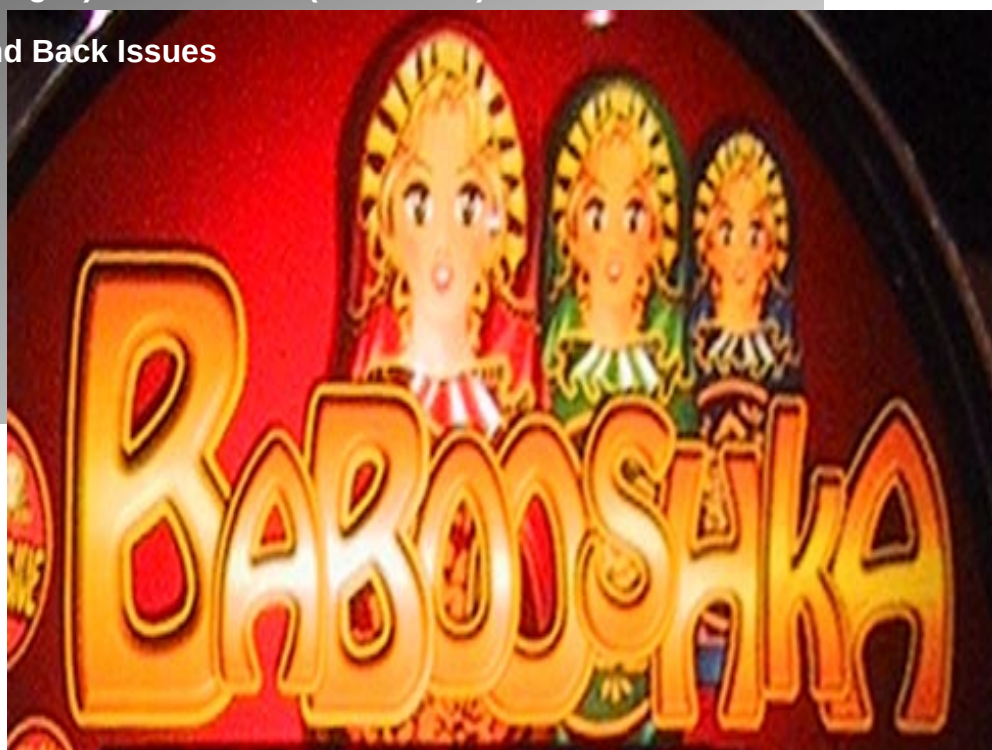
Inside Slot Tech Magazine

July, 2002



Slot Tech Magazine
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Slot Tech Editorial

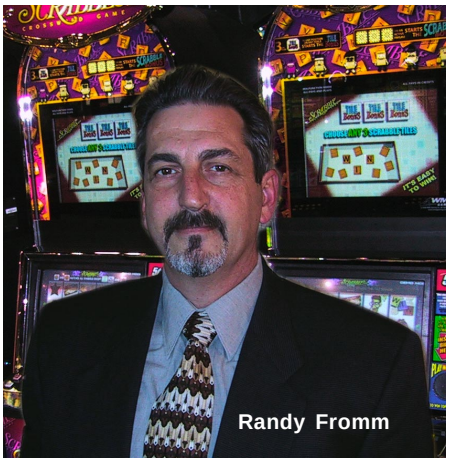
While I was at last month's NIGA show in San Diego, I met a gentleman named Patrick Sam. Patrick is the director of slot technical operations at the Grand Casino Mille Lacs in Minnesota. He asked me if I would ever consider holding a TechFest in his neck of the woods. When he told me where he was located (an hour and a half from Nowhere, MN and turn left at the big tree) I basically said "No way." A few weeks later, I received the following e-mail from him:

Hello Randy,

My name is Patrick Sam. I met you at the NIGA show in San Diego and we talked a little bit about having a TechFest here at our casino. The reason I am writing you is to find out what I can do to make something like this happen. We are very interested in having one here. I know you stated that it might be a problem with us being so far away from the airport but we do have about 50 Native American casinos within driving distance of our casino. We are centrally located in Minnesota and have a convention center with a large ballroom. We also have a hotel on site with 284 rooms and a hotel off site with 80 rooms. There are also 2 other hotels within 10 minutes of the casino. If you would like to check out our casino you can look at our web site, the address is www.grandcasinomillelacs.com. I believe that with our location in Minnesota and the casinos we have around us and with our amenities we would have a great turnout for a TechFest in Minnesota.

Patrick Sam
Director of Slot Technical Operations
Grand Casino Mille Lacs
1-800-626-5825 ext. 8261
milpjs@grcasinos.com

Patrick presents a compelling case in this well-written request and so we have scheduled TechFest 4 for October 22nd through October 24th at his place. You'll find the schedule on page 35 of this issue. This is likely to be a one-time event so if you're interested, please let me know. Enrollment forms are available at the slot-techs.com website.


Randy Fromm

And speaking of Internet thingies, I have established an experimental ftp server for slot techs. As of this writing, the ftp server has technical information (mostly monitor schematics) and some cool promotional presentations from various manufacturers. I will expand it as time permits.

Point your ftp client to slot-tech-ftp.tzo.com. I will ask you to visit the website at slot-techs.com to pick up the username and password as it may change from time to time. At the moment, the username is Slot Tech and the password is kxkvi8 but as I said, that may change.

If you have any cool slot machine related files that you'd like to add to the ftp site, all donations are gladly accepted. I have 12 gigs that I can fill at the moment.

That's all for this month. I'll see you at the casino.

Randy Fromm

Randy Fromm's
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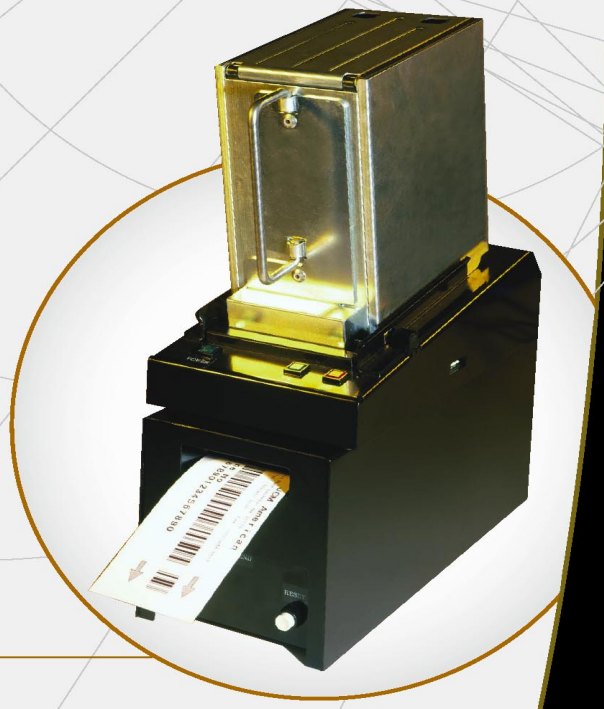

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Swinging Jeannie

By Herschel Peeler

What makes Jeannie swing? Have you ever wondered what makes the little Jeannie figure inside the bottle on the "I Dream of Jeannie" games swing back and forth? We had one stop swinging a while back. I was told the board was a "throw away" item. I seldom throw anything away if it's at all repairable. This one was a keeper.

Undaunted by the fact that the board was almost all surface mounted components, we proceeded to start troubleshooting. A quick check of the obvious parts found that fuse F2 was bad. Not having one in stock, the board got tagged and put on the "one-of-these-days" shelf. Pondering the circumstances, I asked myself, "what if the problem hadn't been so easy to find?" We had no schematic for the board. An entry was put on my "To Do List" to de-engineer the board one of these weekends.

I recently got an e-mail from another of the technically curious who also wanted to know if there was a schematic for this board. Well, here it is.

Explanations and assumptions follow at the end of the description of how the board works. If you get lost, jump to the ending.

An Overview of the Major Parts

U1 and U3 – LM358 dual op amp. There is nothing particularly special about the LM358. Probably most any compatible dual op amp with the same pin out would work. LF353, LF442, LF412, LM2904, TL062ACD (Radio Shack p/n 900-6347), MC1458D (Radio Shack p/n 900-6335), 512-LM358M or 513-NJM358E from Mouser, or from NTE as NTE928SM.

U2 – A Microchip PIC12C509 microcontroller. This cute little girl has one input, four outputs, each capable of driving up to 25 mA, 1K of one-time-programmable EPROM, 41 bytes of RAM, an 8-bit Timer, and a built-in Watchdog Timer and power on Reset. There is much more to this than this paragraph can describe, but you get the general idea. This is a spiffy little package in an 8-pin case.

U4 – LM317. This is a 100 mA voltage regulator with an adjustable output voltage. Two resistors determine the output voltage, R18 and R20. With the values given the output of U4 should be about +20 Volts. Available from Radio Shack, TL317CD, p/n 900-7231; or 511-LM317LD from Mouser.

U5 – (unknown part number, just labeled "L01B") I had no cross-reference for this part, but the function was simple enough. +12 V in, +5 V out. A Voltage Regulator for +VCC to U1, U2, and U3. (I assumed it was +5 V. I never actually measured it.)

Q1 – A transistor array. SI9945A / SI9945DY. Available from Radio Shack, p/n 900-5339. An N-MOSFET device. This is the driver for the coil.

L1 – The coil. Transpower Technologies Incorporated, p/n TTI7321 4600. I don't suggest you try to unsolder it. It should have about 135 ohms resistance.

General Operation

This board requires no outputs from the game, and gives no inputs to the game. Just give it power and it runs.

The two sections of U3 are connected as voltage followers. They provide two positive voltage levels on their outputs.

U1A has two functions. Other than passing along the output of U3A, it also gives a feedback signal from Q1, which we will describe shortly.

The output of U1B is held low during until U3B goes positive. From the values of R17 and R19, I would expect the voltage out of U3B to be about 1.16 V, and that same voltage to be at U1B, pin 5. U1B will compare this voltage against the output of U1A (U1B, pin 6). If U1B, pin 6, is below the voltage on U1B, pin 5, the output of U1B will be high. If not, the output of U1B will be low.

The Output of U3A should be about 1.78 V (judging by the values of R13 and R16). This voltage is buffered along by U1A, and is applied to U1B, pin 6. Assuming U1B pin 5 is at its 1.16 Volt level, the output of U1B should swing low.

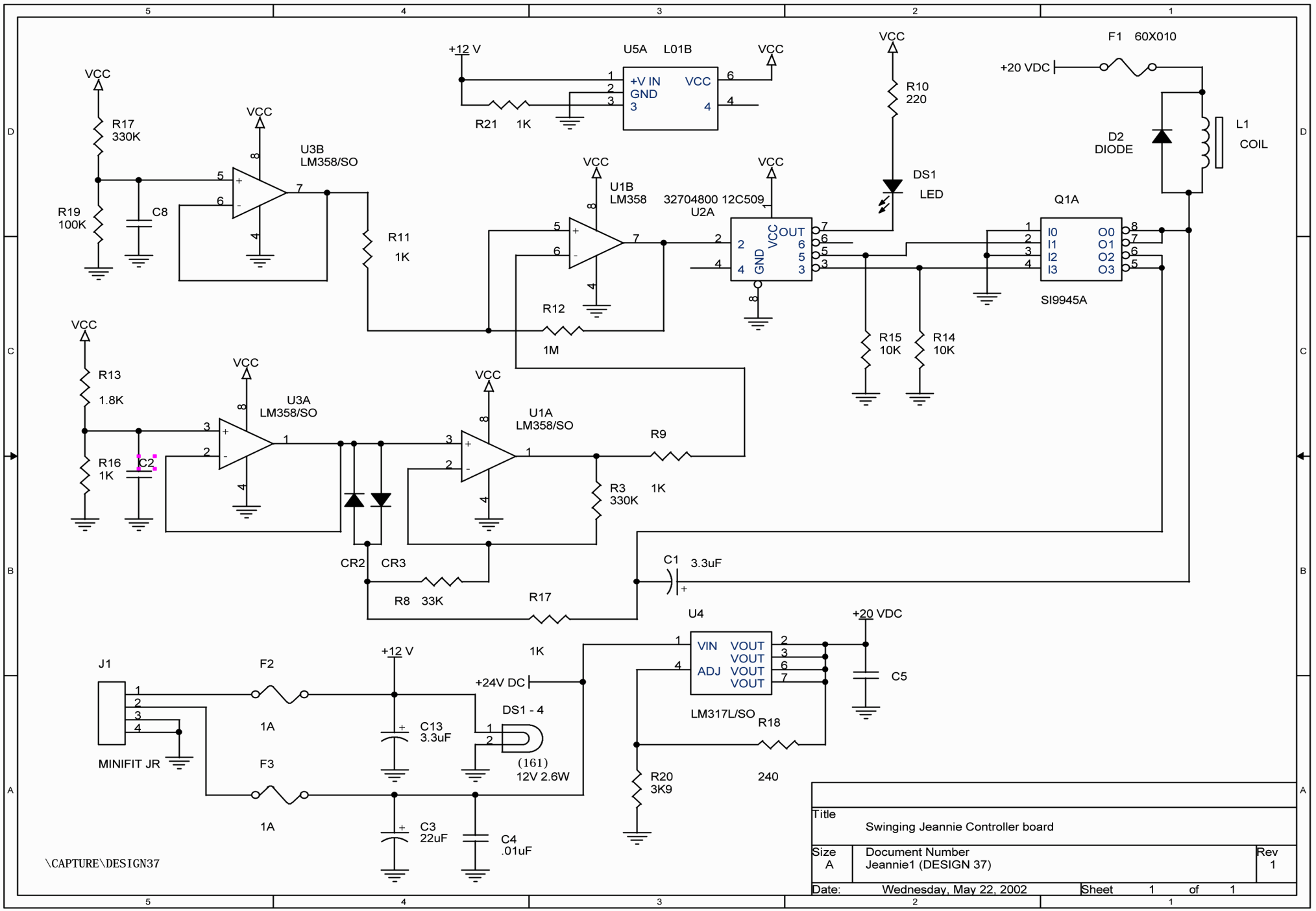
U2 watches for the swing of U1B to go low, and pulses the two outputs on pin 3 and pin 5. Q1 beefs up this pulse to drive the electromagnet coil, L1.

Jeannie sits on a pendulum with a magnet underneath her. The interaction of the magnet and the electromagnetic field of L1 pushes the Jeannie into a swing.

The other output of Q1 comes back into the input of U1A, driving the signal to a lower voltage, resulting in the output of U1B going high.

As the pulse ends the signal fed back to U1A returns to normal, and the output of U1B goes low again, triggering another swing.

The microcontroller determines the timing of the pulse. As soon as power is applied, U2 starts sending pulses. As it gets into a rhythm the circuit should keep Jeannie swinging.


VCC
R17
330K
R19
100K
C8
U3B
LM358/SO
R11
1K
+12 V
U5A L01B
+V IN
GND
VCC
R21 1K
U1B
LM358
R12
1M
32704800 12C509
U2A
VCC
OUT
GND
R10
220
DS1
LED
F1 60X010
+20 VDC
D2
DIODE
L1
COIL
Q1A
I0
I1
I2
I3
O0
O1
O2
O3
SI9945A
R15
10K
R14
10K
R13
1.8K
R16
1K
C2
U3A
LM358/SO
U1A
LM358/SO
R9
R3
330K
1K
CR2
CR3
R8 33K
R17
C1 3.3uF
U4
VIN
VOUT
ADJ
LM317L/SO
R18
240
R20
3K9
C5
J1
MINIFIT JR
F2
1A
F3
1A
+12 V
C13
3.3uF
C3
22uF
C4
.01uF
1K
+24V DC
DS1 - 4
(161)
12V 2.6W
\CAPTURE\DESIGN37
Title
Swinging Jeannie Controller board
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A
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Sheet 1 of 1

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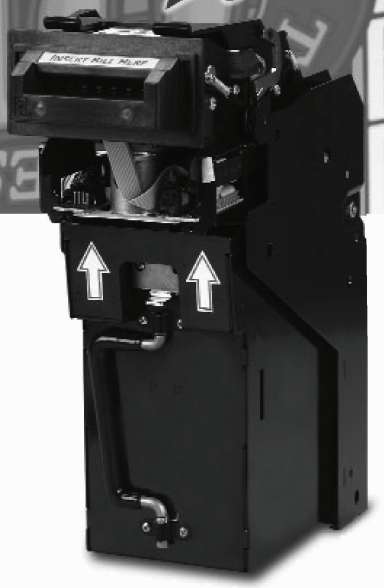

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Things I don't know

1. I've never actually watch the board in action. I don't know if the LED blinks as the Jeannie swings, or if it's a Confidence Check, or an Error Output. This is entirely under the control of the microcontroller.

2 Generic part number for U5A, the L01B. I suspect it is not a custom part, I just have not had a quick and easy reference for it, and I don't recognize it offhand. Perhaps it is a regulator with a control input, therefore the need for the resistor to pull the control input up (Well, it could happen.).

Things to check in case of failure

> Lamps out, no swinging Jeannie.
Check fuse F2. This is the fuse for +12 V that drives the lights, and also is where VCC is derived for U1, U2, and U3.
> Lamps on, but no swinging Jeannie.
Check F3 or polyfuse F1 (it looks like a ceramic disk capacitor, but it's not).
Check for Voltage Regulators to be working. U4, +20 V. U5, +5 V.
Check the voltages on U1B. Pin 5 should be around 1.16 V. Pin 6 should be around 1.78 V. Pin 7 should be low. If all this is good, ground pin 6 temporarily. U1B output should go high, then return low as you remove the ground. Jeannie should jump. If Jeannie doesn't jump, suspect U2, Q1, or the coil.

Calculation and Assumptions Made

U4 – Unadjusted, the output of an LM317 is 1.2 V. This is the voltage that will be across R18, giving a current of 5 mA through it. This same 5 mA passes through R20. The value of R20 determines the output voltage to be regulated. 5 mA through 3900 ohms gives about 19.5 Volts (I called it 20 V).

U3B – R17 and R19 make a simple voltage divider. The voltage at the midpoint of them should be (R19 / (R19 +R17)), which gives a ratio of R19 to the total resistance; that ratio times VCC (+5 Volts) gives 1.16 V. (I did assume VCC is +5 V.) U3B is a Voltage Follower circuit. The output voltage should be the same as the input voltage.

U3A – R13 and R16 make a simple voltage divider. The voltage at the midpoint of them should be (R16 / (R13 +R16)), which gives a ratio of R16 to the total resistance; that ratio times +5 Volts gives 1.78 V. (Again, I did assume VCC is +5 V.) U3A is a Voltage Follower circuit. The output voltage should be the same as the input voltage.

U1B – The voltage on pin 5 should be the same as the output of U3B. No significant current flows through R11. Under static conditions I would expect to find U1B, pin 6, to be the same as the output of U3A. U1B functions as a Voltage Comparator. When the voltage on pin 6 is lower than pin 5, the output goes high. When pin 6 is higher than pin 5, the output goes low.

U1A – Under static conditions U1A is just a Voltage Buffer for the output of U3A. The feedback from Q1 moves the voltage above and below the voltage level on U1B, pin 5. This makes the output of U1B swing high and low.

Filter capacitors were omitted from the schematic for simplicity.

There are jumpers around the driving circuit between Q1 and L1. I took it these are for making changes to the board if L1 were not wound properly. This option does not show in the schematics.

Where to get the information:

Following is a list of sources available to get this sort of information from, their website, and/or a phone number.

Radio Shack, Commercial catalog (These items will not be in your local store.)
www.radioshack.com
1 (800) 442-7221

Mouser Electronics
www.mouser.com
1 (800) 346-6873

Microchip
www.microchip.com
1 (888) 628-6247

One less thing on the To Do List.

- Herschel Peeler
hpeeler@slot-techs.com

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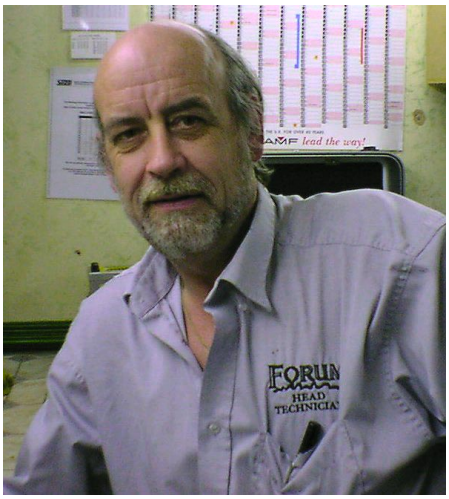
A Plumber's Guide to Fruit Machines - Part 4

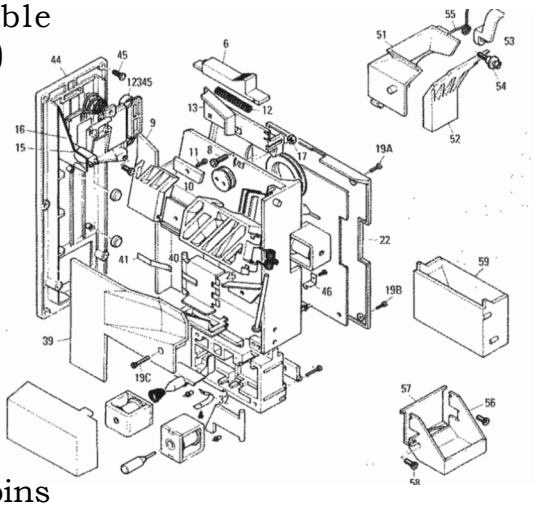
By Gordon Lowe



Section 1.h. Coin Controls(r) Validators

Once again, there are many variations. One of the earliest to be found is the original Sentinel, easily identified by its blue casing. Pin connection as in Table 1.

One of the major differences with other manufacturers is in the routing of coins. No linking plug here, routing is controlled by an electronic sorter that has to be programmed using the "Sentinel Toolkit(r)" available through Coin Controls(r) agents. It is not possible to re-route any coins or replace the validator (unless the replacement is already programmed for the same routing) without this toolkit.



Attached to the validator will be found what is known as a "manifold" used to channel the coins after separation to their respective routes. Note here that there is more than one configuration of manifold. Figure 2 shows the two types found in AWPs.

This validator was replaced with the C200 series, looking identical but black instead of blue. One improvement here lies in the material used in the casing. The earlier Sentinels were prone to breakage at the mounting points, making them virtually unusable without jury rigging a means of securing the validator. The C200 series are far less prone to this problem.

C200 series validators were followed by validators using the same number, but with the suffix "B." This was brought about by the microprocessor used up to this point becoming obsolete, necessitating Coin Controls to re-evaluate this validator and replace the existing PCB. As a result, you will notice that the serial port connector changed from a telephone type to a 3 pin. This port is used during programming at

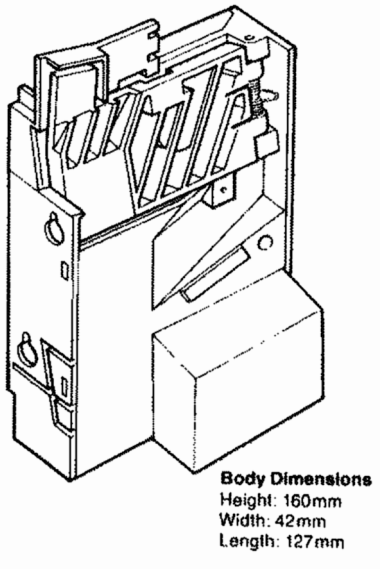
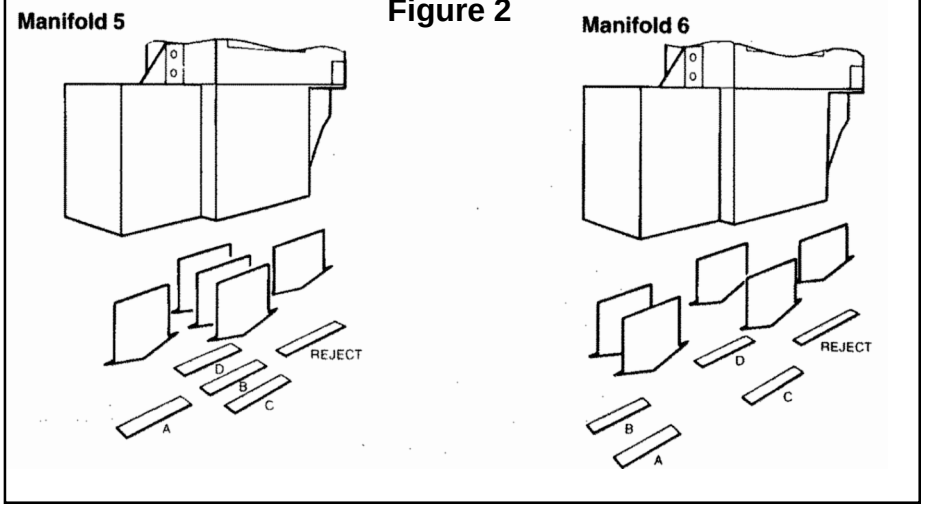


Figure 2



the factory or programming the sorter routing using the "Toolkit."

Section 1.i. Coin Controls(r) C200 series validators

Coin Controls have 4 different types in this series: C220, C250, C235 & C255. The only one we are likely to find in AWPs is the C235 which has an active 4 way sorter module incorporated into the unit. As with the earlier "blue" Sentinel, the routing of the coins requires the use of the electronic toolkit.

Connection to the validator is as listed on Table 1. One important note is pin 8, which is used to configure the validator in either 4 coin or 8 coin mode. When the select is high or left open circuit (not connected) then the validator will operate in 4 coin mode which would be the normal set-up. When the select line is pulled low (ground) 8 coin or "Dual Currency" mode is active. What this does is to enable coins 5-8 in addition to coins 1-4. This can be a little confusing at first. What you then have is the ability to accept 8 different coin types but with only 4 different outputs. To quote 'Coin Controls Technical Manual on the C200 series' - "Coins effectively become paired with outputs as follows:- 1 & 5 on line 1, 2 & 6 on line 2, 3 & 7 on line 3 and 4 & 8 on line 4. This can be used when two different currencies are required and where similar value coins can be linked."

To give an example from our recent past, when in 8 coin mode, we could have had the

validator programmed for the old 50p coin on line 2 and the new 50p coin on line 6. This would have resulted in an output on line 2 whichever coin was inserted. Because both coins are of the same value, no problems arise. It must be noted that it is not possible to identify which of the two linked coins have been inserted. Also, note the extra two pins on the bottom. These are used to enable coins 5/6 and coins 7/8 respectively. Coding on the validator will show what pin is where. You will find variances.

One Coin Controls(r) validator that turns up in AWPs now and again is the C335S, now obsolete along with the blue Sentinel. This is the forerunner to the C435 validators, next on the list. This has a binary switch at the back of the mech that is selected for your particular token type. There is also a self teach for the token whereby 20 tokens are run through the mech to enable it to learn which token type to accept. The C335S did have intermittent problems with token acceptance, something that has now been sorted with the introduction of the C435.

Section 1.j. Coin Controls(r) C435 Validator

The C435 Validator has similar exterior specifications to the earlier Sentinels. Internally, the electronic specifications have changed dramatically to meet today's machine requirements.

Improvements over earlier Sentinels are as follows:

1. The ability to handle up to 16 different coin types (when configured in binary mode.(see section 1.k) 2. 11 pre-programmed token types built in. 3. Teach and Run, enabling validator to learn a new token type. 4. Routing of accepted coins controlled by links on a routing plug or electronically set at the factory. This gets rid of the necessity for a "Toolkit." 5. A diagnostic aid accessed by links that enable testing of solenoids, sensors and DCE chutes.

All these extra facilities are controlled via a rotary switch and a bank select. More specific details on this validator are available from the "Technical Manual on the C435" obtainable directly from Coin Controls(r) or one of its authorised agents. (Coin Controls is now known as Money Controls, reflecting the company's product line which handles both coins and banknotes. You may contact them at: Money Controls Ltd Coin House New Coin Street Royton Oldham OL2 6JZ United Kingdom Tel: 44 (0) 161 678 0111 Fax: 44 (0) 161 626 7674

Routing Connector on the C435

Controlled by the 18-way routing plug connector, this will govern the paths of 6 coins between 4 different routes. Route A being the default cash box route which any un-nominated coins will take. (Coins 7 & 8 will always take this path

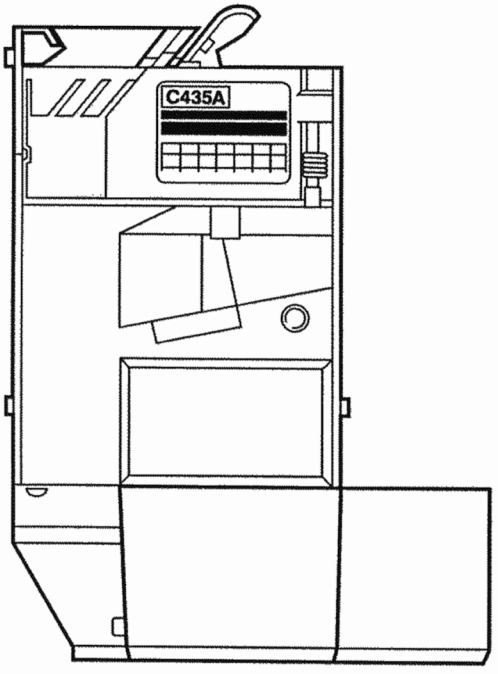
Connection is as follows: Coin 1 = Pin 8 Coin 2 = Pin 10 Coin 3 = Pin 12 Coin 4 = Pin 16 Coin 5 = Pin 18 Coin 6 = Pin 17

Route B = Pin 15 Route C = Pin 13 Route D = Pin 7

0 volts = Pins 14, 5 and 11 Note that any unused sorter paths must be linked to a 0 volt pin.

Simply link the required coin pin to the required route. e.g. Coin 4 to Route C would be pin 16 linked to pin 13.

Where 2 or more coins are required to travel the same path, diodes are used as mentioned previously in section 1.g, noting that cathodes of the diodes are connected together and then onto the required route pin, each of the anode connections going to the required coin pins.



Also found on this validator is the “sorter override connector” the purpose of which is to override a designated path and re-route a coin to the default cash box route (route A). This would be used when, for example, the host machine calculates that a hopper is full. Then any further coins inserted would route to the cashbox.

It is possible with the C435 to connect what is known as an “Active Manifold” which is coupled to the validator on the connector of the same name (surprise, surprise). This manifold would be used where up to 8 different routing paths are required, unusual in AWPs.

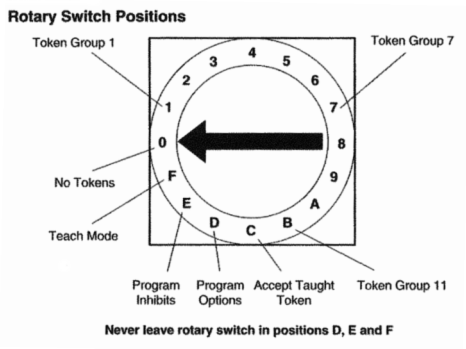
Other functions of the C435

The “Bank Select” switches have two different functions: Firstly, it is used to select or deselect coins in use, i.e. coins 1-8 and coins 9-16. Secondly, this switch is also used to select the programming options that are available, i.e. inhibiting coins, programming tokens, etc.

The rotary switch is used to select the particular programming function that you wish to do. e.g. Select a pre-programmed token, teach the validator your own token or inhibit coins.

How to teach the C435 a new token type.

Do not forget that this validator has 11 different token types pre-programmed into the unit (settings 1 through to 9, A & B on the rotary dial). To teach a token



The rotary switch is used to select the particular programming function that you wish to do

type: 1. Select ‘F’ on the rotary dial. 2. Press program button. 3. Feed a minimum of 20 tokens through the validator. 4. Select ‘C’ on rotary dial 5. Press program button

This completes the set up for a new token but remember never to leave the rotary switch in positions D, E or F

(Leave in position C for validator to accept taught tokens).

Setting 'D' on the rotary switch is used to select the required alarm settings, and the type of rundown (DCE) if any.

1. Note the settings of Bank Select switches 1 & 2
2. Select 'D' on rotary dial
3. Set bank select switches as follows:
switch 1
off = Coin Controls rundown
on = other type (or none)
rundown switch 2 off = alarm and coin jam on on = alarm and coin jam off
4. Press program button
5. Return rotary switch to required token position
6. Return bank select switches to original position.

Note that using this particular program function, a faulty or suspect rundown can be removed out of the circuit and the host machine can continue to function until a replacement can be obtained.

Servicing: Use of foaming cleanser is not recommended on these validators (I have experienced complete disablement of the unit after using this product on Coin Controls validators) nor should any abrasive or solvent-based product be used. It is better to stick to a moist cloth with mild detergent to clean the coin rundowns.

The readily available parts for replacement are the accept gate and the gate spring. The spring particularly can lose its tension over a period of time. This will result in coin jams within the mechanism. Replace it. Don't try bending it; you will only have to do it again later. A similar spring can be found on the flaps at the base of the sorter module. The same comments apply.

Section 1.k. Validators Operating in "Serial" Mode

As mentioned previously, both the Mars Cashflow(r) 115 and the Coin Controls(r) C435 are capable of operating in one of two modes: parallel or serial (binary output). The parallel mode is the normal operation validators will be supplied in. Simply, there is a dedicated output connection for each coin type. This is the mode in which all earlier validators such as the ME/ MS100 series and Sentinels operated.

When these validators are configured in serial mode, the coin output lines are no longer treated as individual coins but as "Accept 1,2,3,4 & 5." (Accept line 4 is known as the "strobe" and is used as a verification of the other 4 outputs).

When a coin is accepted, an output is given out on these lines in binary form. For example, a 10p coin is accepted

TABLE 5

Parallel output	pin	serial (binary) output	binary output function
Coin output A	**1**	**Indent	Status response
Coin output B	**2**	Accept line 5	output line
Coin input common	**3**	Comm A	common accept line
Coin output F	**4**	Accept line 1	output line
Polarising Key	**5**	Keyway	polarising pin
Coin output E	**6**	Accept line 2	output line
Coin output D	**7**	Accept line 3	output line
Output mode	**8**	*Select	selects operation mode
Coin output C	**9**	Accept line 4	output line
Coin C inhibit	**10**	Inhibit line 4	reserved
12 volt supply	**11**	plus V supply	power supply VCC
0 volt supply	**12**	minus V supply	power supply ground
Coin D inhibit	**13**	Inhibit line 3	coin inhibit
Coin E inhibit	**14**	Inhibit line 2	coin inhibit
Coin F inhibit	**15**	Inhibit line 1	coin inhibit
Coin B inhibit	**16**	Inhibit line 5	coin inhibit
Coin A inhibit	**17**	Inhibit line 6	coin inhibit
Coin G inhibit	**#18**	Inhibit line 7	coin inhibit
Coin H inhibit	**#19**	Inhibit line 8	coin inhibit
	#20	Bank select 1	selects coins 1-8
	#21	Bank select 2	selects coins 9-16

Table 2 #pins 18-21 applicable to Coin Controls C435 only
*pin 8 select line = parallel logic 1' serial logic 0
**pin 1 indent = used by host machine to interpret binary code outputs

by the validator and configured on line 4 (or D). What will then happen is that an output pulse is given out on both accept lines 1 & 2 simultaneously. These pulses are then dealt with by the MPU in the host machine as binary information. It is worth noting here that the host machine must be configured to accept binary outputs from the validator, something of which only modern AWPs are capable. Table 5 shows in more detail the pinout of both the Cashflow(r) 115 and Coin Controls(r) C435, parallel and binary

Due to the more recent requirements that necessitate a wider range of coin types to be accepted (such as the 5p and £2 coin) new AWPs being manufactured are supplied with this configuration. Table 5 shows in further detail the differences that occur in the pinout when the validator is selected in binary as opposed to parallel mode.

It must be emphasised that a machine designed to operate in binary mode and fitted with one of these validators, cannot be fitted with any other validator that will configure only in parallel mode, like the ME/MS100 or C200 series.

Section 1.1. DCE Chute

Comprising of two parts, the Y chute and the dual coin entry bezel from which it gets its name. This was fitted with the object of preventing liquid being poured into the coin entry resulting in damage to the validator. It also helps to prevent strimming taking place, a term coined from the use of 'Strimmer' cord used on garden grass trimmers of the same name. In this case, £1 coins are attached to this cord, inserted through the coin entry bezel and passed back and forth in the validator in an attempt to defraud the host machine.

Simply, this unit detects a coin passing an opto sensor and as it does so, the circuitry mounted on the DCE chute switches on the inhibit lines which then allow the validator to determine whether or not a valid coin has been inserted.

When wired into the host machine, a validator can only be tested by allowing a coin to pass through the DCE first. Otherwise, all coins will be rejected.

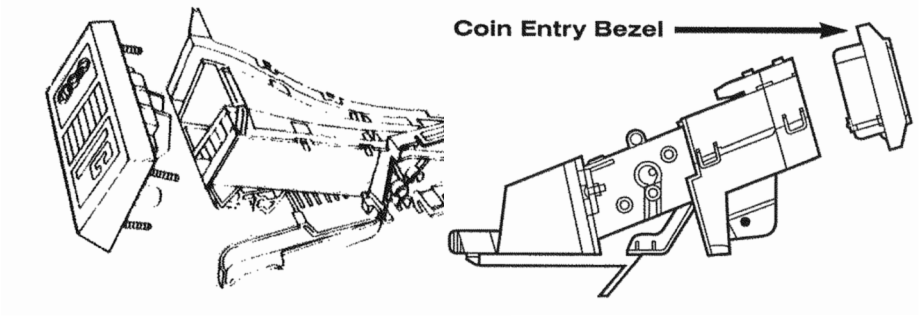
A faulty unit can be a common cause for coin rejection. Bypass it first to see if it is the problem. A bypass is available for the Mars unit from suppliers of spares. When fitted with a C435 validator, the Coin Controls rundown can be tested by following the diagnostics routine from the C435 technical manual.

Easier, test the host machine with a known working unit, if you have one?

Should a DCE chute prove to be faulty, strip it down and wash all the plastic components in warm soapy water with emphasis on the reflectors encased in the sides. This will cure 90% of faulty units. Need I say more? Do not immerse the printed circuit boards. Remove them first and clean the surface of the opto sensors with a dry duster.

Summary on Electronic Validators

My first thoughts when approaching the subject of validators for this series was that I was thoroughly familiar with the subject. Then, I looked further into the binary operation of the new validators. As new machines arrived configured in this mode, it soon became apparent that I would have to learn a whole new concept and freely admit a wariness that turned out to be unfounded. Read the manuals available. Try the different programming functions that are built in and you will soon absorb all that is required. Remember, patience is the keyword.



Illustrated here are both types of DCE chute that you will come across. The Coin Controls unit connects directly to the validator (sometimes referred to as a rundown) whereas the Mars unit will be found wired into the host machine.

Section 1.m. The S10 mechanical coin acceptor

The S10 is a coin validator that is dependent upon individual parts fitted to determine the coin accepted. Adjustments will allow one particular type of coin only. When the coin has been accepted by the mechanism, it will activate a microswitch. This in turn will supply the data to the host machine's MPU.

Very seldom used in any new machines being manufactured, we find this unit fitted to older machines usually as the token acceptor and is now replaced with the electronic validator with token parameters built in.

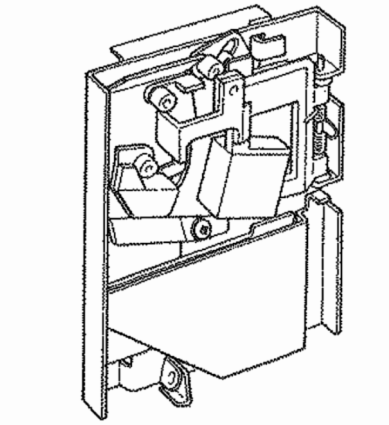
Once again Coin Controls are the main supplier of these mechanisms, and are often used where only a single type of coin is required, for example a kiddies ride where a 20p coin is value.

Microswitch replacement is an important point. Are you aware that there are different weights for different coins? Identified by the colour of the plastic retainer for the actuator wire it is as follows: red for the 2p & 20p coin, white for the 10p & 50p, black for the £1 coin, the difference being in the amount of pressure taken to activate the microswitch. Compare them by activating them by hand and you will feel the difference. Try using a microswitch with a black centre on a 2p unit and all that will happen is that the 2p will sit on the actuator wire without passing it.

Now we have got the coin into the machine, hopefully in the correct place, (read section on routing again!) how do we pay it out ?

Tune in next month to find out . . .

Gordon Lowe
glowe@slot-techs.com



The S10 Mechanical Coin Acceptor

Atronic exceeds projected sales goals at NIGA 2002

Atronic Americas LLC, leading video slot manufacturer, announced that it has exceeded is sales goals by 200% at the National Indian Gaming Association (NIGA) 2002 trade show and convention, April 25-26 at the San Diego Convention Center.

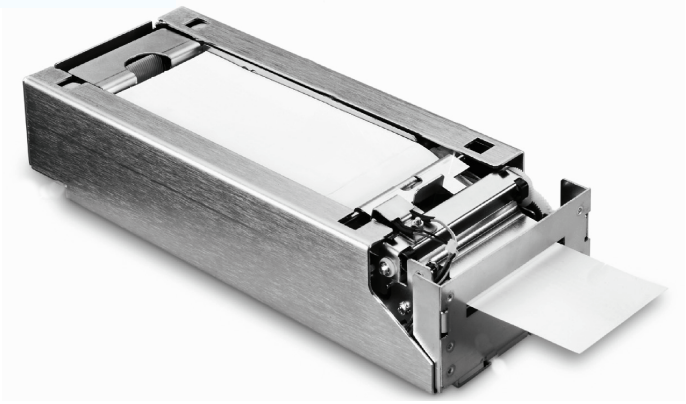
"NIGA has always been good to us, but this year, we did exceptionally well. Customers loved our many new game titles and technology segmentation, and appreciated the exclusive performance by Native American performer, Brulé. We at Atronic enjoyed the chance to give back to the community by providing quality products and also by bringing Brulé." Remarked Joe Bailo, VP of Sales and Marketing of Atronic.

The Brulé performance was well-attended, meaningful event for Atroinc customers. Brulé featured a full band and several dancers, each representing a different tribal area. The performance was standing room only. The combination of dancers and multi-media presentations made many of the concertgoers emotional. "This is the second year we have featured Brulé at NIGA. To have Brulé perform for our customers was a great outreach for us. They are truly a part of the great games great people family. " Remarked Katie Davis, Marketing Manager.

Atronic presented a host of entertaining and exciting new games as well as successful, GLI approved programs in a variety of configurations. Atronic debuted several new games such as Wave Watcher, I.C. Cash, and Beach Patrol. Atronic also featured successful, GLI approved games including Typhoon Lagoon, Babooshka, Beetlemania and Chickendales. The games were shown in a variety of denominations, as well as progressed and merchandised, demonstrating Atronic's commitment to providing the widest variety of options to customers.

Atronic and sister company Atronic International are members of the family-owned and - operated Gauselmann Group, which has sold more than 1.7 million machines since inception, and 97,000 gaming devices in the year 2001 alone. Atronic is headquartered in Germany and has offices in Australia, Austria, Great Britain, Peru, South Africa and the United States.

Ithaca's New Model 850 and 860 Printers to be showcased at Global Gaming Expo



Ithaca's new Series 800 thermal ticket printers join the company's family of thermal ticket printers and deliver the speed, flexibility and functionality to make them clear winners for cashless gaming, kiosks and vending machines. Ithaca will introduce the printers at the Global Gaming Show, October 1-3, 2001, Las Vegas, NV, booth #4233.

"Coinless slot machines are the wave of the future in gaming. When designing the Series 800, we addressed all of the industry's demands, including ticket jamming, regulatory compliance, accuracy and downtime," said Bart Shuldman, President and CEO, TransAct Technologies.

The Series 800 features two models, the 850 and 860. The Ithaca 860 incorporates an additional, patent-pending Void and Reprint feature that automatically reads the barcode for accuracy. It there is an error, the printer will immediately void the ticket and reprint a new one, preventing any downtime and ensuring regulatory compliance.

Tickets taken prematurely are a leading cause of ticket errors in casinos. The Ithaca Series 800 prints so quickly - 5ips - that players literally do not have time to take the ticket before it is printed. The Ithaca Series 800 delivers high quality, sharp vertical and horizontal thermal printing of text, barcodes, graphics and lines, and prints onto "dollar bill" sized tickets, which are compatible with bill acceptors.

The Series 800 features a conveniently designed pull-up release, which provides easy access to the printhead and straight, open paper path, improving reliability and eliminating downtime. Its compact design allows simple integration into any upright, slant top and bar top games.

"We're excited to be at the forefront of the cashless slot machine trend with the Ithaca Series 800 printers. As we work with leading slot machine manufacturers, we're confident that the revolutionary Void and Reprint feature in the 860 will become the industry standard," said Shuldman.

The Series 800 printers are streamlined, complete units with snap-in/snap-out printer mechanism, paper tray, slide mount and controller board for easy OEM installation. No tools are required for assembly or disassembly, which may be accomplished in minutes. The circuit boards are 100% protected from accidental contact, insuring ultimate security.

The Ithaca Series 800 is backed by the company's standard 2-year warranty and solid reputation for quality and reliability. Ithaca's family of thermal ticket printers also include the Series 750, which was launched last year and was at the technological and operational forefront of the cashless slot trend. Contact 1-877-7ithaca or www.transact-tech.com for further information.

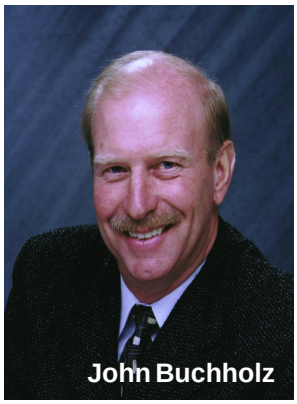
Bally Appointments

Bally Gaming and Systems has announced three executive appointments for its Bally Systems division.

Tom Reilly was appointed Eastern Region Vice President of Sales for Bally Systems and General Manager of the recently acquired Advanced Casino Systems Corp. (ACSC) Product Group. Reilly has 14 years of sales and marketing experience with IBM, including serving as that company's National Sales Manager for the gaming and hospitality industry. Other senior management positions Reilly has held include Vice President of Sales with Logical Solutions International, a software firm specializing in casino player tracking and marketing solutions. During his tenure as Vice President and Managing Partner with The INSIGHT Group, a management consulting firm specializing in developing usiness strategies to help product-based companies transition to service companies, Reilly developed a long-term business partnership as a consultant to ACSC.


Tom Reilly

John Buchholz was named Vice President of Sales for the Western Region of Bally Systems division. Previously, Buchholz served as Vice President, Existing Accounts, for Bally Systems. Prior to his association with Bally Systems, Buchholz served from 1971 to 1995 in various management capacities with Unisys Corporation. He has also held the positions of Vice President of Sales and Marketing for Parsec Automation and Director of Sales for Acres Gaming.


John Buchholz

Rick Flood was named Vice President of Sales in Nevada for Bally Systems. Flood will oversee the combined Nevada sales efforts of Bally Systems, as well as the recently acquired Casino Marketplace™ and (ACSC) operating units in the world's premier gaming market. He joined Reno-based Bally Systems division in 1995 as Regional Sales Manager and shortly thereafter was promoted to Director of Sales. For the past three years, Flood has served as Vice President of Sales for Bally Systems' Reno operations. Prior to joining Bally Systems, Flood spent 28 years in computer sales with Digital Equipment Corp. and Unisys Corp.


Rick Flood

International View

By Martin Dempsey

Maygay Unites With Stargames

Maygay recently announced the signing of a long-term Licensing Agreement with Australia's Stargames Limited, whereby Maygay will manufacture and sell electronic gaming machines incorporating Stargames' PC-based gaming technology within the UK and European gaming markets.

Under the terms of the License Agreement, all of Stargames' PC-based gaming machine technology, and games - including all upgrades to that technology and all new games developed by Stargames - will be licensed to Maygay for an initial term of 10 years. This is expected to lead to a substantial increase in the number of UK casino locations and, therefore, significant opportunities for electronic gaming machine sales." For further information, please contact: Nick Hardy, Maygay Group Marketing Manager. Tel: +44 (0)1902 792 320. E-mail: mailto:nick@maygay.com

IGT Supports NFL In Amsterdam

That's just too many initials for most of us, so let's spell it out. The season opener of the European National Football League saw IGT Europe hosting an American tailgate party for Amsterdam Admirals and German Rhein Fire fans.

Invited guests from both Holland Casino and WestSpiel Casinos were treated to an afternoon and evening of friendly football rivalry at the Amsterdam Arena. After an American-style hot dog buffet, Admirals cheerleaders paid the group a surprise visit for a few cheers and to get rival team supporters warmed up. Then, it was on to 50-yard line seats and lots of American football action. Why all the fuss? To announce the newly released video slot game, Tailgate Party. The IGT Sales Team was on hand to help cheer on the football players and, of course, to promote the latest release.

Star Role For New Design Manager

Starpoint has appointed Luis Sampaio to the role of Design Manager. Luis, who joins the company from a consultancy role, will work with Technical Director Colin Crossman to develop new products for Starpoint's three key markets - amusement/gaming, vending and point-of-purchase. He assumes day-to-day management of the design office and will play a major role in research, development and the scheduling of projects. Luis has been a design engineer for more than thirteen years and has taken a wide range of products from initial concept to full production in the point-of-purchase, white goods, food and beverage industries.

More information from Colin Crossman at Starpoint. Tel: + 44 (0)208 391 7700. Fax: + 44 (0)208 391 7760. Email: mailto:ccrossman@starpoint.uk.com

Novomatic Clearly Distinguishes Its Electronic Live Games From Copies

25 million US dollars and five years´ research and development have been invested by Novomatic Group of Companies in the first-time ever blend of the fascination of the classical live games with the impressing possibilities of advanced slot technology, making the Group a world leader in the realm of electronic live games.

As an increasing number of competitors try to copy the sweeping international success of Novomatic´s electronic

live games product family, the copied products surely do not come anywhere near the high technical quality, precise workmanship and exemplary security of the originals.

For further information contact Karl Neidel, Communications Manager. Tel. +43 2252 606 ext. 242. E-mail mailto:kneidel@novomatic.com http://www.novomatic.com

TCS Headline The Show At Stanley's Circus

The opening of the high profile Stanley's Circus Casino in Manchester city centre on the 22nd of May demonstrated a strong relationship between the TCS group and Stanley Casinos. This new casino aims to appeal to both serious players, and newer customers visiting as a part of a night out. To this end, a mix of differing products have been installed from the TCS portfolio, to create the right balance of games, and to fit with the design and theme of this new development.

Key to the excitement of this opening, is the installation and launch of the progressive poker game. The four tables use Shuffle Master technology including the unique bet detection system, and are linked on a local area network.

Restructuring At Impulse

Following a restructure within Impulse Gaming, it has been announced that Martyn Jones has been promoted from Product Support Co-ordinator to the newly created role of Commercial Manager. This function will cover all aspects of UK testing and sales, with both house accounts and distributors. Martyn will report directly to the Maygay Group's Sales and Marketing Director, Dean Harding.

As part of this re-organisation of resources, Barrie Knighton is to step down from the position of Sales and Marketing Director with Impulse on May 31st.

For further information, please contact Nick Hardy, Maygay Group Marketing Manager. Tel: +44 (0)1902 792 320.
E-mail: mailto:nick@maygay.com

SIGMA MONITORS

TOEI COLOR DISPLAY / MODEL TC-V814H

By Robert Sult

One of the easiest Monitors to repair is the TOEI Monitors. Over the past 4 Years, I have repaired over 125 of the TOEI Monitors.

COMMON PROBLEMS:

Vertical problems
Vertical distortion
Pincushion distortion
Line in center of screen
Black lines
Vertical roll

For about 85% of all problems, doing a complete capacitor job (replacing all electrolytic capacitors)should fix the problem. There are only 32 capacitors. When you figure the low cost of an electrolytic capacitor, it's just best to replace them all at one time. If not, you will find that you just fixed a monitor and in a week or two you will be working on the same monitor for a different problem. You might have saved time if you had just done the complete cap job.

I could describe a problem and direct you to the correct area (e.g. Dark on left side of screen - replace C28 or hourglass (pincushion) problem replace C601 - C602 - C604) but if you did a complete cap job, you do not really need to know that.

The following list of electrolytic capacitors has been recommended for the board in the TOEI Monitor:

CAPACITORS	PRESENT VALUE	UPGRADE VALUE
C7	100 uF @ 10 v	100 uF @ 25v
C8	47 uF @ 16 v	47 uF @ 25 v
C14	100 uF @ 16 v	100 uF @ 25 v
C15	10 uF @25 v	10 uF @ 35 v
C23	100 uF @ 16 v	100 uF @ 25 v
C27	470 uF @ 16 v	470 uF @ 25 v
C44	1000 uF @ 25 v	1000 uF @ 35 v
C49	100 uF @ 35 v	100 uF @ 50 v
C59	47 uF @ 100 v	47 uF @ 160 v
C71	100 uF @ 35 v	100 uF @ 50 v
C43	47 uF @ 35 v	47 uF @ 35 v
C11	10 uF @ 50 v	10 uF @ 50 v
C6	10 uF @ 50 v	10 uF @ 50 v
C2	10 uF @ 50 v	10 uF @ 50 v
C68	22 uF @ 25 v	22 uF @ 25 v
C17	1 uF @ 50 v	1 uF @ 50 v
C40	100 uF 50 v	100 uF @ 50 v
C50	1000 uF @ 35 v	1000 uF @ 35 v
	220 uF @ 35 v	220 uF @ 35 v
C28	10 uF @ 50 v	10 uF @ 50 v
C206	22 uF @ 200 v	22 uF @ 200 v
C204	100 uF @ 16 v	100 uF @ 16 v

For Problems with horizontal distortion, streaks, or tearing and other horizontal sweep problems, change the following caps:

CAPACITORS	PRESENT VALUE	UPGRADE VALUE
C301	220 uF @ 25 v	220 uF @ 35 v
C305	220 uF @ 25 v	220 uF @ 35 v
C302	33 uF @ 16 v	33 uF @ 25 v
C303	1 uF @ 50 v	1 uF @ 50 v
C308	1 uF @ 50 v	1 uF @ 50 V
C309	10 uF @ 16 v	10 uF @ 25 v

For problems in the area of pincushion distortion (hourglass shaped raster) or vertical sweep distortion, change the following capacitors:

CAPACITORS	PRESENT VALUE	UPGRADE VALUE
C601	22 uF @ 16 v B/P	22 uF @ 25 V B/P
C602	22 uF @ 16 v B/P	22 uF @ 25 v B/P
C603	4.7 uF @ 50 v B/P	4.7 uF @ 50 v B/P
C604	47 uF @ 25 v B/P	47 uF @ 35 v B/P

Other Problems
That I Have Seen

BLACK OUT - Fuse Blown

BLACK OUT - Q23 Shorted (2SC2749)
Cross Ref: ECG 2308 - NPN High-Speed Switch - Series Pass

BLACK OUT W/High Pitch sound
Q18 Shorted (2SD1455)
Cross Ref: ECG 2302 - NPN horizontal output transistor with damper diode

Also have seen, flyback cracked - shorting (SPARKING) to the case.

One thing you might want to look for: I had a Sigma monitor come in, BLACK OUT

Found F1 fuse blown
Found Q23 shorted

After replacing them, the monitor would come up but it had a strange sound.
Found IC 2 - Cold Solder joint on all three legs.

Editor's Note: On the following four pages, you will find Robert's monitor repair log. Please keep in mind that this is a raw log and was intended only as a reminder of what had failed, the symptom and what had been replaced. This means that in some cases, the components that were changed may not have been the actual cause of the problem.

- Robert Sult
result1@result1.net

Bally Game Maker

Horiz line	part was LA7850 Replaced 182 & 183
Vert Roll & Horz Problems	Replaced 937 (K PRA Video Amplifier / par #CPR 0510)

Ceronix 1490

Black Out	Replaced 206 (C5184 / par #CPI 1403) Now Chirping - Replaced 207 (100 uF @ 25v / par #CPC 1102)
Bright White on left	Replaced 085 (MC7812-CT / par #CPI1407)
Black Out	Replaced 183 (150 uF @ 250 v / par #CPC 1105) & 207 (100 uF @ 25v / par #CPC 1102)
Vert Roll and Distort.	Replaced 214 (PAR H Vert Cont. par #CPR 0503)& 140 (.01 uF @ 100v -/ par #CPC 1031)
Flashing White Screen	Replaced 227 (Flyback Transformer - / par #CPT 1500)
No Picture	Replaced 125 (220 uF @ 35v / par #CPC 1103) 207 (100 uF @ 25v / par #CPC 1102)
Vert Roll	Replaced 145 (PRA H Vert Control / par #CPR0503)
Vert Roll	Replaced 145 (PRA H Vert Control / par #CPR0503)
Black Out	Replaced 228 (1N5954B 160v Z-Diode / par #CPD 1256)
Vert Roll and distort.	Replaced 145 (PRA H Vert Control / par #CPR 0503) & 98 (10 uF @ 25 v / par #CPC 1101) 146 (1000 uF @ 35v / par #CPC 1104)
Vert & Horz problems	Replaced 183 (150 uF @ 250v / par #CPC 1105) top of cap blown off
Vert Roll (FAST)	Replaced 145 (PRA H Vert Control / par #CPR 0503)
182 Cap bubbled up	Replaced 182 (150 uF 250 v / par #CPC 1105)
Bright on one side	Replaced 215 (150 uF @ 250v / par #CPC 1105)
Bright White Screen	Replaced 227 (Flyback transformer / par #CPT 1500)
Black out	Replaced 125 (220 uF @ 35 v / par #CPC 1103) & 126 (LA7830 Vert Deflection / par #CPI 1401)
Black Out	Replaced 227 (Flyback transformer / par #CPT 1500)
Black Out	Found Flyback Cracked - Replaced 227 (Flyback transformer / par #CPT 1500)
Black Out	Bad Flyback Replaced 227 (Flyback transformer / par #CPT 1500)
top corner black	Replaced 215 (150 uF @ 250v / par #CPC 1105)
Vert Black Lines	Replaced 125 (220 uF @ 35 v / par #CPC 1103)
Black out - Chirping	Replaced 208 (.1 uF @ 50 v / par #CPC 1039)
On power up, 1 quick chirp	Replaced 193 (1N4937 / par #CPD 1253)
Black Out & High Pitch sound	Replaced 215 (150 uF @ 250 v / par #CPC 1105)
Black on left side	Found cap 182 (150 uF @ 250v / par #CPC 1105) loose - - Fixed
Vert Roll	Replaced 145 (PRA H Vert Control / par #CPR 0503)
Black Out - Fast Chirp	Replaced 207 (100uF @ 25 v / par #CPC 1102)
fading out - Black on screen	Ripple and fold over Replaced 183 (150 uF @ 250 v / par #CPC 1105)
Left side Black	Replaced 215 (150 uF @ 250 v / par #CPC 1105)
Bad Screen	Replaced 183 (150 uF @ 250 v / par #CPC 1105)
NO Green	Replaced 36G (2SC3467 Video NPN / par #CPQ1308)
Vert Distortion	Replaced cap 129A (cap 10 uF @ 50 v / par #CPC 1101)
Black on one side	Replaced 183 (150 uF @ 250 v / par #CPC1105
Vert Roll	Replaced 145 (PRA H Vert Control / par #CPR 0503) Found Q18 shorted
Black on one side	Replaced 286 (100 uF @ 25 v / par #CPC 1102)
Black Out- CHIRPING	Replaced 215 (150 uF 2 250 v / par #CPC 1105 Flyback cracked
Black 3/4 of screen	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Black Out	Replaced 182 (150 uF @ 250 v / par #CPC 1105) Replaced 317 (150 uF @ 250 v / par #CPT 1105)
Black on one side - fold over	Replaced 183 (150 uF 250 v / par #CPC 1105)
Bad Picture	Replaced 183 (150 uF @ 250 v /par #CPC 1105) 182 (150 uf @ 250 v / par #CPC 1105) Replaced 215 (150 uF 250 v / par #CPC 1105)
Bad Picture	Replaced 183 - top ready to blow off
bad picture	Replaced 183 (150 uF @ 250 v par #CPC 1105) almost looks like a bad PRA H 182 (150 uF 250 v / par #CPC 1105)
Black Out fast chirp	Now Slow Chirp Replaced 208 (.33 uF @ 50 v / par #CPC 1041) Replaced 286 (100 uF @ 25 v / par #CPC 1102)
Black 6.3 volts on 127v line	Replaced 148 (LA7850) Replaced 207 Replaced Flyback & Replaced 63 & 65
No Picture	Replaced 182- 183- 215
Vert & Horz Distortion	Found Leg broke off & Liquid coming out Replaced 182- 183 & 215 Replaced 186
Vert Fold over	Picture comes in slow now - left side fast Replaced 215 Replaced shorted Z-Diode 295
No Green & No Blue	Replaced 126
Black out	Replaced PRA H Replaced 191 & 192
Black out	Replaced Blown Fuse 183 Replaced shorted Trans, Mt4n45 195 Replaced 228 Z-Diode
Vert Roll no Sync	Replaced 99 98 & 105 Replaced bad cap 257
High Voltage OK Bad Picture	Replaced 182 - 183 & 215
Red colored screen	Replaced 286
White Flicking Screen	Replaced 280 (C5184)
Black Out	Replaced 81G
black out	Replaced 80 - 81 - 82 - 158 - 152
power up/ monitor shout down	Replaced Flyback Replaced 83 B
bad picture/ bad Vert	Replaced 83R - 83B
Vert roll	Replaced c59 - c8 - c14 - c44 - c - c15
black out	Replaced 192
retrace lines at top	Replaced PRA J
ok for a few min. then black	Replaced 191

Ceronix 1492

Black Out	Replaced 192 (LA7830 Vert. Output / par #CPI 1401) & 191 (220uF @ 35V / par #CPC 1103)
Black Out	Replaced 191 (220 uF @35v / par #CPC 1103) & 286 (100 uF @ 25v / par #CPC 1102)
Black Out	Replaced 192 (LA7830 Vert. Output / par #CPI 1401) & 191 (220 uF @ 35v / par #CPC 1103)
Black Out - Chirping	Replaced 191 (220 uF @ 35v / par #CPC 1103) & 192 (LA7830 Vert. Output / par #CPI 1401)
Black Out	Replaced 191 (220 uF @ 35v / par #CPC 1103) and 286 (100 uF @ 25v / par #CPC 1102)
Black Out	Replaced 286 (100 uF @ 25v / par #CPC 1102)
Vert Problems	Replaced 214 (PRA H Vert contorl / par #CPR0503)
Vert Roll - Jumping	Replaced 191 (Cap 220 uF @ 35v / par #CPC 1103)
Vert Roll - No Red	Replaced 191 (220 uF @ 35v / par #CPC 1103) Started Chirping fast - Replaced 286 (100 uF @ 25v / par #CPC1102)
Vert - Jitters	Replaced 214 (PRA H Vert Control / par #CPR0503) & 191 (220 uF @35v / par #CPC 1103)
Black Out Chirping fast	Replaced 286 (100 uF @ 25v / par #CPC 1102)
Jumping No Vert Hold	Replaced 191 (220 uF @ 35v / par #CPC 1103)
Too much blue	Replaced 90B (FDH 400 - .1a, 200v Diode - / par #CRD 1250) & 91B (2SA1370E - / par #CRQ 1309)
Black Out Chirping	Replaced 192 (LA7830 Vert Output / par #CPI 1401) & 191 (220 uF @ 35V / par #CPC 1103)
Black Out	Replaced 286 (100 uF @ 25v / par #1102) & 191 (220 uF @ 35v / par #CPC 1103)
Horz Size too narrow	Replaced 121 (.047 uF @ 50v - / par #CPC 1036)
Picture Jumping	Replaced 191(220 uF @ 35v / par #CPC 1103)
Black Out Chirping	Replaced 191(220 uF @ 35v - / par #CPC 1103) & 192 (LA7830 Vert Output - / part# CPI1401)
Black out - Chirping	Replaced 191(220 uF @ 35v - par #CPC 1103) & 192 (LA7830 Vert Output - / part #CPI 1401)
Vert Roll	Replaced 214 (PRA H vert control / par #CPR0503)
Picture shrinking (Vert Size)	Replaced 214 (PRA H Vert Control / Par #CPR 0503) Now Rolling & Jumping Replaced 215 (1000uF @ 35V- / par #CPC1104)
Black Out Chirping Fast	Replaced 286 (100 uF @ 25v - / par #CPC 1102)
Vert Size Prob - Vert Roll	Replaced 191(220 uF @ 35v / par #CPC 1103) and 214 (PRA H Vert Control / par #CPR 0503)
No Picture - No 127V	Replaced 280 (C5184 Custom P. S. IC / par #CPI 1403)
No Picture - Chirping	Replaced 191 (220 uF @ 35v / par #CPC 1103)
Red over white cards	Replaced 83G (2SC3467F / par #CPQ1308)
Vert Roll	Found Shorted Diode (Add On Mod) Replaced Diode
Vert Problems	Replaced 214 (PRA H Vert. Control / par #CPI 1407)
Black Out vert roll	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Black Out	Found Flyback cracked - Replaced 297 (Flyback transformer / par #CPT 1500)
Horz Distortion	Replaced 215 (1000 uF @ 35 v / par #CPC 1104)-
Black Out - Chirping	Replaced 191 (220 uF @ 35 v / par #CPC 1103) & 192 (LA7830 Vert Output / par #CPI 1401)
Black Out Chirping	Found Fly Back Cracked - Replaced 297 (Flyback transformer / par #CPT 1500)
Screen came up then faded out	Replaced 63 (PN2222A / par #CPQ1303) & 65 (MPSA64 / par #CPQ1302)
NO GREEN	Replaced 81G (Green Video Amplifier / par #CPR0500)
Vert Problems - Jumping	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Black out - Chirping	Found Flyback sparking on case Replaced 297 (Flyback transformer / par #CPT 1500)
Vert Roll	Replaced 214 (PRA H Vert output / par #CPR 0503)
Black Out fast Chirping	Replaced 286 (100uF @ 25 v / par #CPC 1102)
Vert Fold Over	Replaced 183 (.33 uF @ 50 v / par #CPC 1041)
Black on right side	Replaced 317 (150 uF @ 250 v / par #CPT 1105)
Black Out	Replaced 191(220 uF @ 35 v / par #CPC 1103)
Black Out Fast Chirp	Replaced 286 (100 uF @ 25 v / part CPC 1102)
Slow chirp	Replaced 191 (220 uF @ 35 v / par #CPC 1103) & 192 (LA7830 Vert Output / par #CPI 1401)
Black Out - Chirping	Replaced 192 (LA7830 Vert Output / par #CPI 1401)
Vert Roll	Replaced 214 (PRA H Vert Control par #CPR 0503)
Video Jumping	Replaced 214 (PRA H Vert Control / par #CPI 1401) & 191(220 uF @ 35 v / par #CPC 1103)
Black Out - Chirping	Replaced 191 (220 uF @ 35 v / par #CPC 1103) & 192 (LA7830 Vert Output / par #CPI 1401)
NO Green	Replaced 83G (2SC3467F / par #CPQ 1308)
Black Out Chirping	Replaced 286 (100 uF @ 25v / par #CPC 1102)
slow chirping	Replaced 280 (C5184 Custom P.S. IC / par #CPI 1403) NOW Vert problems Replaced 214 (PRA H Vert Control / par #CPR 0503)
Black Bars - Distortion	Replaced 178 (1K ohn / par #CPR 0009) & 183 (.33 uF @ 50 v / par #CPC 1041) - and 146 (LM324 Quad Op amp / par #CPI 1405)
Black Out - Chirping	Replaced 191 (220 uF @ 35 v / par #CPC 1103) - 192 (LA7830 Vert Output / par #CPI 1401) & 256 (150 uF @ 250 v / par #CPC 1105
NO RED	Replaced 83R (2SC3467 / par #CPQ 1309)

Vert Roll	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Black Out	Replaced 286 (100 uF @ 25 v / par #CPC 1102)
Black Out	Replaced 191 (220 uF @ 35 v / par #CPC 1103)
Vert Problems	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Black Out	Replaced 191(220 uF @ 35 v / par #CPC 1103)
Vert Problems - Jumping	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Vert Roll	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Vert Size problem	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Black Out - Fast Chirp	Replaced 288 (330 uF @ 100 v / par #CPC 1002)
Horz center problems	Replaced 230 (1 uF @ 50 v / art # CPC 1100) & 233 (1 uF @ 50 v / par #CPC 1100)
Vert Jump	Replaced 214 (PRA H Vert Control / par #CPR 0503)
Fast Chirp	Replaced 286 (100 uF @ 25v / par #CPC 1102)
Vert Jumping	Replaced 214 (PRA H Vert Control / par #CPI 0503)
Black Out Chirping	Replaced 192 (LA7830 Vert Output / par #CPI 1401)
Black Out	Replaced 286 (100 uF @ 25v / par #CPC 1102) - Now chirping Replaced 192 (LA7830 Vert output t/ par #CPI 1401)
Black Out	Replaced 286 (100 uF 25 v / par #CPC 1102) 127v@ 7.2v
Black Out - Chirping	Replaced 125 (10 uF @ 25 v / par #CPC 1101)
Vert Jumping	Replaced 215 (PRA H Vert Control / par #CPR 0503) Replaced 207 (100 uF @ 25v / par #CPC 1102)
NO GREEN	Replaced 112 (Flyback Transformer / par #CPT 1500)
Vert Roll	Replaced 4 (74LS04 / par #CPI 1410)
Black Out- Chirping	Found 182 cap - top ready to blow off
Red - comes and goes	Replaced 280 (C5184 Custom P.S. IC / par #CPI 1403)
Black Out	Replaced 286 (100 uF @ 25 v / par #CPC 1102) 191 (220 uF @ 35 v / par #CPC 1103) Replaced 83R (2SC3467F / par #CPQ 1308)
No Red	Replaced 286 (100 uF @ 25 v / par #CPC 1102)
Black Out	Replaced 286 (100 uF @ 25 v / par #CPC 1102) Replaced 286 (100 uF @ 25 v / par #CPC 1102)
Fast Chirp	Replaced C59 - C44 - C14
NO Green	Replaced 286 (100 uF 25 v / par #1102)
fast chirp	Now slow chirp Replaced 192 (LA7830 Vert Output / par #CPI 1401)
Vert Roll	Replaced 286 (100 uF @ 25 v / par #CPC 1102)
black out Fast Chirp	Now Vert Roll Replaced 214 (PRA H Vert Control / par #CPR 0503) Replaced 214 (PRA H Vert Control / par #CPR 0503)
Vert. Roll	Replaced Broken V size pot (500 ohm black pot / par #CPR 0413) Found Q18 shorted
Black Out	Replaced 286 (200 uF @ 25 V / par #CPC 1102)
Black Out No Chirp	Replaced 286 (100 uF @ 25 v / par #CPI 1401) (Power outage)
Black Out - fast chirp	now slow chirp (Power outage) Replaced 191 (220 uF @ 35 v / par #CPC 1103) & 192 (LA7830 Vert Output / par #CPI 1401)
Black Out fast chirp	Now slow chirp Replaced 191 (220 uf @ 35 v / par #CPC 1103) & 192 (LA7830 Vert Output / par #CPI 1401)
Black out fast chirp	Found Crack in Flyback (Replaced Flyback) Replaced 230 & 233
Black out	Replaced 91B PRA
1/4 x 1/2 Blue line	Replaced 183 - cap look like ready to BLOW
Black out & Fast Chirp	Now Slow Chirp
Black out	Replaced 145 PRA H
No Blue Now have Vert Roll	Replaced 214 PRA H
Power Up No Picture	Replaced Flyback Replaced 214 PRA H
Vert Roll	Replaced 286
Black out Chirping	Replaced 286 - power up OK
Black out	Replaced 183
Black out	Replaced PRA H
Black out	Replaced shorted Z-Diode 295 Replaced shorted NTE2398 268
Power up & shut down	Replaced C5184 280 Replaced 82B
No Color Green	Replaced 37R 37G 38R
Vert Roll	Replaced 183 (Cap Bad)
Horz center problem	Replaced 230 & 233 10uF @ 50v cap Replaced 182 - 183 & 215
Retrace lines	Replaced 286
Chirping then would come on	Now Vert Roll - Replaced PRA H Replaced PRA H
Horz Size	Replaced 165 Replaced C601 C602 C603 & C604
Black out chirping FAST	Now Retrace lines at top of screen Replaced 191 Replaced PRA H
Vert Jitter	Replaced Pot on remote control board Replaced 183
Horz position will not adjust	Replaced 230 & 233 Replaced 83B (C3467)
No Blue	Replaced 317 (Cap 100 uF 250v) Now Fast Chirp
NO Green	Replaced 83G (C3467)
Bad Picture Bad Focus	Replaced 192
Black out chirping	Replaced 280
Black out 7.5 v on 127 v line	Replaced 191 192 & 286
Black out	Replaced 233, 230 & 191 Replaced 192
Retrace lines	Replaced 191, 230 & 233 change 191 & 192
Vert Roll	Replaced PRA H
Black out then retrace lines	Replaced 191, 230 & 233 Replaced 191, 230 & 233 Replaced 191, 230 & 233
retrace lines	Replaced 191, 192
retrace lines	Replaced 286
black out	Replaced 83G
bright green	Replaced 286
no green - Some Vert jitters	Replaced cap on PRA H board Replaced 233 & 230 adjusted and Replaced PRA H board

unable to adjust picture Horz	Replaced 230 & 233
short Vert	Replaced 230 & 233
Can't adjust picture horiz	Replaced 286
black out	Replaced c71- c603- c601- c602- c604
no blue	Replaced remote board Replaced 215 - 183 - 182 - 125
	Replaced PRA H
bad picture	Replaced 146 - 144 - 125 no red - no blue Replaced Q23
Vert roll retrace lines	Replaced 191
no green	Replaced 83G 191 - 230 - 233 Replaced PRA h
retrace lines	Replaced 83r
Vert roll	Replaced PRA h
no red	Replaced PRA h
Vert roll retrace lines	Replaced 191 Replaced 192 Replaced 83R
black out - chirping	Replaced C610 - C615
no blue	Replaced 191
black out / 30v on 127v	retrace lines at top -
	Replaced 191 found neck board loose
black out slow chirp	Replaced PRA h
too much red	Replaced 122
no blue	Replaced 257
no blue	Replaced 126- also 125 178
black out	Replaced 125 207
black out then Vert roll	Replaced PRA h Replaced Flyback
Vert roll retrace lines	Replaced 191 Replaced PRA h
Vert roll Vert static	Replaced 215
retrace lines	Replaced 191 - 230 - 233 Replaced 83G
no green / too much red	Replaced PRA h
short picture - Vert roll	some retrace lines -
	Replaced 191 - 230 - 233 Replaced 1258 - 162
black out chirping then too much green -	
	found green PRA b board cracked Replaced PRA b
Black out - after a while it will start to chirp	
	Replaced 286 (Cap 100 uF 25 v) Replaced 83G (C3467)
power up, High pitch sound- Black out 295 shorted -	
	Replaced 245 Fuse Blown Replaced Replaced 286
	Replaced 601 - 602 - 603 - 604
24V on 127V line Powered up - Looked OK but after 2 min Black Out and strange Chirping Sound.	
	Replaced 286 (100uF 25 V cap)
	Now Slow Chirp Replaced 192 (La7830) Replaced 280
Ceronix 2793	
Blue retrace lines	Replaced 945 (MPS2907 / par #CPQ 1301) &
	951 (2SA1370AE / par #CPQ 1309)
Wells Gardner 3001	
Vert collapse	Replaced 286
Mini Bertha	
Black Out	Replaced 191(220 uF @ 35 v par #CPC 1103)
	192 (LA7830 Vert Output / par #CPI 1401)
	286 (cap 100 uF @ 25 v / par #CPC 1102)
Sigma TOEI	
Black Out	Replaced Q18 (D1455) Replaced - 286 (100 uF @ 25 v / par #CPC 1102)
Black Out	Replaced C40 - C51 - C50
Black Out	Replaced caps C50 - C51 - C40 - C28
	Powered up 2 picture @ bottom of screen -
	Did A Complete cap job & cap update - .
Black Out	Replaced Q23
Dark on left side	Replaced C40 - C28 - C50
Vert line in center	Found 182 - top of cap ready to blow off
Vert Roll	Replaced 308 (1 uF @ 50 v) 313 301 (220 uF @ 35 v) 302 (33 uF @ 25 v)
Picture OK High Pitch Sound	Replaced C59 C8 C44 C27 & C15 Replaced Flyback
Black out	Replaced Shorted Q23
Black Lines	Replaced 2SC945 also Caps - C7 (100 uF @ 25 v) C8 (47 uF @ 25 v)
Black Out	Replaced shorted Q23 Replaced 191 & some other old caps
black out high pitched sound	Good picture now just high pitch sound found cold solder joint on c59
	Replaced 192 board ok, Replaced CRT
hour glass picture	Replaced PRA h
black out	cap up date Replaced PRA h Replaced 601 - 602 - 604 - 603
Black Out	Replaced Fuse & Q23 (C2749)
power up, high pitched sound	Replaced caps checked ok
Vert Too Short	Replaced Q202 Total Cap Update
Black Out - High pitch Sound	Replaced Q18
Hour Glass Picture	Replaced C601 - C602 - C603 - C604
Black Out	Blown Fuse - Replaced Fuse & Q23 (C2749)
1 Inch of picture at top	Replaced 286 - Now Slow Chirp
Vert Size problem	Replaced 192 (LA7830 Vert Output / par #CPI 1401)

And finally . . .

Sigma monitor - Black out - found blown fuse

Found out Flyback was cracked and it was shorting to case, ***where I was holding it.***

Thought long and hard about just being a floor tech.
GIVE UP THE BENCH WORK....
I'm still here !!! On The Bench..... **- Robert Sult**

Introducing Sencore's HA2500 Horizontal Analyzer

How many times has this happened to you? You're working on a monitor with a straightforward problem; the SMPS audibly is chirping or ticking and you have a shorted horizontal output transistor.

You say to yourself "Easy fix . . . I'll slap in a new horizontal output transistor, replace the fuse and be outta here in fifteen minutes."

But when you fire up the monitor after replacing the bad component, the new part blows out before you have a chance to see what the heck is going on.

As we have seen in previous issues of Slot Tech Magazine, sometimes the switched-mode power supply's primary can fail, causing the B+ voltage to become too high. Of course, this should normally trip the x-ray protection circuit but you never know what kind of damage might be caused by a power supply gone haywire.

Wouldn't it be nice to have a substitute B+ power supply that could be used to power the monitor's deflection circuits independently of the monitor's own B+ supply? Wouldn't it be even better if the power supply's output voltage was adjustable? Ideally, this adjustable power supply would be current-limited as well. That way, you would prevent further burnouts.

Of course, in the past, when working on older monitors, you could use a variac to accomplish much the same task, turning up the AC voltage slowly while feeling (and smelling) for overheated components. But as Slot Tech Magazine readers know from previous articles on SMPS, you cannot use a variac when troubleshooting monitors with switching regulator power supplies. The power supply simply waits until the AC input voltage is sufficient then fires-up at the full B+ output.

HA2500

With this all-to-common problem in mind, Sencore has developed another piece of test equipment that is specifically designed for monitor repair. Dubbed the HA2500, it's a "Universal Horizontal Analyzer" that contains a number of different tools and tests (including a substitute B+ power supply) allowing you to pinpoint these tricky, high-current, "smoke 'em up" kind of problems. We'll start with an introduction to the features of the HA2500 and continue with a more detailed look at the substitute power supply. We'll examine the other tests and measurements in future issues of Slot Tech Magazine.

In a nutshell, the HA2500 provides analyzing tests and substitution capabilities to localize horizontal circuit defects. This generally works out much faster and cheaper than using conventional methods such as unsoldering components, firing the monitor up and seeing what smokes. Its tests isolate defects that often require many hours of expensive troubleshooting and/or component swapping.

If you really want to get sophisticated, the HA2500 can be synchronized to a video or RGB signal generator to become an integrated part of the service bench or it can be used for field servicing. Naturally, in the gaming industry you won't be performing any monitor repairs on the slot floor.

Features of the HA2500

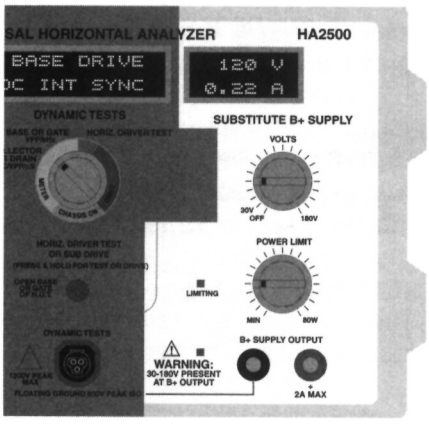
The substitute B+ Supply can be used to test the horizontal output stage to full potential when the chassis power supply is dead or suspected bad. This is a one-hundred percent way to absolutely determine that the power supply itself is at fault AND that the rest of the monitor (the video, sync, deflection, high voltage and CRT) are all working properly.

Also, the substitute power supply enables you to increase the voltage slowly in order to detect high voltage

breakdown failures and to troubleshoot shutdown, regulation, or other problem symptoms. These are the weird problems that fry stuff before you realize what's going on.

Another tool of the HA2500 is a "power-off" test of the horizontal output stage (the flyback transformer, horizontal deflection coil in the yoke and the flyback derived power supplies) to determine it's free of severe defects or if problems exist. This is a really clever test because it stimulates the operation of the horizontal output stage at 1/10 its normal level and analyzes the resulting currents and voltages.

The Load Test is valuable in determining if repairs are feasible without first repairing the power supply. It protects against damaging replacement parts by finding severe problems before power is applied. Of course, if everything in the horizontal output stage is okay, the HA2500 will tell you that as well. This means, of course, that you are free to fire-up the monitor at full power without worrying about letting the smoke out of the components.



The variable substitute B+ SUPPLY outputs 30 to 180 volts for substitution of the chassis B+ power supply to test horizontal stages and HV/ deflection regulators.

One of Sencore's most useful contributions to the world of troubleshooting is their "ringer test." The ringer test is THE way to test the yoke coils and transformers found in horizontal output stages. Several of the pieces of test equipment manufactured by Sencore incorporate the ringer test, including the HA2500.

Coils and transformers often fail from one or more internal wire turns shorting together. A shorted turn lowers the "Q of the inductor (a measurement of the "quality" of the coil that is not related directly to its inductance). At the same time, it lowers the efficiency of the circuit. This type of failure is difficult to confirm because it causes little change in the inductance or resistance of the coil. The ringer test easily identifies bad coils or transformers with shorted turns by sending out a pulse to the coil under test and measuring the return echos. It's like ringing a bell with a single blow of a hammer and listening to the bell as it resonates. The higher the quality of the bell, the longer it will sound. If the ringer test doesn't count at least ten return pulses, the coil is bad. This is a test that cannot be performed with any other type of test equipment.

The HA2500 also has some dynamic tests that analyze the input and output voltage parameters of the horizontal output stage. Of course, the term "dynamic" means "power-on" (as opposed to "static" testing which is done "power-off.") Autoranged measurements are displayed on the fluorescent panel and indicate if the horizontal input drive or B+ voltages are correct.

The horizontal driver test is really cool. It simulates a low impedance base/emitter horizontal output transistor junction and measures the output drive current capability of a horizontal driver stage. The test identifies horizontal driver stages with weak or reduced drive current output or intermittent drive current output, causing the horizontal output transistor to fail.

This tests for a REALLY sneaky type of failure where a weak or intermittent drive causes the horizontal output transistor to fail or overheat. Remember, the horizontal output transistor MUST be driven into full saturation in order to lower the Vce as much as possible. If the transistor is not driven to full saturation, a resistance is developed between collector and emitter. V=IR so the IR drop creates a much higher than normal power dissipation (P=IV) and that translates into BIG HEAT! By the way, if that last sentence didn't make any sense to you, don't sweat it.

The HA2500's "Sub Drive" feature provides a substitute horizontal drive that will drive either the base of a bipolar horizontal output transistor or the gate of a MOSFET output transistor. This is another extremely cool test as it allows you to isolate horizontal problems by driving the output stage with a known good signal.

Substituting for missing or suspected bad horizontal drive enables you to test the horizontal output components. Sub Drive isolates weak, intermittent, erratic or noisy drive signal problems which cause improper horizontal output operation and/or horizontal output transistor failure.

Using the substitute Power Supply

The HA2500's substitute B+ Supply permits testing of the horizontal output stage and high voltage/deflection regulators to full operating voltages independent of the chassis B+ power supply. This lets you identify defective high voltage components without risking damage to the chassis power supply.

The substitute B+ Supply helps troubleshoot breakdown failures of horizontal output components which result in high current loading of the chassis B+ supply at or near full operating voltages. Breakdown failures often quickly damage the horizontal output transistor and power supply components leaving little time to isolate the cause. By using the substitute power supply and gradually increasing the B+ supply voltage to the horizontal output stage, these problems can be isolated.

Other chassis symptoms can be isolated quickly with the substitute B+ Supply. Symptoms of reduced B+ voltage to the output stage, X-ray shutdown or momentary high voltage, vertical noises on the CRT picture, intermittents, start-up problems and others can be isolated quickly by substituting the B+ supply voltage horizontal output stage and HV/deflection regulator.

The HA2500's substitute B+ Supply is a variable DC power supply adjustable from 30 to 180 volts. It's designed to substitute for the full range of chassis B+ power supply voltages found in any brand or model.

The power output from the substitute B+ Supply is determined by the voltage selected with the VOLTS control and the amount of current flowing to the chassis (P=IV.) The substitute B+ Supply outputs over 80 watts for voltages greater than 40 volts. At voltages between 30 and 40 volts, the substitute B+ Supply output current is limited to 2 amps, reducing the total power output to 60 watts.

The POWER LIMIT control provides an adjustment to reduce the maximum power output of the substitute B+ Supply. At the "MIN" setting, the substitute B+ Supply outputs 3 watts or less. At mid-range, the maximum power output is reduced to 1/2 or 40 watts for voltages ranging from 40-180 volts. Limiting the output power causes the maximum current output of the substitute B+ Supply to change with the output voltage according to the power formula. For example, at an output of 160 volts, approximately .5 amps can be output (80 watts). At an output of 80 volts, approximately 1 amp can be output. As the POWER LIMIT control is reduced, the maximum output current is reduced accordingly.

A LIMITING light, located to the right of the POWER LIMIT control, illuminates when the output voltage times current of the substitute B+ Supply is greater than the POWER LIMIT setting. When in limiting, the substitute B+ Supply cannot further increase its output voltage or current. Increasing the setting of the VOLTS control during limiting does not increase the output voltage or the voltage shown in the digital display.

The fluorescent digital display above the VOLTS control indicates the voltage and current outputs of the substitute B+ Supply simultaneously. This is so darned handy! After working on a few monitors, you'll know exactly what's normal and what's not. This is also a great educational tool as well. Knowing exactly what's going on in a working circuit helps you pinpoint failures when things go awry. The voltage measurement is sampled at the B+ Supply Output Jacks for an accurate indication of the output voltage. The current readout indicates the level of output current from the substitute B+ Supply.

When the VOLTS Control is set to "OFF", the substitute B+ Supply output is reduced to near 0 volts. If connections are made from the B+ SUPPLY OUTPUT Jack to the chassis, the volts readout reads the voltage present at the chassis test points so you can use the HA2500 as a digital multimeter as well!

Next month: Understanding Chassis B+ Voltage Substitution

Datasheets

Generally speaking, if you're interested in electronics, you have to teach yourself how it all works. Oh, sure, you can go to a community college to learn the basics but I can almost guarantee that you will be disappointed. You will be loaded down with mathematical formulae from the get-go and, if you're a big fat ZERO at mathematics like I am, you will come away shaking your head after six months of struggles, thinking to yourself, "maybe electronics isn't for me after all."

You see, these types of courses generally are designed as beginning courses for those who want to become electronic engineers. As such, you WILL need to know all the mathematics. But what if you want to actually have fun with electronics? What if you want to be able to build small projects? What if you want to fix stuff? Do you really have to know Ohm's Law, Watt's Law, Kirchoff's Law, Thevenin's Theorem, Norton's Theorem (yes, there really is such a thing) and others in order to do what you want to do?

Another route to follow might be a vocational trade school such as DeVry or ITT Tech but here again, the final goal seems to be a beginning engineering level as the schools concentrate on theory and mathematics and, while there is some hands-on training, it all concentrates on how stuff works with virtually no emphasis on how stuff breaks or how to troubleshoot and repair. Heck, there's barely any soldering practice at all as these schools generally rely on "breadboarding," prototyping boards where circuits are built by simply pushing the component leads into small holes with no soldering required.

Of course, there is my Casino School and TechFest presentations that I hold periodically at various places around the country. The Casino School takes the opposite tack with absolutely no mathematics and heavy emphasis on how stuff works, how stuff fails how to troubleshoot it and how to fix it. But there's a limit to what can be covered in just one or two weeks.

Somewhere between long-term, formal training and my abbreviated Casino School course is really where you want to be. You'll need to spend your entire life learning about electronics because things evolve. New devices come into existence and old ones become obsolete. When you see a new device on a schematic diagram or in a piece of equipment, you need to be able to teach yourself what the part is, what it does and how to determine if it is good or bad. Nobody's going to teach you this stuff. You need to figure it out on your own. The primary way to do that is by looking at the data sheet.

Datasheets

The datasheet (sometimes written as two words, "data sheet") comes from the component's manufacturer. It contains all of the information about the part. Much of this information is geared toward the design engineer who will be designing a circuit around the component. He needs to know what the part does and its operating parameters. The parameters are things like the power supply voltage(s) that the component requires and its inputs and outputs. What support components does the device require?

Many of these parameters and specifications will be meaningless to us lowly technicians but there is still a lot of useful information that can be gleaned from a datasheet. With that in mind, let's take a look at some data sheets and see how we can interpret them. We'll take a look at a datasheet for a discrete component this month. In coming months, we'll look at datasheets for digital integrated circuits and linear integrated circuits.

Let's take a look at a data sheet for a discrete component. Let's say, for the sake of discussion, that you've come across a device in a TO-220 package with which you are unfamiliar. The part number is TIP122. It looks like a transistor but you have been fooled before and you know now that a package is just a package and that what's inside that TO-220 package (or any package, for that matter) might be a transistor, SCR, TRIAC or even an integrated circuit voltage regulator. You won't know what it is until you look it up by its part number. It doesn't test like a conventional transistor, that's for sure.

This datasheet comes from SGS-Thomson Microelectronics, a major manufacturer of this component. How did I know that? Often, the manufacturer's logo is printed on the component. If you don't recognize the logo, a quick websearch on Google (for TIP122) reveals all. The datasheet indicates that it covers the specifications for a family of components, not just for TIP122. It covers specs for TIP120/121/122 and for TIP125/126/127. You'll see why in a moment because the next part of the datasheet says "COMPLEMENTARY SILICON POWER DARLINGTON TRANSISTORS."

Let's dissect this phrase because it tells us quite a bit about the component in which we're interested. "Complementary" refers to two transistors with the exact same specifications but of opposite polarity. "Silicon" is, of course, the material from which the component is manufactured. A "power" transistor is one that can handle substantial amounts of current and is often used to drive loads such as coils, motors and lamps. "Darlington transistors" are really two transistors in a single package; they have very high "current gain" or "beta." Hmmm . . . Could that be why the device doesn't test like a normal transistor?

So, we've learned a lot about the part in just the first phrase on the datasheet. Next comes the description of the device(s):

"The TIP120, TIP121 and TIP122 are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration Jedec TO-220 plastic package, intended for

SGS-THOMSON MICROELECTRONICS

TIP120/121/122
TIP125/126/127

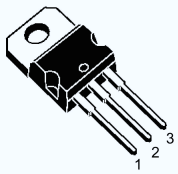
COMPLEMENTARY SILICON POWER DARLINGTON TRANSISTORS

- SGS-THOMSON PREFERRED SALESTYPES

DESCRIPTION

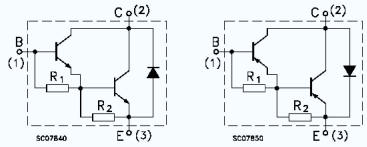
The TIP120, TIP121 and TIP122 are silicon epitaxial-base NPN power transistors in monolithic Darlington configuration Jedec TO-220 plastic package, intented for use in power linear and switching applications.

The complementary PNP types are TIP125, TIP126 and TIP127.



TO-220

INTERNAL SCHEMATIC DIAGRAM



R_1 Typ. = 5 KΩ R_2 Typ. = 150 Ω

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value			Unit
		NPN	TIP120	TIP121	TIP122	
		PNP	TIP125	TIP126	TIP127	
V_{CBO}	Collector-Base Voltage (I_E = 0)		60	80	100	V
V_{CEO}	Collector-Emitter Voltage (I_B = 0)		60	80	100	V
V_{EBO}	Emitter-Base Voltage (I_C = 0)		5			V
I_C	Collector Current		5			A
I_{CM}	Collector Peak Current		8			A
I_B	Base Current		0.1			A
P_{tot}	Total Dissipation at $T_{case} \leq 25$ °C $T_{amb} \leq 25$ °C		65 2			W W
T_{stg}	Storage Temperature		-65 to 150			°C
T_j	Max. Operating Junction Temperature		150			°C

* For PNP types voltage and current values are negative.

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.92	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
I_{CEO}	Collector Cut-off Current (I_B = 0)	for **TIP120/125** for **TIP121/126** for **TIP122/127**	**V**$_{CE}$ = 30 V V_{CE} = 40 V V_{CE} = 50 V			0.5 0.5 0.5	mA mA mA
I_{CBO}	Collector Cut-off Current (I_B = 0)	for **TIP120/125** for **TIP121/126** for **TIP122/127**	**V**$_{CE}$ = 60 V V_{CE} = 80 V V_{CE} = 100 V			0.2 0.2 0.2	mA mA mA
I_{EBO}	Emitter Cut-off Current (I_C = 0)	V_{EB} = 5 V				2	mA
$V_{CEO(sus)}$*	Collector-Emitter Sustaining Voltage (I_B = 0)	I_C = 30 mA for **TIP120/125** for **TIP121/126** for **TIP122/127**		 60 80 100			 V V V
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	I_C = 3 A I_C = 5 A	I_B = 12 mA I_B = 20 mA			2 4	V V
$V_{BE(on)}$*	Base-Emitter Voltage	I_C = 3 A	V_{CE} = 3 V			2.5	V
h_{FE}*	DC Current Gain	I_C = 0.5 A I_C = 3 A	V_{CE} = 3 V V_{CE} = 3 V	1000 1000			

* For PNP types voltage and current values are negative.

use in power linear and switching applications. The complementary PNP types are TIP125, TIP126 and TIP127."

"Epitaxial" refers to a fabrication method whereby thin layers of silicon are vapor-deposited on the silicon substrate (the silicon wafer from which everything is made). As a technician, you don't care about this at all. "Monolithic" literally means "one stone" as the component is made from a single, tiny chip of silicon. You can see this for yourself by cutting open a transistor. You'll see the little silicon chip inside the much larger package.

"JEDEC" stands for "joint electron device engineering council." It is the semiconductor engineering standardization body of the Electronic Industries Alliance (EIA), a trade association that represents all areas of the electronics industry. JEDEC was originally created in 1960 to cover the standardization of discrete semiconductor devices and later expanded in 1970 to include integrated circuits.

Finally, the description goes on to say, "The complementary PNP types are TIP125, TIP126 and TIP127." That explains the two sets of part numbers. TIP120, TIP121 and TIP122 are NPN while TIP125, TIP126 and TIP127 are PNP.

Next comes the internal diagram where we clearly see why our component doesn't test as a normal transistor does. The schematic shows us that not only do we have the two transistors inside the TO-220 package but that there is a diode in there as well connected between the collector and emitter lead. That will surely change the way the device tests. Additionally, we can see a pair of resistors in the device, connected between the base and emitter of each of the two internal transistors. That will surely skew our readings when checking the reverse-biased (non-conducting) mode of the device between base and emitter. What might otherwise be interpreted as leakage becomes normal once we know about these internal resistors.

Next, we see a table for the ratings of the devices. Again, this instantly answers the question of the six different part numbers. We can see that the different numbers are for different voltage ratings and polarities. TIP120, TIP121 and TIP122 are NPN transistors at 60, 80 and 100 volts respectively while TIP125, TIP126 and TIP127 are PNP at 60, 80 and 100 volts.

There are other specifications listed as well but as Slot Tech Magazine readers know, there are really only three that we, as technicians, really care about: V_{ceo}, I_c and h_{FE}. The rest of the specs are important to design engineers but not to us techs.

Available OnLine

Naturally, datasheets are now available online. Each semiconductor manufacturer posts their data sheets (typically in pdf format) at their own website. Another source for datasheets is a website at http://www.datasheetlocator.com/. This is actually a shell that either allows you to type in a part number which it passes to the actual manufacturer's website, gathers the data and returns it to you or simply opens up a new window with a frame that carries the actual manufacturer's website.

Another source is NTE. Of course, NTE is well known to everyone in electronics as a prime source for replacement components. When you find a bad diode, transistor or other semiconductor, chances are pretty good that you will not obtain the OEM (original equipment manufacturer) component but rather a replacement substitution component. At the NTE website (http://www.nteinc.com), you can take advantage of their extensive library of datasheets by typing in the OEM part number and looking at the datasheet for its NTE substitution. The specs will be, for all intents and purposes, identical.

Visit the website at slot-techs.com

Slot Tech Magazine's

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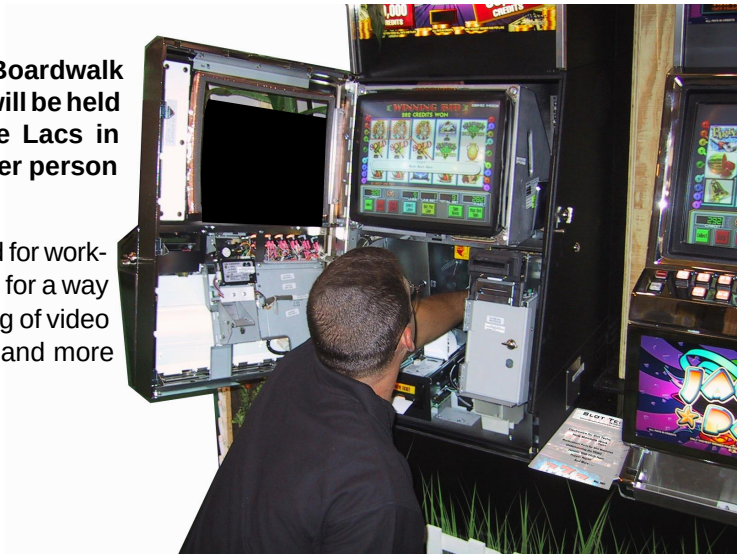

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Wednesday, August 14th, 2002
Tuesday, October 22nd, 2002

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

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

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

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

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

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

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

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

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

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

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

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Space is limited - Register today!

TechFest 1 and 2 were both sold-out events.

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Randy Fromm's
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