one company. The year brought both opportunities and challenges for Eurocoin. The arrival of the euro opened up contracts for renewal of entire chip racks, but at the same time, our competitors were marketing their products very aggressively.

More information from Colin Veitch at Eurocoin on Tel: +44 (0) 208 275 3000. Fax: +44 (0) 208 275 3030.

Martin Dempsey
MD Associates
Enterprise Centre
Melitta Road
Kildare Ireland

Email
mailto:mdassociates@eircom.net
Phone + 353 (0)45 521190
Fax + 353 (0)45 521198
Mobile + 353 (0)87 2209732

A Standing Ovation!

As a further addition to its already extensive range of quality products Happ Controls has recently launched a new range of machine top signs, Ovation Marquees. Despite only being available for a few weeks the demand has been strong for this highly competitive product.

Ovation Marquees are a machine top signage system that offers clients quality and flexibility at competitive prices. With 6 unique and stylish designs to choose from, Shield, Ellipse, Showcase, Tiara, Crown and High Top, clients will have the ability to create eye catching displays to ensure high product visibility in areas where they wish to increase customer flow.

In addition to the different designs Ovation Marquees come in 2 finishes, Bright Chrome or Gold and have the option of tower lights and also customised finishes to suit individual client requirements. With an illuminated display and up to eight different lighting effects plus flat or radius bases, Ovation Marquees fit all machines and provide solutions to many promotional demands. For further information on Ovation Marquees and other Happ Controls products contact Ray Hazelton or Geoff Spencer on ++44 (0)1843 871100 or e-mail mailto:europe@happcontrols.com

Happ Controls
106 Garlisch Drive
Elk Grove, IL 60007

TOLL FREE PHONE:
888-BUY-HAPP(289-4277)
PHONE: 847-593-6130

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FAX: 847-593-6137
International Sales Fax:
847-981-2690
E-MAIL:
info@happcontrols.com

LAS VEGAS BRANCH
Happ Controls
6870 S. Paradise Rd.
Las Vegas, NV 89119
TOLL FREE PHONE:800-831-0444
PHONE: 702-891-9116
TOLL FREE FAX:877-870-2259
FAX: 702-891-9117

Test fixture designs

By Herschel Peeler

I would guess that you have a box of small assemblies sitting around in your shop somewhere. Coin Comparators, Coin In Optics assemblies, hopper control boards, you know the things I'm talking about. It hurts you in the pocket book of your heart to throw them away, even if you were absolutely sure they were bad. Don't throw them away, just yet. It doesn't take much to build a fixture to let you test these assemblies for proper operation, and provide an environment for troubleshooting.

Test fixtures simulate the environment the board is in while it is installed in a game. Inputs to the board that would normally come from the game MPU (Logic Assembly, if you prefer) can be simulated by just switches in some cases. Outputs from the board can be simulated with simple lights. The objective is to put the board in a simulated operation to allow you to confirm the board works or let you troubleshoot the board if it doesn't.

For example, a test fixture can be bought for testing coin comparators. If you have a large budget, they cost about $750 to $1,000 and will test a number of coin comparators. *Or* you can build a small fixture that is for a specific coin comparator for really small change. If you are going to test CC-16D, +12 Volt, Inhibit coin comparators, for example. All you need to deal with is +12 Volts, an inhibit switch, and a "credit" output. This can be done for under $20. (A lot under $20 if you know what you are doing.) This same fixture can work for the "+12V" or "+13V" variety with a change in connectors only.

Reliability and Survivability

Test fixtures need to be more reliable than the circuit being tested. A circumstance to avoid is to be troubleshooting a problem you think is a malfunction on the board being tested and it turns out to be the test fixture itself that is malfunctioning. Switches should be of a good quality. You can build a test fixture on a real budget using DIP switches as inputs. I have done this in a classroom environment on setups that demonstrate how various ICs work. I would not suggest it as a dependable design. If you flip a switch you want to have confidence that the input went in the direction you intended.

A few suggestions about designs:

> Put an LED on inputs to monitor that line. When you put an input high, you want confirmation that the input really went high. Many board failures are input lines stuck high or low.

> Use LEDs in the design instead of incandescent lamps. If an output isn't working (some light you expected to come on didn't) you don't want the problem to be a simple burned out lamp on the test fixture.

> Monitor power lines coming in. Putting an analog meter on power lines is a good idea, but costly. I suggest at least putting an LED on all power lines so you have a quick visual indication of a power problem.

> Current limiting power. A power supply capable of delivering an amp of current can do major damage to a low power circuit before you can get your hand back on the switch to turn it off. If the circuit you are testing normally draws 150 mA (typical for coin comparators and such)

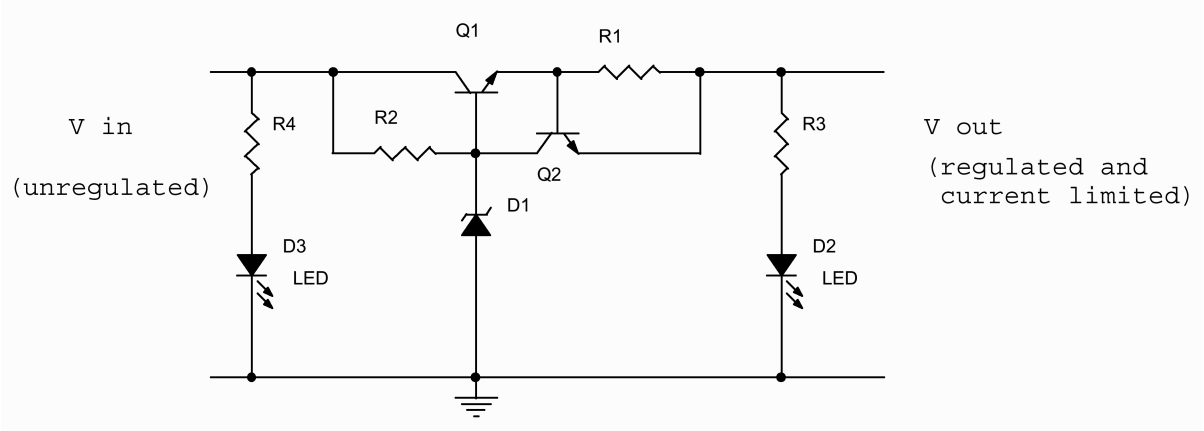


Figure 1 is an example of a Pre-regulator and current limiter circuit.

limit the current to just above that. Fuses are a bummer to keep replacing. Polyfuses are too slow. Solid state solutions are best. Most lab grade power supplies have built in variable current regulation. You can set the output of the power supply at the desired voltage and a maximum current desired. These are costly. A convenient solution is to use a pre-regulator circuit that sets the maximum current in that circuit to the level you want. These can be built for under a dollar in parts for low current applications.

For an example, I built a test setup for a coin comparator the runs on +12 volts, and typically draws 150 mA maximum. The main power source was an 18 volt "wall-wart" power supply I picked up at a local second hand store for a dollar. A pre-regulator circuit brought that voltage down to +15 volts, and limited current (two transistors, two resistors, and a zener). A voltage regulator (LM7812T) brought the +15V down to +12 volts.

LEDs monitored the power at all stages (voltage out of the wall wart, voltage out of the pre-regulator, and the +12 volt line).

If the coin comparator drew an excessive amount of current, the pre-regulator would shut down before the LM7812 could and I would know instantly by the condition of the LEDs. This design gives reliability. The likelihood of the power supply being destroyed by a faulty coin comparator is almost impossible.

> Run outputs below the rated values. This philosophy runs contrary to what I would suggest for a manufacturing environment. For manufacturing, I suggest testing output drivers at real-world voltage and currents. For troubleshooting purposes I suggest using lighter loads at the outputs. Lower than normal currents. Lower than normal voltages. All we want to know is if the output works or not. If the output normally drives a 24 volt motor that draws over an amp of current, drive it at 5 or 12 volts and use an LED, limiting current to 20 or 30 mA.

An exception to this would be a motor driver circuit that checks for a specific current level. For instance, Bally XS-1200 Hopper Control Board. There is a circuit that monitors hopper motor current. The purpose is to check for excessive motor current, indicating a stalled motor due to a hopper jam. To test the general circuit operation, I would use a two color LED (so I get an indication of forward and reverse direction) for the load, running power at 24 V. But to test the over-current part of the circuit, I would use a real motor I could manually stall. Running power at 24 volts is necessary because a circuit on the board actually checks for the +24 volt line to really be +24 volts.

Simpler motor control circuits could be run at a lower voltage, staying with the LED as the motor load.

Schematics for circuits referenced

Figure 1 is an example of the Pre-regulator and current limiter circuit mentioned. For low current loads (as described) most any NPN transistors you have on hand will suffice. With a load current of 200 mA, most any NPN TO-92 case transistor used in the

gaming industry will work. Gain is not critical, but needs to be known.

How the circuit works

Normally Q1 is on. The output voltage will be the voltage across the zener, minus the voltage across the Emitter-Base junction of Q1. The basic nature of the zener is to run at some rated voltage. Since the Emitter-Base junction of Q1 is about 0.6 volts, and current is flowing from the load, though the emitter of Q1, the voltage at the emitter of Q1 will be about 0.6 volts lower than the voltage of the zener.

In Q1 the emitter current is split according to the gain of Q1. With emitter current of 150 mA (the normal rated current), the base current of Q1 will be 150 mA (200 mA, max), divided by the gain of the transistor.

Q1 stays on, outputting a voltage of Vz (zener voltage) - 0.6 volts.

This circuit could be used as a voltage regulator except for the fact that the emitter current also passes through R2. Output voltage will vary as emitter current varies. If a little slop in voltage regulation is tolerable (+ or - about 1 volt), then this circuit could be used as the voltage regulator, also.

As long as the load current is below the set limit (200 mA) we drop less than 0.6 volts across R2. The resistance of R2 is so low that Q1 can't turn on. As load voltage approaches 200 mA the voltage across R1 approaches 0.6 Volts where Q2 starts to conduct. When Q2 conducts it shorts out the Base-Emitter junction of Q1, turning it off, turning off the circuit.

We have the ultimate fast blow fuse / circuit breaker. The reaction time of the circuit is as fast as the transistors can operate (nanoseconds). Fuses take time for the metal to heat up to the melting point. Even fast blow fuses take tenths of a second to operate. Slow blow fuses can take seconds. So can polyfuses and circuit breakers.

When the overload is removed, the circuit turns back on. The ideal self-resetting circuit breaker. The LEDs give a visual indicator of proper operation. Output current being regulated is actually the 80ma to 150 mA the coin comparator draws, plus 10 mA for the LED on the output. The coin comparator draws about 80 mA when idle, or about 150 mA when the Accept coil is energized (according to the data sheet for the comparator).

Setting the limit to 200 mA means if anything is wrong that causes excessive current, applied voltage drops to a minimal value, and current drops to a trickle. This allows me to troubleshoot the circuit with power on, without smoking any components.

R1 calculation

(Vin minus the Voltage of the zener) gives the voltage across R1. (Typical current divided by the gain of Q1) plus (current through the zener) will give you the current through R1. This gives you voltage and current values to calculate R1 resistance. Precision is not required.

Current through the zener - 20 mA (suggested by the data sheet for the zener).

Load current, 200 mA, divided by the gain of the transistor (100) = 2 mA.

Current through R1 is 22 mA.

Voltage in (Vin) = 18 V.

Voltage of the zener (Vz) = 15 V.

Voltage across R1 = 3 V (18 V - 15V)

Calculated resistance for an R1 = 3V / 22 mA, or 136 ohms. Closest value, 130 ohms. Either 120 or 150 would probably work, also. No precision required here.

R2 calculation

The objective of the current limiter revolves around this component. Q2 turns on when Emitter to Base voltage exceeds 0.6 V. When as the voltage dropped across R2 approaches 0.6 Volts Q2 will start conducting. If we want to set this limit at 200 mA, the calculation for R2 becomes 0.6 V / 200 mA, or 3 ohms. (Already a standard value.)

R3 calculation

The voltage across the R3 is easy to find. Vin minus the voltage across the LED. If a general purpose red LED is used, figure 1.6 volts at 20 mA. (Actually rated value was 30 mA. I ran it at 10 mA,

expecting to get eternal service out of the LED at a small sacrifice to brightness, and another reason I'll explain in a second.) With 18 volt applied at the input, the voltage across R3 is 18 minus 1.6, or 16.4 volts. At 10 mA, we have the calculated value for R3 as 16.4 volts divided by 10 mA, or 1640 ohms. Closest values are 1500 or 1800 ohms. I chose 1800.

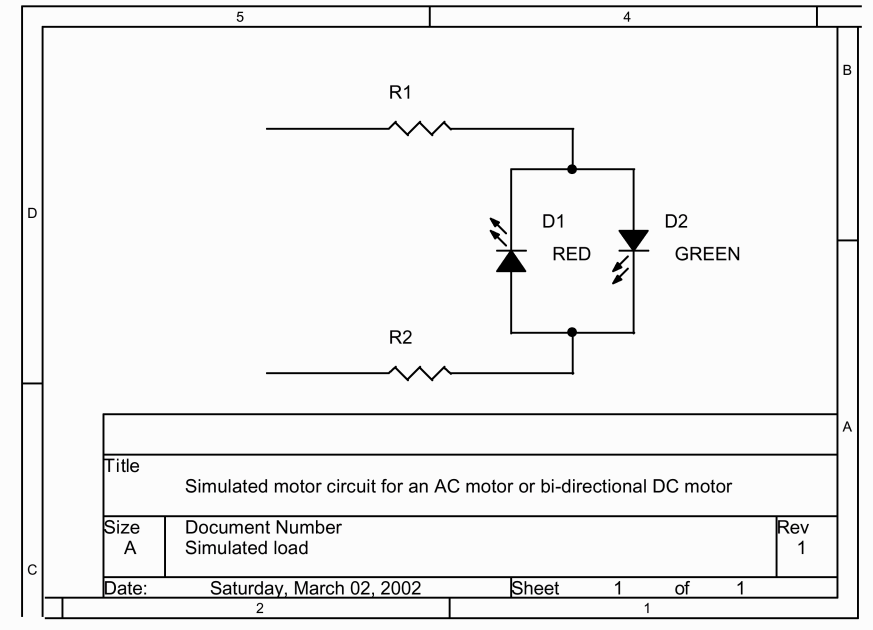
Another reason for setting the LED current here at 10 mA revolves around the wattage rating of R3. Even at 20 mA, the wattage rating of R3 calculates at over 350 mW. Too much for a 1/4 watt resistor. Almost too much for a 1/2 watt resistor, if you want reliability. Dropping the current down to 10 mA brought this level to about 150 mW, quite suitable for a 1/4 Watt resistor to handle.

R4 calculation

The voltage across the R4 is easy to find. Vout minus the voltage across the LED. Again, figure 1.6 volts at 10 mA. (Actually rated value was 30 mA. I ran it at 10 mA, also for all the same reasons listed above.) With 15 volts coming out at the output, the voltage across R4 is 15 minus 1.6, or 13.4 volts. At 10 mA, we have the calculated value for R4 as 13.4 volts divided by 10 mA, or 1340 ohms. Closest values are 1300 or 1500 ohms. I chose 1500.

Load emulator

We can't test outputs without a load of some kind to simulate the circuit being connected to a real circuit. For DC outputs, a simple LED can be used with a resistor to limit current. AC motors (or anything that runs on AC), and bi-directional DC motors, present a little more complicated problem. We want to know that, not only is current flowing, but if both phases of the AC are present. There are LEDs that have a red and green LED in the same package. Of these there is the two-lead variety, and the three-lead variety. On the two-lead variety, the LEDs are placed back-to-back. If current flows one way through the LED the Red LED will be on. If current flows the other way through the LED, the green LED will be on. If we pump AC through it, each LED is on half the time and the eye sees yellow. That's right, red and green combine to make yellow. If you have any progressive dot matrix displays where you work that go red, green, or yellow, this is how they work. It is a question of additive or subtractive colors mixing. Light sources follow additive color rules. Reflected colors follow subtractive rules (red and green makes the brown you got when you mixed your water colors).



The resistors limit current to safe values. With 12 volts applied, assuming the voltage across the LED is about 1.6 volts, the voltage across the resistor(s) is 12 V minus 1.6 V, or 10.4 Volts. The resistance required calculates out to 10.4 V / 30 mA, or 350 ohms, at just over 0.3 watts. Not having a 360 ohm 1/2 Watt resistor, I used two resistors, as shown, of 180 ohms, 1/4 watt. Each resistor drops half the voltage (5.2 volts, at 30 mA, and 150 mW).

If you don't want to put out big pennies for the dual element LED, this circuit can be built using two LEDs.

- Herschel Peeler
hpeeler@slot-techs.com

Dion's Corner

By Dion Anderson

So, I am out on the floor walking around and see an Odyssey game down with a touchscreen fault. I check out the book to see what has already been done on it and one of our excellent swing shift techs had been through pretty much the whole game doing everything possible, from basic calibration to replacing the touch screen board.

You would think that replacing the touch screen board would do the trick but not this time. Ram clear? Nope. So, I dig into this lovely game (and all of you that have had the great privilege of working on an Odyssey know that pulling out the monitor is a great joy. Oh, and the Microtouch screen cable? Just cut that thing and put in a Molex connector and save yourself a lot of time and hassle).

Anyway, I got the monitor out and to the shop and peeled off the tape that holds the touchscreen sensor to the face of the CRT in order to expose five wires, one main and one for each corner of the screen. Well, two of the corners were smoked and the traces were smoked off the touchscreen itself. Never having done this before, I tried to make a trace but as soon as the iron touched the trace I was making, it would melt off... ummm, solder wick, that's the trick!

Regular wire will not hold to the trace so solder up the wick before trying to make the connection. Once you get the solder wick on, the wire has to go directly in the corner of the screen. You know, for all the grids to line up. The finished product worked like new and six months later, is still going strong.

Tips From the Bench

Here are some good tips from Dan Morgan, our bench tech:

For the Williams video games that we all get called to for no touch screen response - Power down and reseat the monitor but it has no effect? Then you start getting into it a little more and take the monitor down to the shop to take a gander at it. Touch screen board? Maybe even the touch screen itself? Throw it in the tester and it works fine in there. Go back to the game, pull the I/O board out, put in a new one and this should solve the problem. Have your ET replace xu48 and it will be back in business. Next time you see this problem, you can go directly to the source and swap the I/O board or you can carry an xu48 on you, swap it out and save yourself a whole lot of time. Most importantly, get the guest playing as quickly as possible so they are happy, the boss is happy, and they are all saying, "Damn, that guy is good! I like this place. Let's put another hundred dollars in!" That's one of my recipes for job security.

Here's another one we've all seen - that annoying, bonging, secure memory failure-CRC corrupt. Basic power down and up gives you absolutely nothing. Well, you don't want to do it, it's a hassle, and a long trip to the shop for the chips, but you need to "get the game up." Let's try a partial clear... nothing... OK, full clear and a joyous set up process. Still no help "Bong bong" secure memory failure-CRC corrupt... what the@#$& is going on? Why does the cyclic redundancy check (CRC) fail and why is my memory corrupt? Pull out the I/O board, replace xu28, and go fishing. Put a cherry on a sundae or stake a claim in the Yukon... Oh, and don't forget to tip your cocktail waitress!

More Williams? Say "Dan's the man!"

Blacked out screen? xu12 or your battery on the CPU board.

WBA Tip

Here's a tip for JCM's WBA validators. I'm sure everyone has come across one that has a real weak motor when you put the bill in. It goes in very slowly, sometimes, even getting stuck in the transport. Some of the time it is a bad motor. However, in those cases were you replace the motor and end up with the same problem, check the home position flag on the side of the transport. If this is bad, it will have symptoms the same as a bad motor.

Odyssey games, as you all know, have the Mars validator. They are usually pretty good BVs. I got a call to a BV on an Odyssey game last night. When I got to the game, the BV was up, the lights were green and it looked ready to accept bills. I tried a bill but it wouldn't even take it in. I pulled out the BV and checked to make sure that the can was seated all the way. It looked good so I reseated the validator and it made a complete cycle with no gear grinding. I closed the door but it still wouldn't take a bill.

With my reset key, I went into mms to make sure that the game was seeing the validator. It was. I pulled the validator. For those of you that are not familiar with the Mars set up, there is a flag behind the BV on the left side next to the power plug. That flag has a groove in it and the top portion of the flag has to sit in the groove. If it is out of the groove, it will sound good and cycle fine but it will never take a bill. Once you get the flag into the groove, push on the stacker assembly (the black goal post looking thing all the way in the back of the BV). If the flag moves, the BV will take bill. There is a common problem with this flag becoming damaged so always check it when you have a Mars BV not taking bills.

Also, if you cant get the stacker to complete its full cycle, check the gear to the stacker. It is on the right side of the unit.

Omniview

For any of you that have the CDS tracking system and have seen Omniveiw you can create floor plans for up to nine different floors. You can also add DPU symbols and get oasis stats for all the games on the line. In addition, you can get total percentages of games on the floor in play carded or uncarded. If anyone wants to know more about Omniveiw, e-mail me and I'll include it in a future column here in Slot Tech Magazine.

Well, that's all folks! Until next time, continue to strive for excellence.

- Dion Anderson
danderson@slot-techs.com

AmEx 2002 Reflects Busy Irish Market

AmEx 2002 - The 23rd Irish Amusement Trade Exhibition was held on 5 & 6 March at Jury's Green Isle Hotel, Dublin. The annual event is organised by MD Associates (publishers of Coin-Op News Europe and AmusEmail) and is supported by IAEA - The Irish Amusement Equipment Association.

There was considerable interest in gaming and many new gaming products were shown, in anticipation of demand after the introduction of the new Irish Gaming Act, which is now expected in the second half of this year.

Irish gaming giant (and Slot Tech Magazine subscriber) Kimble Manufacturing's Tanya McCann, Jim McCann, Siobhan Breen and Paul Hoey, Kimble with some of their latest gaming machines.

Derek Lynch, Franco Gaming Ltd and Ian Jamieson, Radical Shock.

Kenny Simpson and Carlton Murphy, Sega Gaming Technology (Europe) with Sega Royal Derby.

Introduction to The Oscilloscope Part 2

The Horizontal Section

The horizontal section of the oscilloscope is also known as the horizontal sweep or horizontal timebase. The graticule is divided into horizontal divisions just as it is divided into vertical divisions. The oscilloscope shows you "time" in the horizontal direction.

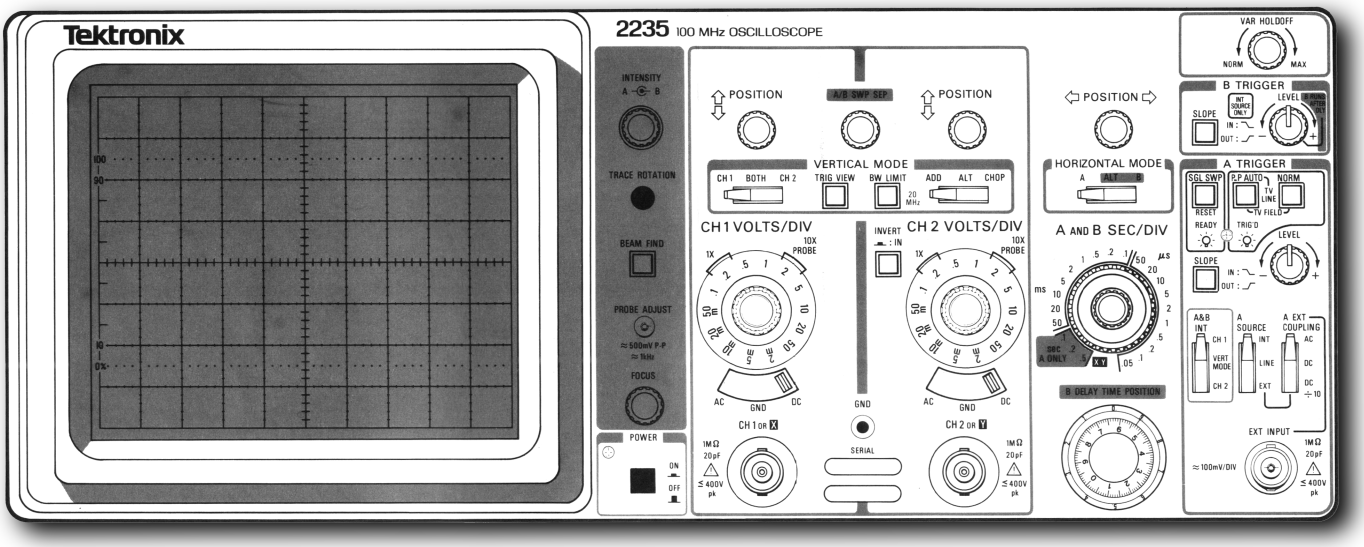
Just as the vertical control sets the volts/div, the horizontal control sets the seconds/div (see figure 1.) At its slowest setting of .5 sec/div, the beam takes a full 1/2 second to cross just one horizontal division on the graticule. With the scope set at its slowest sweep speed, we can clearly see how the electron beam in the scope's CRT scans across the screen from left to right. Remember, the oscilloscope draws a graph of voltage versus time. The vertical direction is the voltage; the horizontal direction is time.

The next setting of the sweep speed is .2 sec/div. As we increase the speed of the sweep, we decrease the amount of time required for the beam to move a distance of 1 division. Now it takes just .2 sec for the moving beam to pass each division. The next step up is .1 sec/div.; just one-tenth of a second for each division. Since there are 10 horizontal divisions, it takes 1 second to complete the trip from the left side of the screen to the right. You may have noticed the 1/2/5 sequence we discussed when we looked at the vertical section.

As the speed of the horizontal sweep is increased, it eventually becomes so fast that you can't even see it move across the screen. It just looks like a continuous line. At its fastest setting, it takes just .05 microsecond (that's 50 billionths of a second!) for each division.

Many of the measurements you make will be of "periodic" waveforms. That is to say, the waveform repeats itself after a specific period of time. In our 120 volt AC power we find a good example of a periodic waveform. We looked at this "sine wave" last month. Let's take a look at it again on the oscilloscope (see figure 2.)

We can measure the "period" of the waveform by lining up an easily identifiable portion of the waveform with one of the vertical lines of the graticule and counting the num-



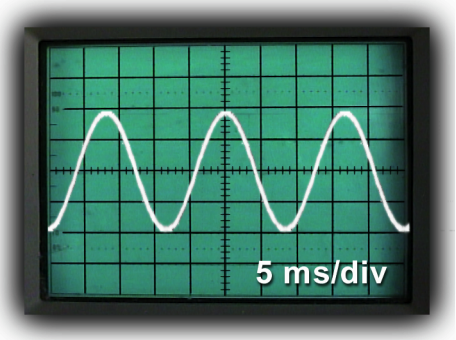


Figure 2 - We can measure the "period" of the waveform by lining up an easily identifiable portion of the waveform with one of the vertical lines of the graticule and counting the number of divisions until the waveform repeats.

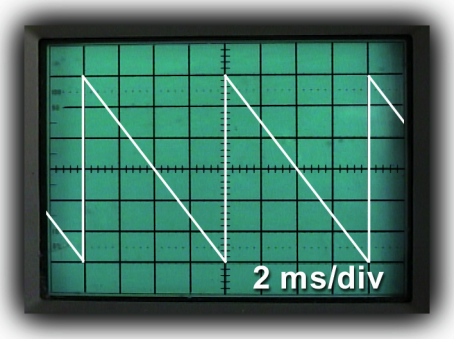


Figure 3 - Here, the waveform takes exactly 4 divisions to display one cycle.

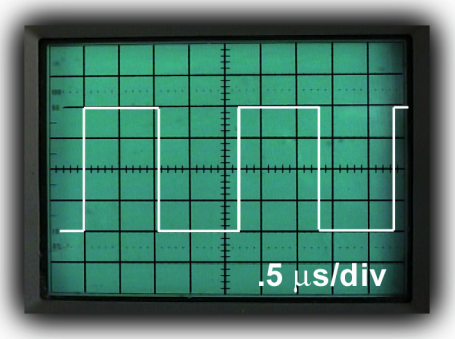


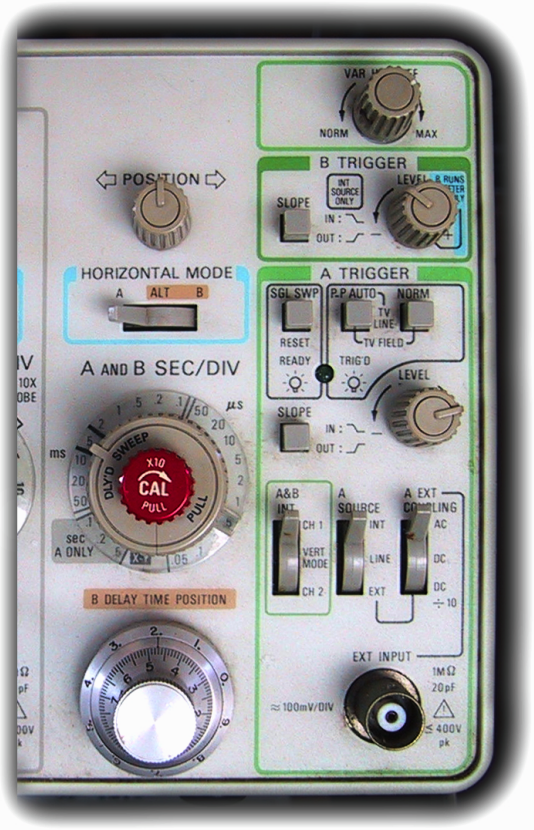
Figure 4 - A square wave that repeats itself every 4.4 divisions. The sec/div control is set at .5 microseconds/division so the period is 2.2 microseconds.

ber of divisions until the waveform repeats. Here we see the positive peak of the sine wave lined up with one of the vertical lines. The next positive peak comes a little more than 3 divisions away, at about 3.3 divisions. It's hard to be exact when you're measuring period on an oscilloscope. Sometimes it may help to try different horizontal timebase settings in an effort to get the waveform to line up on major divisions. However, the waveform should be reasonably spread out for the best possible accuracy.

But how much time is represented by each division? A quick check of the sec/div control shows that it's currently set at 5 ms/div. Multiplying 5 times 3.3 gives us a period of approximately 16.5 milliseconds. I happen to know that the period is actually 16.666666 milliseconds. This is an important number to remember because you will encounter it again and again in troubleshooting. 16.6 ms is the period of our AC power. When we use the oscilloscope to look at monitor circuits, the 16.6 ms period will come up again. The frequency of the monitor's vertical deflection circuit is the same as the frequency of our AC power; 60 Hertz.

I'm sure it comes as no surprise to anyone here that the frequency of our 120 volt AC power is 60 cycles per second or 60 hertz. What does that have to do with our 16.666666 ms period? How is period related to frequency? Okay all you math majors, here it comes . . . *Frequency and period are inverse, reciprocal functions.* What the hell am I talking about? Well, first of all it's something that you probably don't actually have to know about in our line of work so don't freak out. It's actually quite simple. period = 1/frequency and frequency = 1/period.
Let's take our 16.66666 ms period as an example. 1 / .016666666 = 60. There's our frequency. 60 cycles per second or 60 hertz. If we go the other way, 1/60 = .01666666 seconds or 16.6666666 milliseconds.

Let's figure out the period and frequencies of a few examples. Figure 3 shows a sawtooth waveform. Here, the waveform takes exactly 4 divisions to display one cycle. The horizontal timebase is set at 2 milliseconds per di-



vision. The period is 4 (divisions) times 2 (milliseconds) or 8 milliseconds. Dividing 1 by 8 milliseconds (1 / .008) gives us a frequency of 125 cycles per second or 125 hertz.

Figure 4 shows a square wave that repeats itself every 4.4 divisions. The sec/div control is set at .5 microseconds/division so the period is 2.2 microseconds. This translates into a frequency of 454,545.454545 hertz or approximately 454.5 kilohertz.

If you want to take a close look at a small piece of the displayed waveform, there is a knob in the center of the sec/div control called the X10 Magnifier. Pulling out the knob multiplies the horizontal sweep speed by a factor of 10. In other words, if the sec/div is set for 1 millisecond, pulling out the X10 Magnifier increases it to .1 millisecond/div. To use the X10 magnifier, center the portion of the waveform you want to see by using the horizontal position control, then pull out the knob.

This same knob also functions as a variable control in the same manner as the variable control for the vertical volts/div. Normally, this control will be in its locked, calibrated position. Rotating the control will slow the sweep speed.

DO NOT USE THIS CONTROL TO TRY AND STABILIZE THE DISPLAY WHEN IT IS "RUNNING." This is a common mistake. There is another section of the oscilloscope that stabilizes the displayed waveform. It's called the "trigger" section and we'll get to it shortly.

Delayed Sweep

Here's a neat thing that the oscilloscope can do. Remember how we used the X10 magnifier to expand the waveform? There's another way that we can look at just a small portion of a waveform. It's called "delayed sweep." Delayed sweep is much more versatile than the simple magnification provided by the X10 magnifier.

Just as there are two vertical channels, there are two horizontal sweep generators as well. The main sweep generator is called "A"; the delayed sweep is called "B."

Horizontal Mode Switch

This three position switch controls which of the two sweep generators are active. Normally, this will be kept in the "A" position because "A" is the main sweep. Flipping to "alternate" mode engages the "B" sweep as well. This control may be labeled "A intensified by B" in some oscilloscopes because that's what it does. A small portion of the "A" sweep can be illuminated by the "B" sweep and displayed at the same time. I can select the portion of the waveform I want to display. The speed of the "B" sweep is selected by pulling out and turning the "A and B sec/div" clockwise.

Not only can I select a tiny portion of the waveform to view with the delayed sweep but I can look at any part of the waveform with the "B delay time position" control. It's also called the "Vernier"; a technical term for a multiturn potentiometer with a calibrated set of dials. By using the vernier, I can scan the entire length of the waveform and look at any portion of it in great detail. An A/B sweep separation control adjusts the spacing between the A and B traces.

Trigger

Now we come to the last section of the oscilloscope. It's also the least understood part of an oscilloscope. It's called the "trigger" section.

If you've ever worked with monitors, you know that there is a sync signal that tells the monitor when to begin and end scanning. Without the sync signal, the picture would roll and shift; it would be completely useless!

For the oscilloscope to display a stable waveform as shown in figures 2, 3 or 4 it must synchronize itself to the incoming signal. That is, the horizontal sweep must begin at exactly the same point each time it traces across the screen. Otherwise, you'll see a display that is "running" (see figure 5.) The oscilloscope will display the waveform in a different place

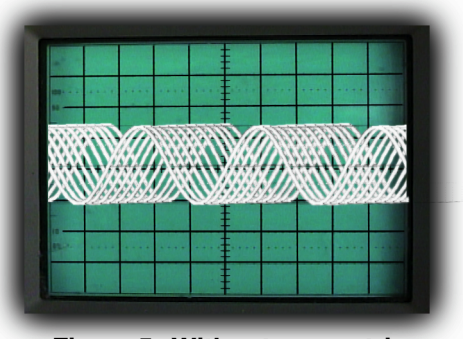


Figure 5 - Without proper triggering, the 'scope will "run."

during each pass of the beam.

Unlike the monitor (which has a separate sync signal input) the oscilloscope synchronizes by looking for periodic changes in the waveform. The trigger section of the oscilloscope looks for voltage changes in the incoming signal and triggers the horizontal sweep when it detects either a rising or a falling voltage.

You can determine which "slope" or "edge" the oscilloscope will use with the slope selector. The "slope" control selects the "positive slope" (also known as the "leading edge" or "rising edge") of the waveform as the trigger when the button is out or the "negative slope" (also called the "falling edge" or "trailing edge") when the button is pushed in.

The "level" control is a very important little knob. The level control selects the point at which the triggering occurs. In other words, the level control selects where in the waveform the oscilloscope will look for a transition in voltage. It's usually a matter of slowly rotating the level control back and forth until the waveform stabilizes and you have a solid display. When the oscilloscope is triggered properly, the "triggered" LED will also light.

Trigger Mode Switches

There are three push-button switches that set the trigger mode for the A sweep. They are:

Auto Trigger - The "automatic trigger" allows the sweep to "free-run" regardless of whether or not there is a triggering signal applied. This setting also allows the oscilloscope to trigger properly on "TV lines"; the 63 microsecond time required to draw a single, horizontal line across the CRT of a standard resolution (NTSC) monitor.

Normal - The "normal" trigger setting will not show you a trace unless the oscilloscope is receiving an adequate trigger signal and the trigger level control is adjusted properly. If the oscilloscope isn't triggered, there will be no baseline. Use this setting when you want to precisely trigger the oscilloscope for maximum stability of the observed waveform. You will probably not use the normal setting too often.

TV field - Pressing in both AUTO and NORM buttons simultaneously allows the oscilloscope to trigger properly on "TV field" signals; the 16.66 millisecond time required to scan an entire field (one screen full of lines.)

Single Sweep Reset - To observe single events, the single sweep is used. When the oscilloscope triggers, it displays just one sweep, then stops. The sweep will not reset until you press the reset button. Then the oscilloscope will trigger on the next trigger pulse.

Ready Light - The ready light indicates that the single-sweep is reset and ready for the next trigger. Without this light, you wouldn't know if the oscilloscope was waiting for a pulse or if you missed it!

B level control and slope button - Remember that we actually have two horizontal sweep generators: A sweep and B sweep. The level control we just looked at is for the A sweep. There is a separate level control and slope selector for the B sweep.

Variable Holdoff - Now we're getting complicated! The "variable holdoff" control can be used to increase the holdoff time between sweeps. It controls the amount of time the oscilloscope will wait for a good trigger signal (a change in voltage) before going ahead and triggering on its own. Like the level control, the variable holdoff is one of those controls that you just end up playing around with until the waveform stabilizes on the display.

A Source - And finally, you can select the source for the A sweep trigger signal. That is, you can select where the

oscilloscope will look for its trigger signal. There are three choices: Internal, line and external.

Internal - The oscilloscope gets its trigger from the vertical inputs. Using the A&B Internal switch, you can select channel 1 or channel 2 as the input. You can even choose both inputs as the trigger source by using the "vertical mode" setting.

For example, when troubleshooting a monitor, you might connect channel 2 to the sync signal that's coming from the logic board or pattern generator, and select channel 2 as the source for the trigger. You're not going to view this signal, you're just going to use it as a trigger source. This way, the oscilloscope will maintain a solid trigger, regardless of what you're looking at with the other probe. Since everything but the power supply is synchronized with the sync signal, the display will remain locked in place no matter what signal you're probing.

Line - For working on linear power supplies, you might want to use the "line" setting. This selects the AC power source as the source of the trigger signal so that any 60 or 120 Hertz ripple will be perfectly synchronized with the trigger. You will probably not use this setting too often.

External - You can even couple an external trigger source to the oscilloscope. That is, you can use both vertical inputs (channels 1 & 2) to view two different signals, while triggering the oscilloscope on a third signal that's connected to the "external input" connector (see figure 1) The external input can be coupled to the oscilloscope in one of three ways:

AC - Signals above 60 Hertz are capacitively coupled to the input of the A trigger. Any DC in the incoming signal is blocked. Any signals below 60 hertz are attenuated. Attenuation refers to the lowering of an input voltage.

DC - The entire input is coupled to the A trigger circuit. This is good for triggering on low frequency signals.

DC :10 - External trigger input is attenuated by a factor of 10 before being passed to the A trigger circuit. For every 10 volts of input at the connector, 1 volt is passed to the A trigger circuit. This is useful when your trigger source is a high voltage. The maximum input voltage for the external trigger is 400 volts in this oscilloscope.

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