Slot Tech Editorial

I've been waiting for someone to contribute an article on electronic ballasts and, as usual, Herschel Peeler comes through with a vengeance. In this month's look at Aristocrat DC Ballast 430946 and 430959, Mr. Peeler has even provided us with a reverse-engineered schematic diagram so we can understand how the unit operates and how to repair it when it fails. We should all know how these devices, also known as "inverters" operate as inverter failure is a common thread in both standalone lighting and the illumination (backlighting) in LCD monitors. In many cases, when you have an LCD panel failure, it's not the LCD itself that has failed, it's simply the inverter that drives the backlighting. The image is there; you just can't see it. It kills me to see a casino send in an LCD panel for repair (or >gasp< buy a new monitor for $2500) when the repair can be effected so easily and cheaply in many cases.

In a double-header for this final issue for 2004, Herschel also presents an overview of job descriptions, testing and training in an article entitled "Job Descriptions, Testing and Training." Flip to page 26 if you want to skip the technical and go directly to the Slot Tech Management series.

Have you been following John Wilson's series on slot machine mathematics? It's not as difficult as you thought, is it? In fact, it's all pretty interesting. But all good things must come to an end and so, Mr. Wilson's saga, The Big, the Bad and the Bonus comes to a close this month with part 5 in which you complete the Max Millions project and fly to a desert island to live with Elvis.

In this month's Slot Tech Electronics 101, we take a look at a potentially destructive force called "inrush current." As the name implies, this is a surge of electric current that can rush into a circuit and cause destruction. What causes the inrush current and what can be done to mitigate its destructive effects or prevent them altogether? Turn to page 33 - What a Rush!

That's all for this month. Happy holidays to all. I'll catch up with you in 2005 with a report on the record-setting TechFest 10.

Oh . . . Just kidding about the Elvis thingy.

Randy Fromm

Randy Fromm - Publisher

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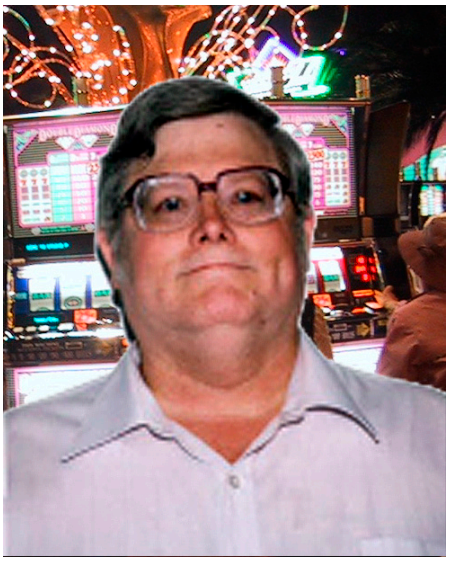

Aristocrat DC Ballast 430946 and 430959

By Herschel Peeler

These assemblies are purchased by Aristocrat, not designed by them, so documentation is harder to find. The original equipment manufacturer's part number for the 15-Watt lamp version, 430946 (Aristocrat), is EB2415A (Setec Pty. Ltd). The 6-Watt version, 430959 (Aristocrat), is EB246A (Setec Pty. Ltd). The assemblies are similar in operation but not interchangeable. The Setec part number breaks down simply: "EB" for Electronic Ballast, "24" for the voltage it runs on, followed by "6" or "15" for the lamp wattage it is intended to drive. Most of the parts are generic and clearly labeled.

We will first describe the 15-Watt version, then the 6-Watt by noting the differences. We will cover circuit operation, then common failures. An elaborate test fixture is not required. All that is needed to bench test these assemblies is a 24-volt power source capable of about 1 Amp (actually 0.75 Amps for the 15-Watt or 0.32 Amps for the 6 Watt) and a lamp (15-Watt or 6 Watt). A bench grade power supply with meters for current and voltage is suggested but not required. If you buy everything you need cheaply enough, this is another of those $10 test fixtures. Ours was built out of scrapped cables and cost us $0.00 using the bench power supply. The connectors going to the fluorescent lamp are 0.093" Molex female pins with no housing, just heat shrink tubing. The same connectors fit both the F15T8 and F6T5 so the same cable setup can be used for either.

With the exception of the transformer, all the parts are cheap, making this a repairable item in my book. It is a bit more elaborate than the design IGT uses and seems to have a much lower failure rate.

The Design

The main IC used is a Pulse Width Modulator, part number SG3525AN. "SG" is just the manufacturer's designation. "AN" designates the 16-pin DIP package. "3525" is the actual meaningful part number. This integrated circuit is kin to the ever-popular 3524 used in many other assemblies by a dozen other power supplies. If you know one well, the other is easy.

The 3525 is basically an oscillator with two alternating outputs, "Out A" and "Out B." These pulse high one at a time. "Out A" turns on Q1. "Out B" turns on Q2. Q1 and Q2 drive the primary winding of the transformer that has two windings. This is a "pseudo-sinewave" generator that fakes an AC-like input to the transformer. The frequency is set at around 55 KHz. Feedback is provided by the circuitry made up of D4, D5, C16, D9, Q4, R15, C7 and D1. The pulse width varies slightly during operation and looking at it with a scope you will see a little jitter during operation. This is normal.

The transformer has two outputs. One goes to D11, C3, C4, C5 and C6, and should be +24 Volts DC at the cathode of D1 or the positive side of C3, C4 or C5. The other transformer output is about 150 V AC (Peak-to-Peak if measured with a scope) or about 50 V RMS (if measured with a meter). This output powers the fluorescent lamp. At 55 KHz you may not be able to get a good meter read-

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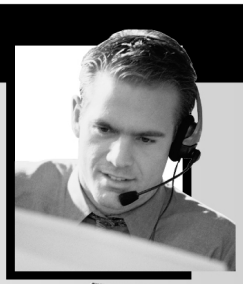

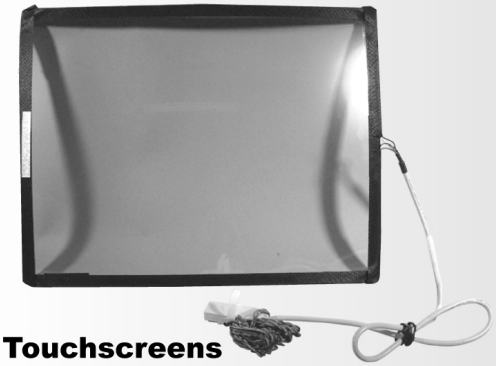

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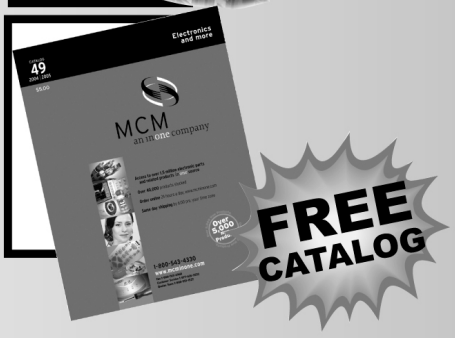

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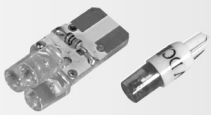

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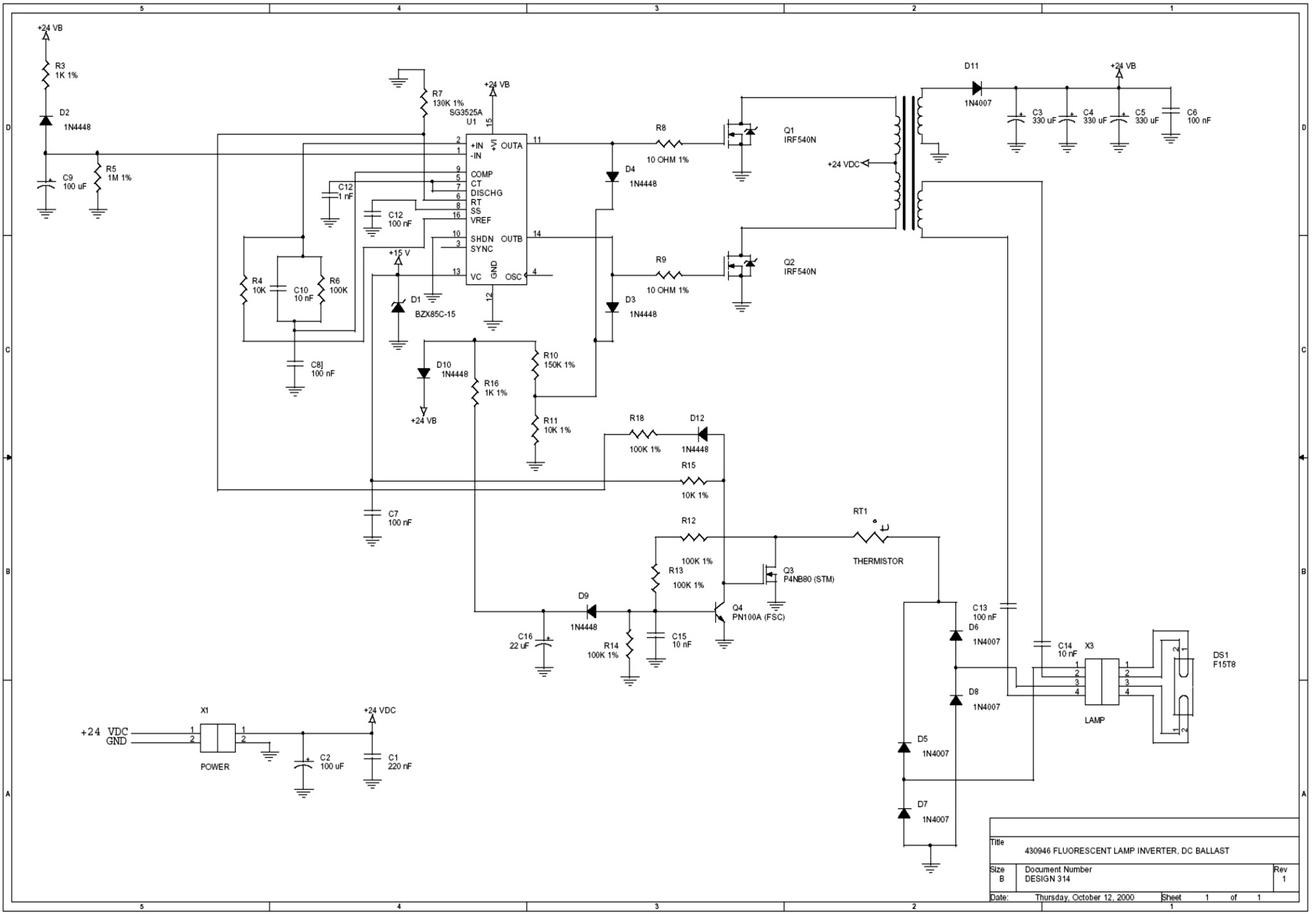
+24 VB
R3 1K 1%
D2 1N4448
C9 100 uF
R5 1M 1%
R7 130K 1%
SG3525A
U1
+IN
-IN
COMP
CT
DISCHG
RT
SS
VREF
SHDN
SYNC
VC
GND
+VI
OUTA
OUTB
OSC
C12 1 nF
C12 100 nF
C12 100 nF
+15 V
D1 BZX85C-15
R4 10K
C10 10 nF
R6 100K
C8] 100 nF
R8 10 OHM 1%
R9 10 OHM 1%
D4 1N4448
D3 1N4448
Q1 IRF540N
Q2 IRF540N
+24 VDC
D11 1N4007
C3 330 uF
C4 330 uF
C5 330 uF
C6 100 nF
D10 1N4448
R16 1K 1%
R10 150K 1%
R11 10K 1%
R18 100K 1%
D12 1N4448
R15 10K 1%
C7 100 nF
R12 100K 1%
R13 100K 1%
RT1 THERMISTOR
Q3 P4NB80 (STM)
D9 1N4448
Q4 PN100A (FSC)
C16 22 uF
R14 100K 1%
C15 10 nF
C13 100 nF
D6 1N4007
D8 1N4007
D5 1N4007
D7 1N4007
C14 10 nF
X3
LAMP
DS1 F15T8
X1
+24 VDC
GND
POWER
C2 100 uF
+24 VDC
C1 220 nF
Title
430946 FLUORESCENT LAMP INVERTER, DC BALLAST
Size B
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Rev 1
Date: Thursday, October 12, 2000
Sheet 1 of 1

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ing, depending on the quality of your meter (in general, digital multimeters are looking for 50/60 Hertz, sinewave AC in order to provide a true RMS reading). This should look like a good sine wave on the oscilloscope. This AC voltage passes through a couple of capacitors (C13 and C14) before going to the lamp connector. Measured at the lamp, this should be about 45 V AC between pins 2 and 4 of the connector. Pins 1 and 3 of the connector should measure about 0.7 Volts to 1 Volt AC.

The lamp is turned on by Q1 (a P4NB80 N-channel MOSFET) that sits inside a bridge of rectifiers made of diodes D5, D6, D7 and D8. Thermistor RT1 should protect Q3 from overloading at high currents but . . . well, the world is not perfect. Q3 is driven from Q4 (PN100A, an NPN transistor) that is part of our feedback loop. Putting Q3 (that runs on DC) inside a diode bridge allows it to control an AC signal. A neat trick worth spending a paragraph on.

Lamp Current Circuit

Looking at the output of the high voltage winding, we have AC. Assuming the negative on the top wire (as shown in the picture) and positive on the bottom wire, let's look at the "electron current" flow. Current flows out of the negative side, through C14, pin 2 of the lamp connector, one side of the heater of the lamp, pin 1 of the connector, through D7, up through Q3, through the thermistor, through D6, pin 3 of the lamp connector, through the other heater, pin 4 of the lamp connector, C13, and back to the lower (positive) side of the transformer winding.

During the following half-cycle, the top wire is positive and the lower wire is negative. Current flows through C13, pin 4 of the lamp connector, one heater of the lamp. pin 3 of the lamp connector, D8, up through Q3, the thermistor, D5, to pin 1 of the lamp connector, the other lamp heater, pin 2 of the lamp connector, C14 and back to the upper (positive) side of the transformer winding.

We have AC going through the lamp being controlled by a MOSFET transistor that is passing DC. This circuit was worth getting familiar with because most failures occur in this circuit.

About the Resistors

Most of the resistors are 1% types. These have five bands instead of the usual four bands you find on 5% resistors. Reading them is similar. Instead of two significant digits and a multiplier, we have three significant digits and a multiplier. Brown, Black, Black, Red would be 1,0,0 followed by two zeros, or 10K Ohms.

Personally, I see nothing in this circuit that requires 1% values. I would be tempted to use 5% values for repairs. There is probably a valuable lesson for me in there somewhere but I haven't had to replace a bad resistor on this board yet so I haven't learned it. I just don't see the need for precision values in this circuit.

The 3525 circuit

Going around the 3525, Pins 1 and 2 are the inputs to the Error Amplifier. Pin 3 is the Sync input (not used). Pin 4 is the Oscillator output (also not used). Pins 5, 6, 7 and 8 are the oscillator circuit. Major frequency determining components are C8 and the resistors around it. Pin 10 is Shutdown (also not used). Pin 9 is frequency compensation and C8 determines how quickly the Error Amplifier will respond to changes in operating conditions. Pin 16 is the Reference Voltage output of the 3525 and should be 5.1 Volts, plus or minus 1% (or the 3525 is bad). The reference voltage powers the Oscillator section of the 3525 so the oscillator should be fairly steady over broad swings in power supply changes. Pin 13 is the Collector Supply Voltage and should not be more than 15 Volts in this design. During operation, it should read close to +15 Volts. This voltage is also the high side of the output drivers. Pins 4 and 11 are our two outputs. These can drive actively High (+15 Volts) or Low but should alternate. They should not both be High or Low at the same time or the 3525 is bad. Pin 15 is +24 Volts, supplied to power the Error Amplifier in the 3525. Pin 12 is ground.

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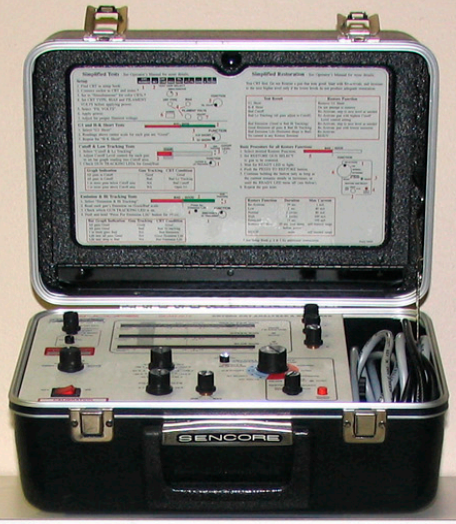

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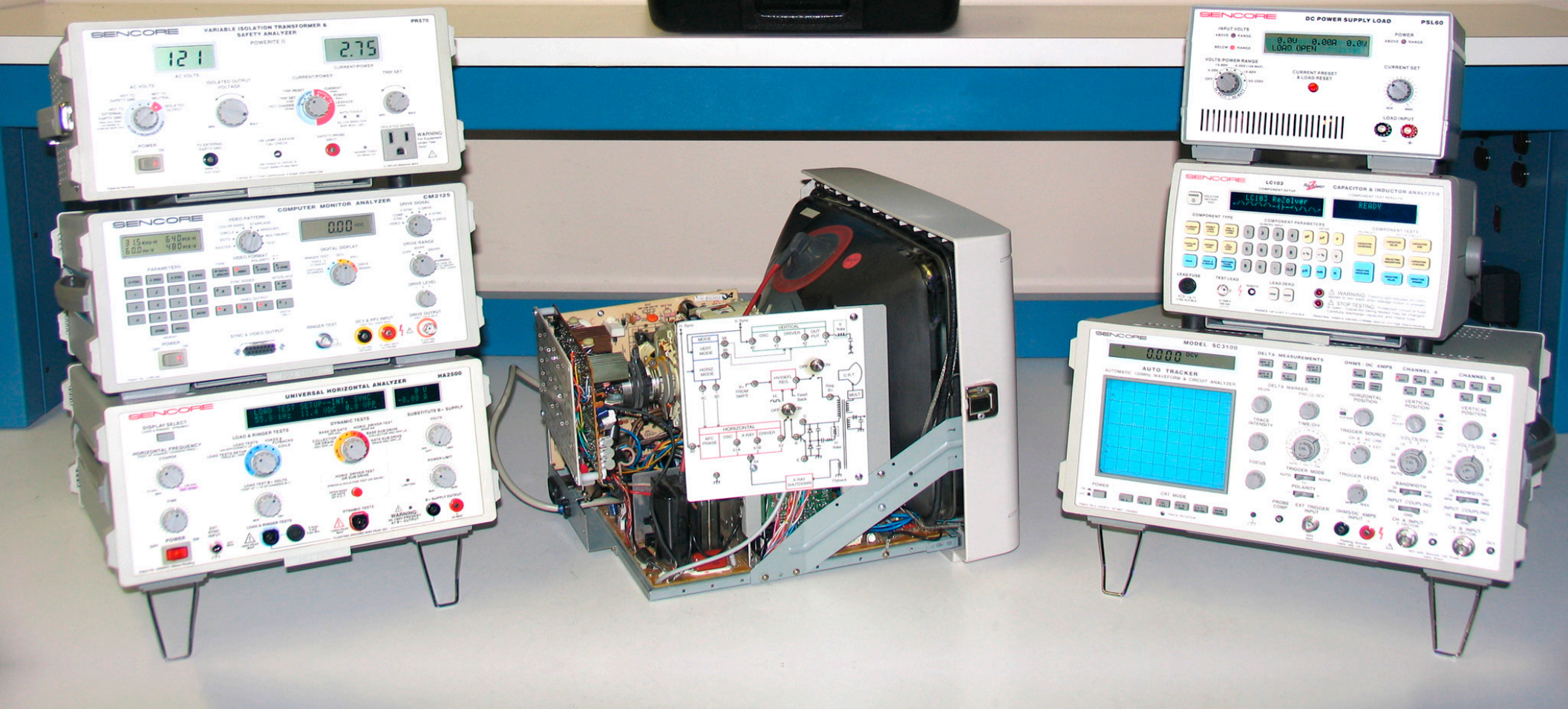

SG3525A

Pulse Width Modulator Control Circuit

The SG3525A pulse width modulator control circuit offers improved performance and lower external parts count when implemented for controlling all types of switching power supplies. The on−chip +5.1 V reference is trimmed to ±1% and the error amplifier has an input common−mode voltage range that includes the reference voltage, thus eliminating the need for external divider resistors. A sync input to the oscillator enables multiple units to be slaved or a single unit to be synchronized to an external system clock. A wide range of deadtime can be programmed by a single resistor connected between the C_T and Discharge pins. This device also features built−in soft−start circuitry, requiring only an external timing capacitor. A shutdown pin controls both the soft−start circuitry and the output stages, providing instantaneous turn off through the PWM latch with pulsed shutdown, as well as soft−start recycle with longer shutdown commands. The under voltage lockout inhibits the outputs and the changing of the soft−start capacitor when V_{CC} is below nominal. The output stages are totem−pole design capable of sinking and sourcing in excess of 200 mA. The output stage of the SG3525A features NOR logic resulting in a low output for an off−state.

- 8.0 V to 35 V Operation
- 5.1 V ± 1.0% Trimmed Reference
- 100 Hz to 400 kHz Oscillator Range
- Separate Oscillator Sync Pin
- Adjustable Deadtime Control
- Input Undervoltage Lockout
- Latching PWM to Prevent Multiple Pulses
- Pulse−by−Pulse Shutdown
- Dual Source/Sink Outputs: ±400 mA Peak

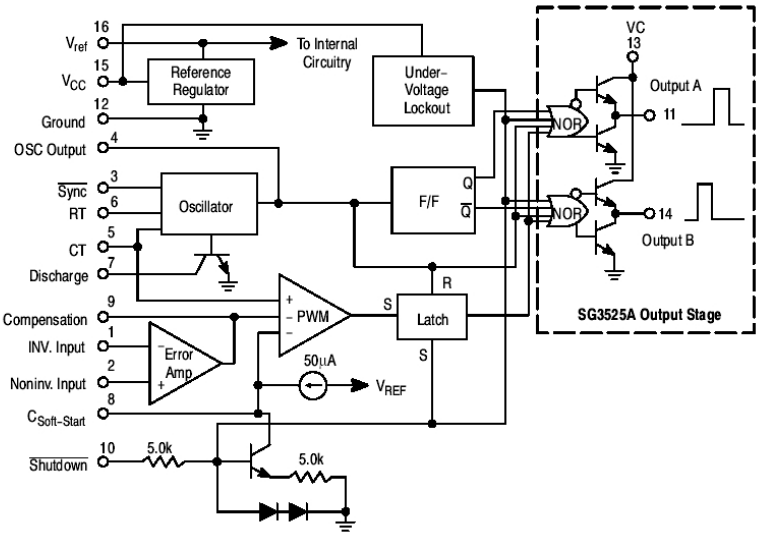

Figure 1. Representative Block Diagram

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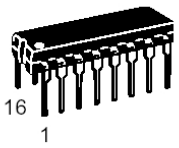
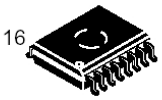


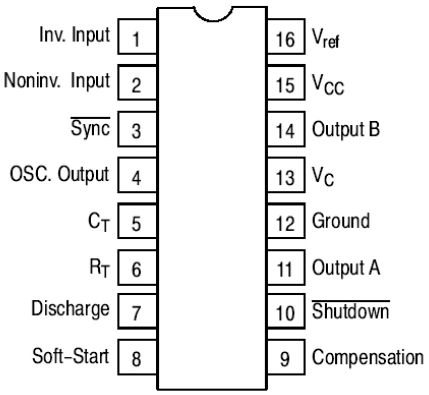
PDIP−16
N SUFFIX
CASE 648



SO−16L
DW SUFFIX
CASE 751G

A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week

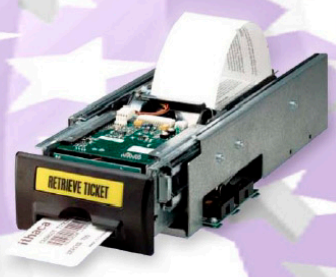
PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

Device	Package	Shipping
SG3525AN	PDIP−16	25 Units/Rail
SG3525ADW	SO−16L	47 Units/Rail
SG3525ADWR2	SO−16L	1000 Tape & Reel



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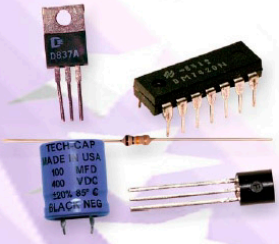

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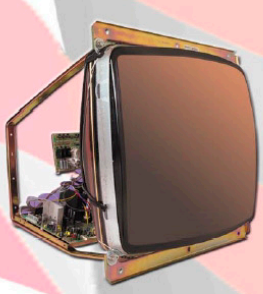

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Quick Voltage Checking Points

The Drain (tab) of Q1 and Q2 should read about 24 VAC with a meter or about 50 VAC Peak-to-Peak with an oscilloscope. If you don't see AC here, the 3525 is not operating. While one primary coil is collapsing the other is expanding. This actually gives us a primary voltage of around 50 VAC as the two voltages add together.

Pin 1 of the 3525 should be +24 VDC. This comes from the +24 Volt output of the transformer. The cathode of D11 should be +24 V DC but you may not get a good reading of AC at the anode, again because of the high frequency. This +24 VDC is filtered by C3, C4, C5 and C6, which are all in parallel.

Pin 15 should read 15 Volts. This is the high rail side of the output drivers so if it is incorrect, so will the output's high side.

Coming out of the high voltage winding, you should see around 50 VAC with a meter or 150 V AC P-P with a scope. With no lamp connected, this may be 500 to 600 Volts! Always run this board with a proper lamp connected!

Between the ends of the lamp, you should see around 45 to 50 VAC. Across each filament at the end of the lamp you should see around 0.7 V AC.

Most Often Failed Components

Q3. The P4NB80 by STM. You can find the data sheet on the STM web site. I could not find an NTE cross-reference for this puppy. I left an e-mail for NTE to suggest a cross-reference but got no answer back as of the time this article was submitted for publication. It is an N-Channel MOSFET rated at 800 Volts at 4 Amps, well above the 50 Volts the fluorescent lamp normally runs on. As the lamp goes bad and flickers, the voltage spikes to 500 to 600 VAC, which can stress this transistor, causing failure. *Change the lamps when they start blinking, please!* The same thing causes most failures on IGT DC Ballasts and probably anyone's as well.

Blinking lamps are not just unpleasant; they cause voltage spikes that take out the DC Ballasts. The magnetic fields (EMI) from the high voltage spikes also can reek havoc with other circuits in the game.

Differences Between the 6-Watt and 15-Watt Designs

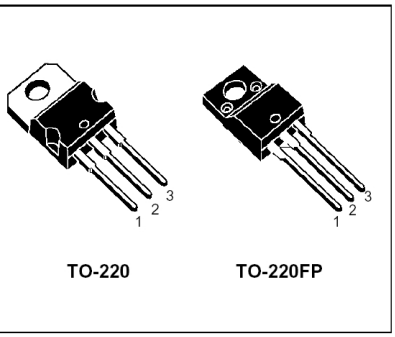
On 6-Watt ballasts, C14 is a 6.8 nF (as opposed to a 10 nF). C3, D12 and R18 are not

STP4NB80
STP4NB80FP

N - CHANNEL 800V - 3Ω - 4A TO-220/TO-220FP
PowerMESH™ MOSFET

TYPE	V_{DSS}	$R_{DS(on)}$	I_D
STP4NB80	800 V	3.3 Ω	4 A
STP4NB80FP	800 V	3.3 Ω	4 A

- TYPICAL $R_{DS(on)}$ = 3 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED



TO-220 TO-220FP

DESCRIPTION

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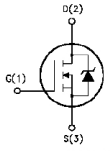
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STP4NB80	STP4NB80FP	
V_{DS}	Drain-source Voltage (V_{GS} = 0)	800		V
V_{DGR}	Drain- gate Voltage (R_{GS} = 20 kΩ)	800		V
V_{GS}	Gate-source Voltage	± 30		V
I_D	Drain Current (continuous) at T_c = 25 °C	4	4(*)	A
I_D	Drain Current (continuous) at T_c = 100 °C	2.4	2.4(*)	A
I_{DM}(•)	Drain Current (pulsed)	16	16	A
P_{tot}	Total Dissipation at T_c = 25 °C	100	35	W
	Derating Factor	0.8	0.28	W/°C
dv/dt(1)	Peak Diode Recovery voltage slope	4.5	4.5	V/ns
V_{ISO}	Insulation Withstand Voltage (DC)	—	2000	V
T_{stg}	Storage Temperature	-65 to 150		°C
T_j	Max. Operating Junction Temperature	150		°C

used on the 6-Watt version.

Caveats, Disclaimers and Helpful Suggestions

These drawings were made by reverse-engineering the board and I confess to not spending a lot of time on the parts of the circuit that seldom fail, notably the area around U1. Don't be surprised if you find errors.

If you replace the IC, install a socket. This is generally a good idea. Changing the IC puts the board under stress. Changing the IC twice usually ruins the board, unless you are very good. Installing a socket makes later changes no stress on the board at all.

Remove the IC by cutting the leads off as close to the IC body as possible. The leads can then be removed one at a time with less stress to the board. ICs are cheap. Boards are expensive. Spare the board as much stress as possible.

Parts List, substitute parts and available sources

U1

SG3525AN, 16-pin DIP
(substitute xx3525xx as long as it fits, NTE1721, or anything that crosses to NTE1721)
(511-SG3525AN, Mouser, $0.70)
(511-SG2525AN, Mouser, $0.74, improved temperature range)

(235328 from Jameco (UC3525AN, $0.62 ea, $0.58 @10 BEST PRICE!) The catalog may say it is an 8-pin device but if you go to the data sheet, you realize it really is the 16-pin creature.

Q1, Q2
IRF540N, N-Channel MOSFET, TO-220
(substitute NTE2396)

(512-IRF540N from Mouser, $1.78)
(210518 from Jameco, $1.05 ea, $0.95 @ 10)

Replace them both if you replace one. Use a matched set or at least two with the same batch code.

Q3
P4NB80, N-Channel MOSFET, TO-220 (by STM, STP4NB80)
(511-STP4NB80 from Mouser, $1.64)

Q4
PN100A, NPN, TO-92
(substitute NTE123AP, 2N3904, or equivalent. Most

any NPN TO-92 with the same pinout will probably work.)
(512-PN100A from Mouser, $0.10)

D1
BZX85C-15, 15 Volt Zener Diode
(substitute NTE145A, 1N3683A, 1N4744A)
(512-BZX85C15 from Mouser, $0.10)
(512-1N4744A from Mouser, $0.09)

D2, 3, 4, 9, 10, 12
1N4448, general purpose silicon signal diode
(substitute 1N4148, 1N914, NTE519, or equivalent, used in everything I think. Keep a hundred on hand)

D5, 6, 7, 8, 11
1N4007, general purpose 1 Amp 1,000 Volt silicon rectifier
(substitute NTE145, or equivalent)
(512-1N4007 from Mouser, $0.05)
(583-1N4007 from Mouser, $0.04)

Keep a hundred on hand. They are used in everything.

Connectors are Molex Mini-Fit family.

Sources of Data Sheets

Other than the manufacturers' web sites, there are a number of general sources of data sheets if the manufacturer can't be identified.

www.alldatasheet.com (tons of data sheets)
www.web-ee.com (very educational also)
www.jameco.com
www.mouser.com
www.digikey.com
http://us.st.com/stonline/index.html for ST Microelectronics (STM, was SGS/Thomas)

Original Manufacturer:
Setec Pty Ltd
19 Henderson Rd.
Knoxfield VIC 3180, Australia
Po Box 509
Ferntree Gully Business Center, VIC 3156, Australia

+61 3 9763 0962 voice
+61 3 9763 8789 fax
www.setec.com.au

Don't forget, you can always Google the part number.

- Herschel Peeler
- Hpeeler@slot-techs.com

For schematic diagrams, service manuals and more, visit the Slot Tech Magazine FTP site.

Point your ftp client to:
slot-tech-ftp.serveftp.com
username = Slot Tech
password = kxkvi8

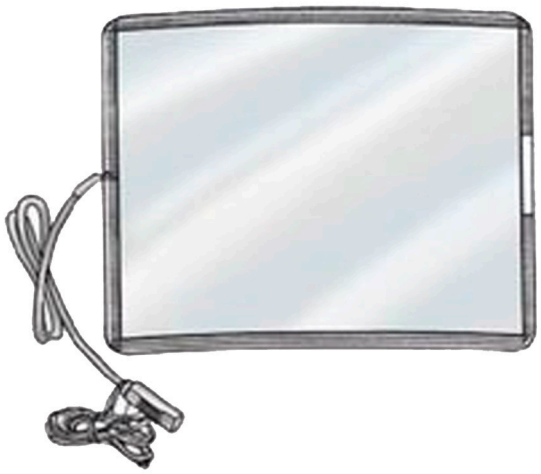
Bulb, Be Gone!

MCM Stocks LED Replacements for Incandescent Lamps

LEDTECH brand LEDs are designed to be drop-in replacements for incandescent bulbs in gaming machine buttons and other lighting applications such as bill validators.

LEDs are a popular alternative to incandescent bulbs because they have a 100,000 hour average life span. An increasing number of gaming manufacturers are beginning to use LEDs in new machine production and many casinos are retrofitting to LEDs as bulbs are replaced in existing machines.

MCM stocks the most popular colors and sizes or the LEDs can be custom designed to any color or brightness. LEDTECH LEDs are over-voltage protected for additional product life.



Replacement Touchscreens Offered

MCM has expanded its line of gaming products to include capacitive touchscreens.

Designed to be a drop-in replacement for 3M MicroTouch[tm] touchscreens, they are universally compatible with the 3M MicroTouch[tm] Controller. The electronics are baked into the edges of the glass, not taped on, making them ideal for high use, high abuse public access environments where added durability is a key requirement. In addition, the adapter is removable so it can be reused. An adapter cable is available to allow the touchscreens to work with older machines. With MCM's high quality drop-in replacement products which are designed to integrate seamlessly into any current project, customers now have an alternative supplier of touchscreens.

MCM offers one of the most comprehensive, competitively priced, capacitive touchscreen product lines on the market today.

For more information, contact:
MCM an Inone Company
650 Congress Park Drive
Centerville, Ohio 45459-4000
937-434-0031
800-543-4330
www.mcminone.com

The Bonus Part 5 of 5

The Big, The Bad and

By John Wilson

When we last saw our dynamic duo, it appeared that things were in a tail spin. Were the walls about to come crashing down? Had they overlooked some vital mathematical calculation? Were they about to become greeters for a major department store chain?

All of a sudden, the CEO gets a worried look. He stands up and exclaims, "Oh, no! This isn't right. We've made a big mistake somewhere. What are we going to do?"

"What's wrong, Boss?" you ask.

"Your PAR sheet. It can't be right. You show the cycle there - with payout percentage. The total coins in is 1.8 million, and the coins out 1.76 million!"

"Uh, right. That gives us 92% of coin in paid back out to the player."

"That's right. But the bonus game pays out 4 million credits. We aren't taking that into account. We take in 1.8 million but we haven't paid out the bonus. That would mean we pay out 4.76 million coins plus the other bonus amounts. Oh, no. Tell me that I'm missing something. The bonus game pays out 7.5 million coins, doesn't it? This explains why our test results came up outside of the range in the Volatility Index calculation." He sits down, shakes his head and looks down at the table. Silence fills the room.

You take a moment to catch your breath as you have a sudden rush of fear that perhaps you did miss something key to the design of the game. No, you think, it's exactly as it should be. You wait for the tension to drop down and take a deep breath.

"Actually, Sir, that's not correct. I do see what you are thinking and at a glance it looks like a major problem has developed. However," you reassure, "the figures are exactly like they should be."

The CEO looks confused and asks, "I don't mean to ask a stupid question, but can you explain where I've gotten lost here?"

"The only stupid question is a question you don't ask. It's easy to get lost here so I will review the math for you. I think that you understand the concept of the base game - 72 symbols on 3 reels, 72 x 72 x 72 = 373,248 total combinations available. Five coins per game is 5 x 373,248 = 1,866,240 coins taken in per cycle at maximum coins played. Paying out 1,720,445 coins per cycle, that gives us 1,720,455 / 1,866,240 = 92.19% of all coins taken in that are paid out."

"Right. I was with you at that point. I don't get where the million dollars has gone."

"Ok, I think I see where the confusion comes from. If you don't understand what I have explained to you, then I obviously haven't explained it properly. Let me continue. The

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

Brian Rankin - Slot Technical Manager

On-Site Slot Tech Training
Customized Classes Available

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

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

Students learn how to work with:

THE DIGITAL MULTIMETER

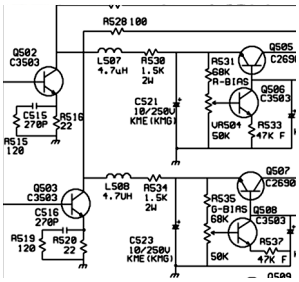
This relatively inexpensive piece of test equipment is easy to operate. Casino School students learn to use the digital multimeter to perform tests and measurements that will pinpoint the cause of a failure down to a single component.

ELECTRONIC COMPONENTS

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

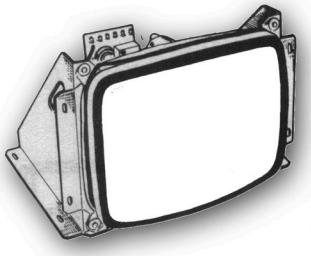
SCHEMATIC DIAGRAMS

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



POWER SUPPLIES

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



MONITOR REPAIR

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

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

Randy Fromm's Casino School 1944 Falmouth Dr. El Cajon, CA 92020-2827
tel.619.593.6131 fax.619.593.6132 e-mail CasinoSchool@slot-techs.com
For a complete brochure, visit the website at: slot-techs.com

percentage that we have calculated, 92.19%, takes into account the payments from the bonus game. However, it is only the average bonus game payment."

"The bonus game contains 40,000 possible outcomes, and each one is a winning outcome. 8,000 of these games will pay 10 credits. 8,000 of these games will pay 20 credits, etc. Now then, if we look just at the base game, we see that it has 323,748 possible combinations. We realize that since every outcome is selected randomly, we won't necessarily go through each of the 323,748 possible combinations each once and only once before starting over. For example, in the base game, mixed bars occurs 16,515 times. That means that in the 373,248 possible outcomes, 38.37% of these (16,515) games will be mixed bars. However, if you sit down at the machine and play 373,248 games, recording each time you receive mixed bars, it is doubtful that you will have 16,515. The random number generator will cause this to be slightly higher, or lower. That's the volatility factor."

"It has been stated that if you leave the probability alone, it will work itself out. That's very true. Eventually, at some point, even with the random factor of the machine, the theoretical probability will happen."

"The base game calls the bonus game 3,840 times each cycle. The same thing happens with the bonus game as well as the mixed bars as well. The base game might call the bonus game only 3,000 times in a cycle, or it might call the bonus game 6,000 times. The randomness introduces an element of variance, or volatility."

"In order to quantify the payout from the machine, we look at the average payout from the bonus game. On average, over the long term, the bonus game pays out just over 188 credits each time it is called. We know the total amount paid out from the bonus game, and we divide this by the number of bonus games available. This number we plug into the base game calculation, and it will eventually work out as well."

"It might be less, it could be more." answers the CEO. You nod your head. "So why is the PAR sheet only showing a payout of 1.76 million? Should it not be higher?"

"If we looked at every combination, then yes. We take a short cut, if you will, in order to make the values relate to the base game cycle. We could display every base game that would result in all of the bonus game combinations being selected. If the bonus game has 40,000 combinations and is called 3,840 times from the base game, then it would take 40,000 / 3,840 = 10.42 base game cycles to account for every combination of the bonus game. In this case, our base game PAR sheet would show 373.248 * 10.42 or 3,889,244.16 games. The numbers don't work out

Award Credits	Award Dollars	Quantity	Factor	Contribution	% Contr
4,000,000	$1,000,000	1	0.0000	100.0000	53.12%
1,000,000	$250,000	1	0.0000	25.0000	13.28%
1,000	$2,500	1	0.0000	0.2500	0.13%
1,000	$250.00	1	0.0000	0.0250	0.01%
750	$187.50	996	0.0249	18.6750	9.92%
500	$125.00	700	0.0175	8.7500	4.65%
200	$50.00	700	0.0175	3.5000	1.86%
100	$25.00	900	0.0225	2.2500	1.20%
75	$18.75	4700	0.1175	8.8125	4.68%
50	$12.50	8000	0.2000	10.0000	5.31%
25	$6.25	8000	0.2000	5.0000	2.66%
20	$5.00	8000	0.2000	4.0000	2.12%
10	$2.50	8000	0.2000	2.0000	1.06%
		40000	1.0000	188.2625	100%

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evenly. That's why we use the average. It is accurate and it does work out. For accounting purposes and for approval of our game, it's a simpler way to represent the total payout."

"We create the sheet in whatever format the gaming commission wants. If we do it by the base game, then we're using the average payout. Using the bonus game, then we're not likely to have an even number of base games. It's more of an accounting report in this case."

"Right. Using the average payout, we get an exact amount of the payout over the long term. The payout percent will be accurate. The coins paid out is for one cycle of the base game, which will be pretty close but have some variance. Given enough games, all the numbers will fall into place." states the CEO. "If we did use the three million, eight hundred and some odd games that you just mentioned, then the total payout would include all payments from the base game and would reflect the million dollar top payment, the two hundred and fifty thousand payment, the 8,000 10-credit payouts, etc."

"Correct. That's where the missing millions went. Not into my bank account but into a condensed version of the bonus game payout. They're still there, just shown in a format that is easier to digest."

"Let me direct your attention to the simulation on the CD I'm handing out now. The previous one let you play the bonus game and get a feel for how it looks and feels. This one is geared more towards the numerical side of the game, giving you play statistics. If you call the game up on your screen, I'll give you a brief overview."

The program is also on our server at www.slot-techs.com and can be downloaded in a ZIP format. You will need WinZip or, if you are using Windows XP, the operating system will unzip it for you. There is a file in there called SETUP.EXE. Run this program (double-click on the icon) to install the Max Millions Simulation Console. All of this software comes with an uninstall program to remove it entirely from the computer. You get to this through the Control Panel and Add & Remove Software.

"Why would anyone want to remove this great software?", asks the CEO.

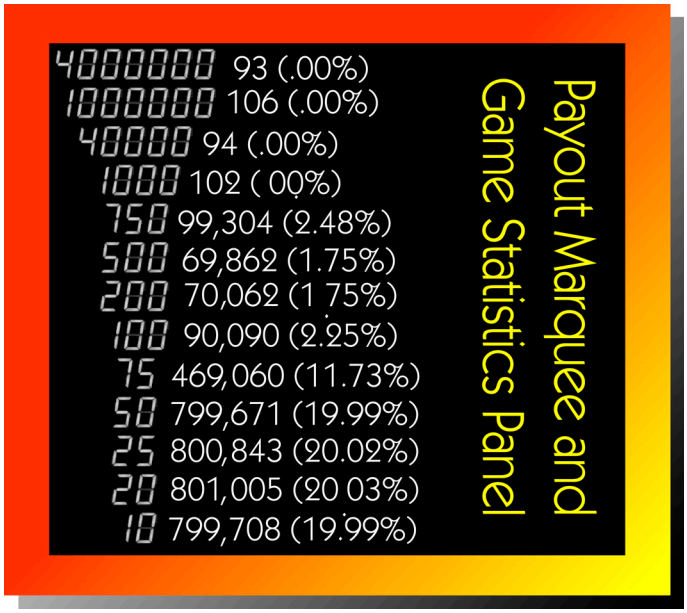
"Beats me," you respond. "But, the feature is there just in case you want to."

When you start the program, you will see an introductory screen. From here you can run the simulation, exit the program, or open one of two websites - ours at www.icsgaming.com or www.slot-techs.com.

"Ooh, that's handy." replies the CEO. "That Slot Tech website is chock full of very valuable information!"

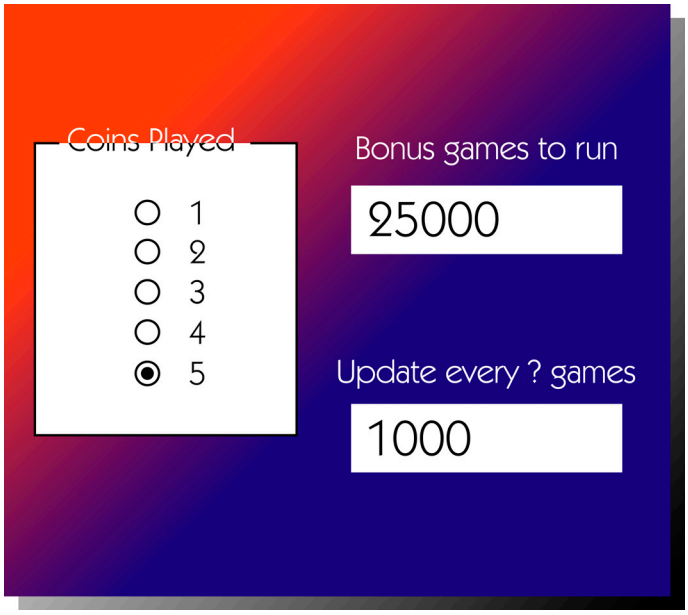
"Once you start the simulation, you'll see a black screen with tons of information on it. The screen is broken into various components. I'll take a few moments to explain each section."

"This shows the payout. It doesn't change colour like the previous program you have. It was designed to allow you to play the game and give you an idea how the game looks and feels. This is more mathematically oriented and isn't quite as fancy. If you click the box below, you can select the coins played, from 1 to 5. The marquee payouts change



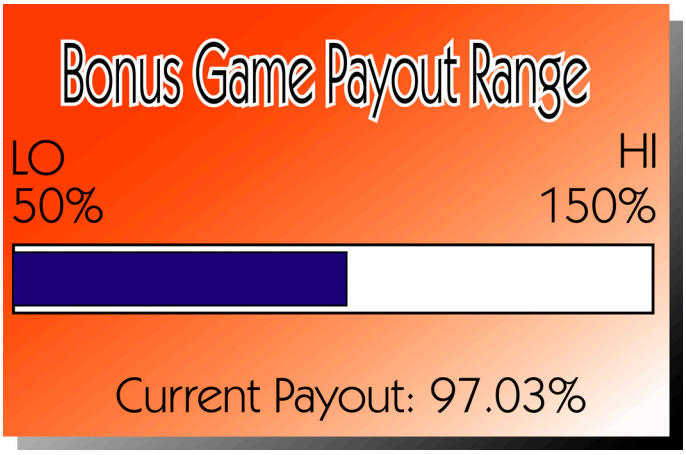
to show you how it would appear to the player. When you run the simulator, however, it always plays at five coins. That keeps the stats working at the max-coin level."

The next section allows you to set how the simulator will run. Each time you run it, it will go through a certain number of bonus games, allowing you to see what combinations came up. In the top box, "Bonus games to run", enter the number of bonus games to have. The default is 1,000. Below that, it says "Update every ? games." As the simulator runs, it will update the statistical displays every so often. If you enter "1" it will update every game. However, this slows down the simulation and causes a bit of display 'flicker.'



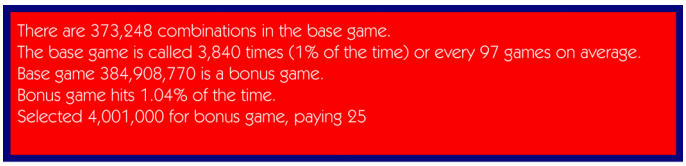
If you set it to '10' then every 10 games, your display will be updated. You could, for example, run through 40,000 bonus games and update the display every '10,000' games. This will show you the current statistics four times when it is running. At the end of the bonus games, the displays are automatically updated and the simulator stops running. Incidentally, the numbers are all saved for you when you leave the program, so you can come back later and pick up where you left off.

To the right is a small display showing how the overall payout is. It is based on a payout of 188 coins per bonus game. If the simulator has that value, then it shows 100%. If it's 90%, that means that the actual payout is only 90% of that, or 169.2 credits. The blue bar gives you a graphical representation, showing 50% payout to 150%. The simulator may run outside of this range for a short time, but it will eventually settle pretty close to 100%.



As the simulator runs, it shows a white box around the amount paid out. To the right, it shows you how many times each payout has happened. For example, next to '10', you might see '8,000.' This means that there have been 8,000 bonus games where 10 credits were paid. The number in the parenthesis is the percent of the payout. A '10' credit payout should happen 20% of the time. You'll see the value get very close to 20% very quickly.

The red box shows an overview of the bonus game. It tells you how many games there have been, etc. It also shows you the value that the random number generator picked, from 1 to 40,000. It also tells you how many base games have been played, etc.



The part above this red box gives you the heart of the statistics. It will display how many base games have been played, in order to pick the base games. This is random, so it won't be exact either. On average, though, the bonus game will happen every 8.92% of the base games. If we have 1,000,000 base games, we'll have close to 89,200 bonus games.

The "Maximum base games to bonus" tells you the longest run between bonus games. It should be "97" since the bonus game happens every 97 games. However, the maximum will probably end up around 1,500 games. The "Minimum base games to bonus" will end up as "1." This means that one game happened between bonus games at some point. In other words, eventually the player will get a bonus game and then another bonus game on the following spin. Again, randomness comes into play here.

The "Total bonus payout" is how much we have paid out on all bonus games. The "Average Bonus Payout" should end up around 188. If you get a million-dollar payout early on, though, it will be quite high. If you don't, it will be lower. In test cases, many simulations start out around the 63% mark and stay there for a short time.

You will see three buttons at the top. Exit does the obvious. Run starts the simulator and runs through the number of bonus games you specified. Reset has a double function. When the simulator is running, it will stop it. If you enter 10 billion games and then decide you don't want to wait for the simulation to finish, Reset will stop it before it's finished. When the simulation is not running, however, Reset will allow you to clear all of the statistics and start from the beginning.

The board members talk briefly amongst themselves while Larry comes back into the room. He's ready to demonstrate the prototype game, hoping that all has gone well with your presentation. In a few minutes, the CEO stands up.

"Gentlemen, on behalf of the board, congratulations! We think that we have a winner on our hands. There's quite a bit of information to digest and we'd like to run both of your programs a bit more. We're pleased with the results, though! I think we'll be sending the game to the gaming commission for approval!"

After some chitchat with the board members and a high-give from Larry, you head back to your office.

Late Friday afternoon you're sitting in your office at ICS Gaming. The bonus game for the Max Millions/Blazin' 7s games have tentative approval by the board and should be going to the gaming commission for approval. After a long project, you're planning to ride the wave from this game for some time. Kicking back and resting your feet up on the desk, it's a perfect chance to catch up your reading with some back issues of Slot Tech Magazine. Next week promises to be a walk in the park! Thirty seconds of silence are broken by a knock at the door.

The V.P. of Game Development comes into your office and sits down.

"You know, I had a thought. If we could convert Blazin' 7s to a 5-reel video penny game, you could put that same Max Millions bonus game into it and . . ."

- John Wilson
jwilson@slot-techs.com

Press Release

Heber at EELEX

Heber Limited, designers and manufacturers of the Pluto and Firefly electronic control systems, will be exhibiting at EELEX 2004 (Moscow, Russia) for the first time in December, and will also preview a major new addition to their existing product range. Heber will use EELEX 2004 for the first ever showing of the new Axis product range.

This is a compact, high performance dedicated video controller, with new levels of security and multiple I/O connectivity options.

'We are very excited about previewing our new Axis range of controllers at EELEX 2004' said Richard Placito, Managing Director 'EELEX is the perfect platform to show the potential of the Axis system as it meets with the technical demands of the Eastern European market. EELEX is also the perfect lead up to Axis's official launch at ATEI 2005 where it will make it's debut and exhibit it's full potential. '

For further information about Heber Limited and the new Axis range visit www.heber.co.uk or phone +44 (0) 1453 886000.

UNICUM Joins Microsoft

Russian gaming giant makes another step towards legitimising gaming industry in the Eastern Europe

Unicum Group of Companies, the leading Eastern European (Russian) supplier of gaming products and solutions, has become a member of the Microsoft Windows Embedded Partner Program (WEP). A partnership contract was signed by Unicum Group of Companies and Microsoft Corporation to develop and provide Unicum gaming solutions based on leading-edge Microsoft Windows XP Embedded technology and resources.

By choosing Microsoft XP Embedded operating system, Unicum strengthens development and compatibility of its new generation gaming products. Video slot games produced by Unicum will be supported by the MS technology in its key functionalities and features: games engine, graphics, sound and peripheral device management. The XP Embedded provides user interface and resource management services (such as memory management, disk access, graphics display, peripheral device interfaces) that would normally require incommensurably more time for a developer to create individually. By using Microsoft OS which has become an industry standard, Unicum's Research and Development professionals leverage their own efforts on the knowledge and creativity already inherent in the work performed by Microsoft.

"Through this partnership, we have taken one of the many important steps towards legitimising our industry in the Eastern European and international markets. We have raised the performance bar for our competitors and have demonstrated to our customers that we are committed to providing them with products based on legally compliant and legitimate software. That we have been able to access superior development aids, technical support and pre-release 'partner software' which will enable Unicum to deliver stable, advanced and leading-edge gaming systems to our client base - surely a win-win situation." commented on the new partnership Peter Moffitt, R&D Vice President of Unicum Group of Companies.

Unicum technical specialists intend to use the MS system in designing video slot games for Tam Tam slot machine as well as other platforms from partner suppliers, such as AGT. The company also discusses further plans about implementing Microsoft technology into products developed for next generation platforms.

For additional information, contact:
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Unicum Group of Companies
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cell. +7 (903) 225 2474
fax. +7 (095) 247 9852
e-mail: ak@unicum.ru
www.unicum.ru

Anastassia Kojemiakina

EELEX Experiences Further Growth

EELEX 2004, the 13th international tradeshow that gathers leading gaming business representatives every year in Moscow, represents not only for the Russian gaming market but for the Eastern European entertainment industry.

Once again, EELEX's popularity and the interest of potential exhibitors led to the show's expansion. Since last year the tradeshow grew out of two halls and now occupies all three halls in the Expocentr pavilion 2. It allowed the EELEX organisers to offer 36 more stands and welcome new participants. The majority of stands were reserved at EELEX 2003 and the waiting list has been growing ever since.

The number of exhibitors has increased to 200 companies from 21 countries. This year EELEX visitors will be able to see more participants from the USA, Belgium and Holland. Russian exhibitors account for over 50 percent of EELEX exhibitors. The show organisers predict a variety of fascinating and extraordinary stands built by Russian companies who have been experiencing impulsive development of the local gaming market.

The largest world gaming producers and suppliers have taken part in the recent EELEX exhibitions. This year 50 international companies will introduce their new products to a Russian audience. It is a great opportunity for operators who come to Moscow from all over the CIS to test not only "home-made" equipment but to evaluate technology produced by international companies. The exhibitor list includes many familiar names such as Atronic International, Bally Gaming, Brunswick, IGT, Novomatic, Unicum, Unidesa and WMS Gaming.

EELEX organisers anticipate that the visitor flow will bring about 10 000 visitors - casino and entertainment equipment consumers; operators of gaming halls and entertainment centres; night and bowling club owners. The show is the meeting point for suppliers, producers and their customers. The largest percentage of visitors come from Moscow and Moscow region and Russia, followed by representatives from the Baltic states, Eastern Europe and further afield.

It is almost a must for an industrial tradeshow to have a supporting conference. For many years the Russian Gaming Business Development Association has organised a one day conference (on December 15) covering the most important issues in the Russian gaming industry.

The EELEX 2004 conference program will cover legitimate issues and analysis of the latest development of the gaming business in Russia. Legitimate issues are always a big hit among Russian operators, especially those who come from the regions and have a poorer access to the current news on gaming legislation.

The second conference event is a round-table talk «Consulting In The Gaming Industry» hosted by Unicum Group of Companies. The discussion will take place on December 14 at 13:00 in the 'Blue Hall' of Pavilion 2. The organisers hope that EELEX 2004 will prove its status among the largest gaming industry forums; that new products will find their customers and the results of the tradeshow will reveal the future trends of the Russian gaming and entertainment industries.

For further information email ak@unicum.ru or go to http://www.unicum.ru

Job Descriptions, Testing and Training

By Herschel Peeler

Setting standards for personnel in a slot department determines the level at which the people in that department will perform. Job descriptions must cover the needs of operations. Tests given for promotion must meet the needs of the job description. Training must fit the needs of the tests.

We can not justly evaluate an employee by criteria that are not in the job description. The job description must be a minimal standard but setting this minimal level determines the capability and performance of the people on the job; the higher this standard, the better the personal performance of each employee. You get what you ask for. If you ask only for minimal performance, that is likely all you will get from the average employee.

Most people are capable of performing beyond the limits they set for themselves. Good employees are seldom picked off the shelf as if shopping for produce. Good employees are created by good training programs. Futures are better built by design than just experienced by luck.

Will They Stay or Will They Go?

One concern in instituting a training program is that the employee will leave after being trained. The casino as well as the employee benefits from the training. Seldom does the employee have the resources for their own training. The employer should set the standard and provide structure to the program. It is the responsibility of the employee to take the challenge and perform.

In California casinos, we have little turn over among higher technical jobs (compared to lower technical jobs). The people are committed to the local area by family ties. This is in contrast to Las Vegas where an employee can change jobs easily and stay within the Las Vegas living area.

Employees are more apt to be happy and stay where they are if training is provided and their accomplishments are recognized. Contented workers accomplish more and do so willingly.

In California, all of our casinos are Native American. The tribe benefits when the members get the training, whether the member stays at the home casino or moves to another. His life is changed for the better by the education and this flows down through future generations. I am a strong advocate of putting a portion of the casino profits back into the education of tribal members in order to improve their future and the future of generations to follow. California casinos do not necessarily exist to provide entertainment for their customers. They are not the "for profit" companies Nevada and Atlantic City have. They exist in order to provide for the future independence of Native American tribes. The Native American casino has more in common with church bingo than a Las Vegas casino.

Will the trained employee more likely stay after being educated? More likely a "yes" if he or she is tribal. Also likely to be a yes if there is only one casino in the area.

Promote Then Train, or Train Then Promote?

Promoting from within is, I think, healthy for the company. It improves morale and gives the employees a sense of history with the company. Hiring from the outside should only be done if the needs can't be filled from within. Earning a promotion should be a reality for anyone who wishes it. One big question here is: Do we promote people based on attitude and potential or train people and promote those who have shown an ability to do the job?

If we "Promote Then Train" a majority of our people is in training for the job they currently hold and are getting paid for. In a high tech world of today's casino this often results in smoke from the games, down games, and games that stay down for long times because the tech just doesn't understand the real problem.

The high tech nature of today's and tomorrow's casino necessitates an approach of "Train Then Promote." Today's casino is a system of say 1,500 computers networked together. Each computer (game) may well have four or more microprocessors and microcontrollers that work together to make the game work and make the floor work as a system. Few buildings have a network of computers similar to what we find in a casino. Every year, this gets more complicated as player tracking and accounting systems include bonusing, wide-area progressives and multi-media features. Make no mistake, there is an aspect of the casino operation that is more than just the hospitality and entertainment industry. This is a very high tech world we live in.

Technicians or Mechanics

In any most industries, a mechanic is someone who takes things apart and puts them together. Little education is required. A technician understands the technology by which the device operates and can troubleshoot from the standpoint of knowledge and understanding. Education is required. The definition of Electronics Mechanic closely parallels that of a Slot Mechanic. The definition of an Electronics Technician closely parallels that of a Slot Technician.

"Good employees are created by good training programs."
Herschel Peeler

The term "Technician" usually implies a formal education of some sort and the ability to pass a rigorous test. Automotive Technicians are graduates of college level courses. MIS (Information Systems) Technicians must pass something similar to an "A-Plus Certification" test. This is usually the graduate of a formal course but the field is well documented and the education can be attained from books. Certified Electronics Technicians are also well educated, formally or through personal endeavor. Surgical Technicians are most certainly a product of extensive formal education and testing. Atlantic City requires an education before being a Slot Technician. Nevada expects an education but does not require it by law. California has no such standard or training.

Job Descriptions

Each level is more detailed than the previous.

It is recognized that we cannot jump instantly to these standards. We could set a goal that by, say 2006 all Slot Technicians should fit these standards, 2008 all Lead Technicians, and so on. The training required for each step is significantly more technical and will take more time to attain.

For Slot Tech, this training amounts to about 480 hours of formal education. In a school, this comes to four hours a day, five days a week for six months. Randy Fromm's Casino School is a two-week class that offers 72 hours of tech training (mostly on monitor repair). The IGT classes cover about 40 hours. TechFest covers about 24 hours. There are still 416 hours of such instruction to be had beyond such training.

Each step up to Senior Technician, Assistant Bench Technician and Bench Technician are about 480 hours each. There are few schools teaching such things. At present, it is the result of individual effort.

Basic electricity, analog and digital electronics may be picked up through college classes. Military schools covering the same subjects are also valuable, as are technical schools in electronics in general. Knowledge gained through general education seldom has immediate application to any specific industry, especially gaming. This is becoming easier as more games are built around the structure of personal computers.

Training programs need to match the job descriptions. Tests for promotion should match the training. Tests themselves present a unique problem. If the test only covers a few minor points of the subject, the students tend to "learn for the test" instead of "learn the subject." It is suggested a format more along the lines of that required for "Certified Electronic Technician" and amateur radio operators be followed. The student must be sufficiently knowledgeable of the subjects to answer any question put to him / her.

For the purpose of organization between Job Descriptions, Tests and Training, the subjects are noted by a reference number.

These job descriptions cover technical subjects only and are aside from floor operation concerns that would be unique to the specific casino's needs. Game and system specific questions would be needed also. They should be considered equally important but it would be difficult to include here and cover all casinos, games and systems.

Slot Mechanic (Entry level with no schooling)

The Slot Mechanic takes some of the manual workload off the Slot Technicians. These are Slot Technicians in training. SM1 Moves games and wires them up under close supervision. SM2 Makes minor repairs to games such as coin jams, replacing light bulbs and cleaning. SM3 Follows procedures to perform lower levels of Preventive Maintenance on games. SM4 Works under the supervision of a Slot Technician or higher.

Slot Technician (Entry level with schooling)

The Slot Technician is generally described as someone with a two-year degree in electronics (or graduation from a Slot Tech school of 480-hours) and a year's experience or five years of experience and comparable self-education. The dearth of schools teaching the required subject dictates that self-education or in-house training is a suitable substitute for two years of electronics. It would be ideal if a standardized test could be given to evaluate the education and experience level of people applying for this position. ST1 Understands basic game assemblies by description and function. ST2 Repairs games by replacing assemblies. ST3 Follows procedures to maintain games. ST4 Able to operate the games sufficient to get to basic bookkeeping and diagnostics.

Lead Technician

Lead Technicians are responsible for providing leadership, training, communications with other departments, handing out job assignments, signing out controlled parts and making technical decisions. (Thank you, Kevin Noble for providing us with that excellent description of a Senior Technician.)

The level of technical understanding is somewhat higher than that of the Slot Technician. An understanding of Progressives Systems, Accounting and Player Tracking systems is expected. LT1 Understands game assemblies signals and operation. LT2 Troubleshoots problems not found by replacing assemblies (wiring problems, etc.) LT3 Understands personal computers to the operators' level. LT3.1 Has a functional understanding of Excel, Word, and basic programs sufficient to create paperwork as required by the job. LT3.2 Must be able to navigate their way around a computer network and find their way through directories with an understanding of what they are doing and where they are. LT3.3 Able to send and receive e-mail with attachments. LT3.4 Must be able to edit and manipulate graphics. LT4 Writes procedures to maintain games following manufacturers' recommendations. LT5 Has a more complete understanding of game operation and is capable of modifying game setup and configuration. LT6 Has an understanding of the games sufficient to match PAR sheets and Program Summary Reports and match the details of these reports to game operation. LT7 Teaches both hands-on and basic theory of slot machines to Slot Technicians and Slot Mechanics.

Assistant Bench Technician

ABTs do most common repairs on assemblies. Slot

Techs remove bad assemblies. ABTs are the first line of off-the-floor repairs. Minimal expectation is for them to make quick repairs on those assemblies that have repetitive failures. Two years of college level electronics is suggested. Graduation from a gaming school emphasizing Bench Technician duties is suggested. That is 480 hours above and beyond the 480 hours for a Slot Technician's school. This is a Slot Technician with some electronics.

Again, abilities should be measured by a standardized test. Source of the education is secondary but it is expected that they understand how slot machine assemblies work at the component level. ABT1 Understands internal functioning of game assemblies. ABT2 Troubleshoots assemblies to board level. Repairs circuit boards to component level on leaded (through hole) components. ABT3 Understands discrete active components (transistors) and how they work. ABT4 Understands microprocessors sufficient to follow circuit operation. ABT5 Understands schematic generation software, such as OrCAD sufficient to create or modify a schematic. ABT6 Follows procedures to repair at the component level. Recommends changes and improvements to procedures to improve functionality.

Bench Technician

A strong background in electronics and gaming is required. The Bench Technician should have mastered analog and digital electronics as found in the gaming industry. The BT should have a detailed understanding of how slot machines function at the assembly, component, hardware and software level. An understanding of microprocessors is mandatory. 10 years of electronics at the component level. 10 years in the gaming industry at the technician and/or instructor level. Specifying requirements for test fixtures, designing test fixtures and building test fixtures are his responsibility.

The Bench Technician is the Alpha-Nerd of the Slot Department. In our casino he writes the training program for technical subjects, is advisor to Slot Managers on technical subjects, writes magazine articles for Slot Tech Magazine, creates and maintains the web site for our training and reference material, suggests changes in policy and procedures that deal with technical subjects and a hundred other duties as they come up. BT1 Repairs boards to component level on surface mounted components. BT2 Troubleshoots boards with an understanding of the integrated circuits and how they work. BT3 Understands analog and digital circuits. BT4 Identifies ICs by part number and understands how they work. BT5 Knows where to find information on components in data books and web sites. BT6 Recognizes component manufacturers by their logo. BT7 Able to assign substitute parts based on functions and specifications. BT8 Understands analog and digital circuits sufficient to design circuits used for test fixtures. BT9 Designs test fixtures. BT9.1 Designs simple test fixtures made of lights and switches with discrete component support. BT9.2 Designs more complex test fixtures using integrated circuits (LSI, MSI and LSI). BT9.3 Designs smart test fixtures (microprocessor based). BT10 Understands microprocessors sufficiently to write programs in Assembly language, BASIC, C++, etc. BT11 Understands personal computers comparable to the "A+ Certification" level. BT12 Understands schematic generation software sufficient to modify or create new schematic symbols that would function properly under emulation modeling. BT13 Writes test procedures and designs test fixtures based on knowledge of component level functioning. BT14 De-Engineers boards and assemblies when documentation for these assemblies is not available.

Summary

The objective here is to set goals for various job descriptions for where we want to be at some time in the near (2 to 6 year) future. We want to establish a training program that trains our people to meet those goals and establish tests that evaluate the training level. We want to bring the level of our people up to the same (or higher) level as that found in Las Vegas or Atlantic City.

- Herschel Peeler
hpeeler@slot-techs.com

Slot Tech New Products From Asahi Seiko

DROP'N MASTER MODEL: AS-3 and AS-RC1 - Coin Validator and Remote Control Box

Asahi Seiko USA, Inc. introduces DROP'N MASTER model: AS-3 and AS-RC1 remote control box.

FIELD PROGRAMMABLE
DROP'N MASTER model: AS-3 is a field programmable coin validator. With the aid of the AS-RC1 remote control box, converting from one coin or token is made easy. Already preset US coins are (1, 5, 10, 25, 50 cents and $1). All you have to do is connect the remote control box, flip the switch, and press the button. Another feature is a programmable channel for an additional coin or casino token.

SECURITY FOR PROGRAMMING
The setting of AS-3 can be changed only with the aid of AS-RC1 remote controller. In other words, you have to have access to this remote controller to change the setting.

USER FRIENDLY INTERFACE
There is no menu or command to memorize. Pick the denomination and flip the switch.

WIDE RANGE
Acceptable coin size (diameter) is 17.9mm~38.0mm. US 10 cents ~$1 gaming token can be used without any parts change.

STRAIGHT DROP
The AS-3 has the straight drop design. Thereby allowing high-speed acceptance response with minimum rejection. This includes fast feed.

ANTI-STRINGING
The AS-3 has unique patented coin detection system allowing it to detect the reverse motion of coins near the entrance of the unit.

REDUCE INVENTORY
The benefit of using AS-3 is to reduce your inventory. You don't need coin specific units and parts any more. This will improve your inventory situation dramatically.

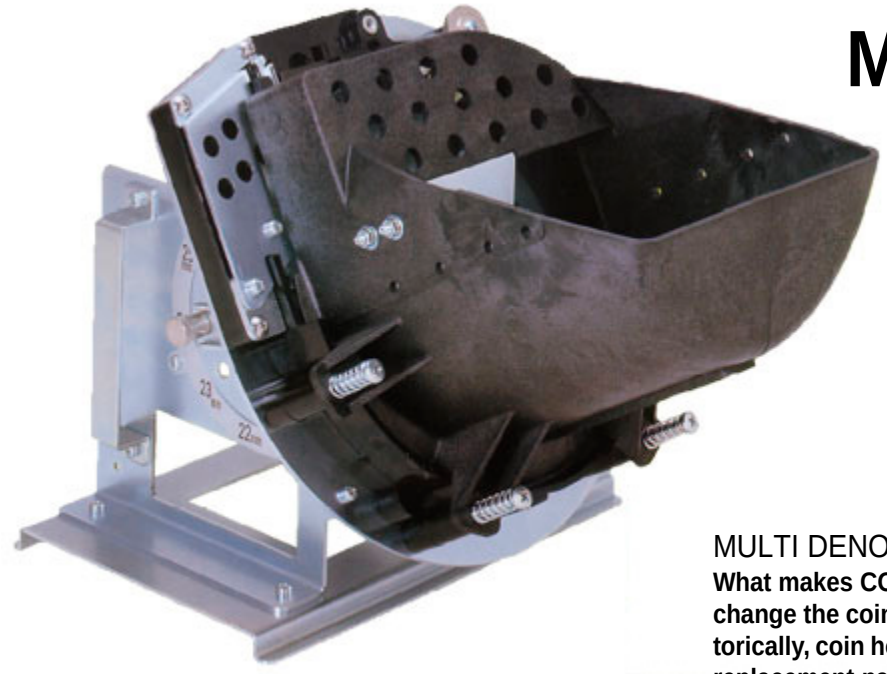
For more details please contact:
Asahi Seiko USA, Inc. Sales Department
6644 Paradise road
Las Vegas, NV 89119-3719 U.S.A.
Phone: 702-260-6666
FAX: 702-260-6493
E-mail: Roberta@asusainc.com
Web: www.asahiseikousa.com

DROP'N MASTER MODEL: AS-3

AS-RC1

COINFLEX: MODEL EH-750

Multi-Denom Coin Hopper



MULTI DENOMINATION HOPPER

What makes COINFLEX a new generation hopper? You can change the coin size with just a simple flip of the lever. Historically, coin hoppers have been coin specific. It took many replacement parts to convert from one denomination to another. Asahi Seiko's technology has revolutionized this entirely. You can convert a nickel hopper to a quarter hopper with the flip of a lever. No replacement parts are needed.

REDUCE INVENTORY

The economical benefit from using this hopper is significant. You do not have to carry coin specific hoppers and supporting parts any more. This will reduce your inventory dramatically.

DIRECT REPLACEMENT OF DH-750

Also, COINFLEX is direct replacement for Asahi Seiko's DH-750. All the hopper bowls are compatible with COINFLEX.

COINFLEX: MODEL EH-750
There are three different size ranges (coin diameter) to choose from:
20~26mm, 26~32mm, 32~38mm

If you want to convert between the size ranges, all you need is 4~5 parts and #2 Phillips screwdriver.

Easy to service!

For more details, please contact Asahi Seiko USA, Inc.

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FutureLogic's GEN2 VST™ Thermal Printer Wins Gaming and Technology Award for Excellence in Innovation and Practical Application

FutureLogic's GEN2 VST™ Thermal Printer Wins Gaming and Technology Award for Excellence in Innovation and Practical Application

FutureLogic's GEN 2 VST™ printer was recently awarded one of nine Gaming and Technology Awards presented by Global Gaming Business (GGB) magazine. The awards, which recognize excellence in innovation and practical application, will be presented at the 6th Annual Gaming and Technology Conference to be held at the Atlantic City Convention Center on November 9. Nominees for the GGB award program were evaluated during the Global Gaming Expo 2004 in early October.

The GEN2 VST printer was awarded third place in the Best Productivity-Enhancement Technology category, and was the only hardware component to be recognized in the awards program. Other winners included IGT, Bally Gaming, Konami Gaming, and Cyberview Technology. Judges for the competition included George Mancuso, vice president, slot operations for the Tropicana in Atlantic City; Claudia Winkler, president of GHI Solutions Inc. in Las Vegas; and Judy Cornelius, associate director of the Institute for the Study of Gambling and Commercial Gaming at the University of Nevada, Reno.

Building on the technology leadership that resulted in an award from Casino Journal's Top 20 Most Innovative New Gaming Products for 2003 for the FutureLogic GEN2 printer, the ultra-compact vertical format GEN 2 VST printer is specifically designed for slim-top gaming machines. The thermal printer offers several productivity-enhancement features, including ITH™ (Intelligent Ticket Handling), which makes the ticket available only after it is fully printed internally and automatically burst, ProMatrix™ (an advanced Promotional Matrix Couponing System), PromoPort™ (a dedicated promotional print port), color printing capability, and the option to store up to 1000 coupon templates in an 8MB chip. Other enhancements include TRT™ (Tamper Resistant Ticketing), a USB communication port (future GSA compliant), and an easy-to-use download tool for a convenient firmware upgrades.

"FutureLogic is honored to be recognized by GGB and the best-of-field judges who selected the GEN2 VST printer for its productivity-enhancement and innovative technology attributes," said Nick Micalizzi, Director of Gaming at FutureLogic. "As evidenced by this award, our commitment to providing our customers with new and improved thermal printer solutions is helping us consolidate our pace-setter position in the cashless gaming arena."

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What A Rush!
Inrush Current Limiting

I enjoy helping people with their technical problems. Depending on the skill and experience of the person I'm trying to help, I can often accomplish this on the telephone or through e-mail. Naturally, the first thing I ask is "What is the symptom?" I always get a kick out of the following description (which I receive about once a month):

"The (insert item here: monitor, power supply, slot machine, television, VCR) was working perfectly when I turned it off," the caller will say. "When I turned it on again, it was dead. Weird, huh?"

No. Not weird. Not weird at all. In fact, if something is going to fail, it's much more likely to fail after it has been turned off for a while and subsequently turned back on. There are a couple of reasons why this occurs. One of them is due to a potentially destructive phenomenon known as "inrush current." Here's the deal:

When a piece of equipment is off, naturally all of the voltages are at zero. Everything is dead. All of the capacitors are completely discharged and all is quiet, peaceful and calm.

However, when you first turn something on, an enormous amount of electric current rushes in to the circuitry in order to get things started. This inrush current can be 10, 50 or even 100 times higher than the normal operating current of the circuit. In a monitor, for example, the normal operating current might under one amp but for the first split-second of operation, as many as 50 amps of current might be flowing. Inrush current can be destructive.

Thought Experiment:

Have you ever been in a room with incandescent lighting and had a light bulb burn out while it was on? It's not too common. When does the light bulb blow? When you first turn the bulb on! With a bright blue flash, that's inrush current doing its dirty business of blowing stuff up.

Specifically, it's the electrolytic capacitor in the primary of the power supply that is the cause of this phenomenon. When an electrolytic capacitor is fully discharged, it has a very low resistance. It's supposed to. In fact, that's one of the qualities of a good electrolytic capacitor. We even pay extra for it when we purchase "low ESR" (equivalent series resistance) for some

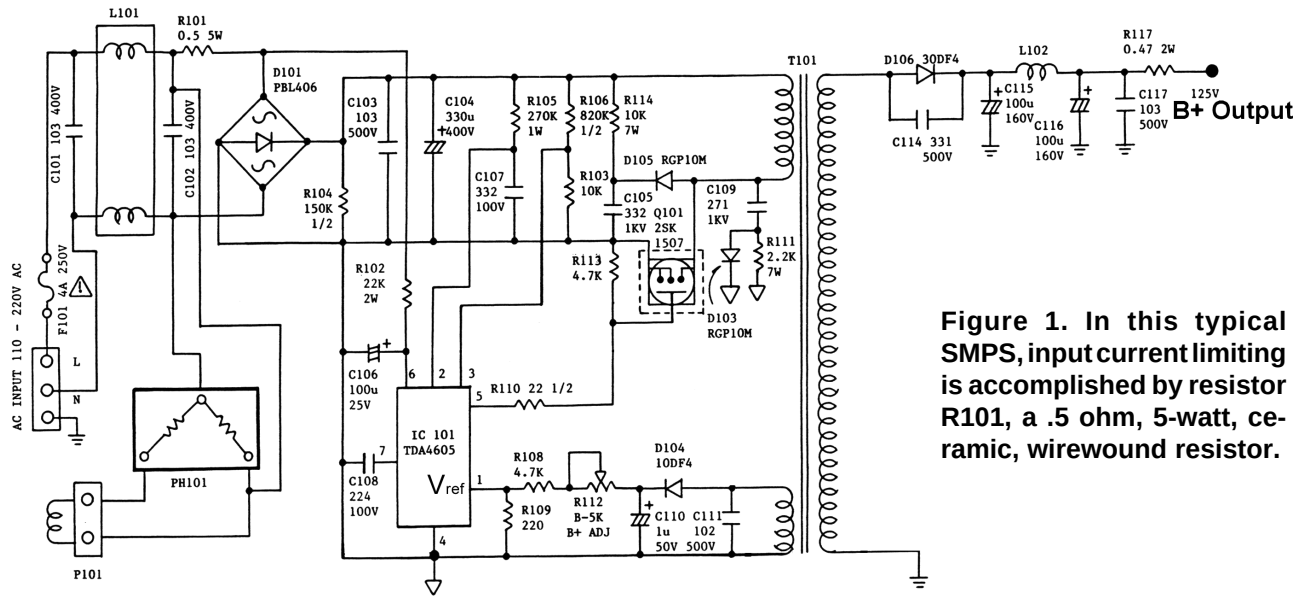


Figure 1. In this typical SMPS, input current limiting is accomplished by resistor R101, a .5 ohm, 5-watt, ceramic, wirewound resistor.

specific applications such as output filter capacitors in power supplies.

At the moment power is first applied (during the first half-cycle of the AC power) current flows from the hot side (also known as "line") through the fuse, through one of the diodes in the bridge rectifier, through the primary filter capacitor (which, at the moment of power application is zero ohms) through another diode in the bridge and back to the neutral side of the AC power. During this first half-cycle, the only thing limiting the current is the forward junction drop of a pair of rectifiers and impedance of the AC source itself. That's some pretty scary stuff when you are a 2-amp diode and you're looking at a spike of 50 amps. Granted, it's only for a half cycle (1/120 second in North America and the Caribbean, 1/100 second elsewhere in the world) but it would be better (much better) if it didn't happen at all.

Current Limiting Resistor

Enter the series current limiting resistor to the rescue. Instead of allowing the inrush current to crash our party, we can post a doorman of sorts in the form of a current limiting resistor. The resistor is in series with the AC input as shown in figure 1. It's R101. A typical value for this ceramic, wirewound resistor is .47 to 2.7 ohms. Typically, it's a 5-watt or 7-watt resistor.

When current first begins to flow, it must now pass through the current limiting resistor as it makes its way to the filter capacitor. At first, there is a tremendous IR drop (the voltage that is dropped across a resistor - R - when current - I - passes through it) across the resistor as the discharged filter capacitor first begins to charge. This causes to filter capacitor to charge more slowly, limiting the inrush current. Consequently, the strain is taken off the diodes in the bridge rectifier, all but eliminating what would otherwise be a common failure, a shorted bridge rectifier.

You may find the inrush current limiting resistor in other locations as well (figure 2). As long as the resistor is in series with the filter capacitor, the goal is accomplished. Alternate locations for the inrush current limiting resistor are:
A - In series with the hot side of the AC input
B - In series with the neutral side of the AC input (the return path)
C - Between the output of the bridge rectifier and the primary filter capacitor
D - In the return path of the filter capacitor

The point of this discussion is not so much to praise the current limiting resistor for what it does but to point out that the resistor itself now becomes a point of failure. If something fails such that too much current is drawn continuously across the current limiting resistor, the resistor will open-circuit. If, for example, the bridge rectifier fails despite the heroic effort of the resistor to protect it, it will short-circuit. This may simply blow the fuse or, if the resistor is in location A or B, it may open the resistor instead. It may even do both simultaneously. This can be a bit confusing for a novice tech as he/she has found the blown fuse and the shorted rectifiers, and has replaced them but still finds a completely dead unit, as the resistor is open as well. Like just about everything else in electronics, it's actually simple once you know what to look for. Any time you see a low-ohm, high wattage resistor in series with a power source, it should raise a big red flag for you as a technician as a potential point of failure. When resistors fail, they always open-circuit or increase in resistance.

It's also pretty typical to see a low ohm, one or two-watt resistor in series with low-voltage power supplies and even the B+. This resistor not only serves to limit inrush current but also act as a sort of protection device in case something on the line shorts to ground (a good example of this is when the vertical output IC fails and loads the +24 VDC power supply). Instead of dragging the power supply all the way to ground and causing the SMPS's Over-Current Protection (OCP) to kick in (as it does when the HOT shorts) or cause some other type of loading problem, the series resistor will

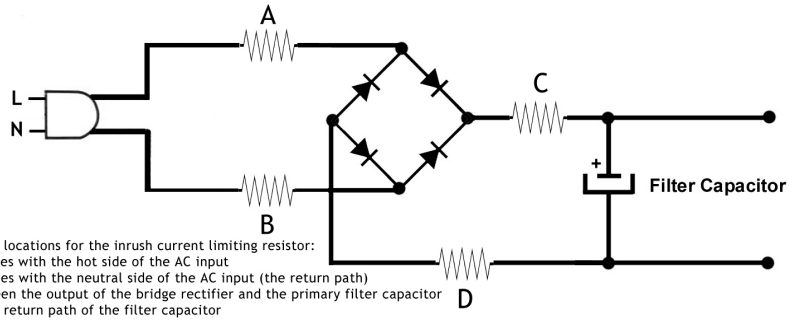


Figure 2

either dissipate the energy as heat or will simply open circuit. FYI, this will almost always be a non-flammable, metal-oxide resistor.

Enter the Thermistor

An improvement over the use of a ceramic, wirewound resistor for current limiting is the thermistor. The name comes from the Greek word "thermos" meaning heat. A thermistor is a heat-dependant resistor. That is to say, it's a resistor that changes its value depending on its temperature.

The type of thermistor used here is called an NTC thermistor. The negative temperature coefficient thermistor begins at room temperature with some small amount of resistance. This will vary between types but a few ohms (maybe even a half-dozen) is typical. When the unit is first energized, the current passes through this resistance on its way (eventually) to charge the filter capacitor.

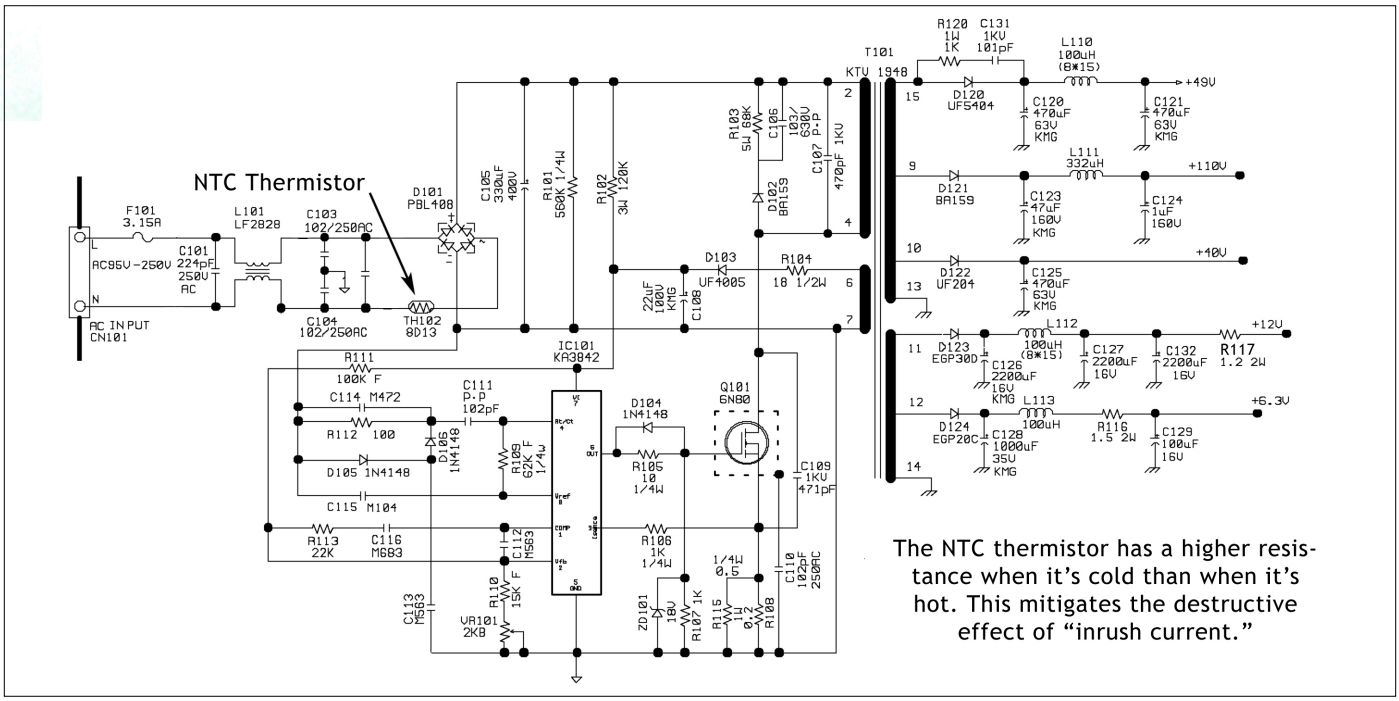
However, as all good technicians know, when current passes through resistance, it generates heat. The thermistor self-heats due to the current flowing through it. As it does, its resistance drops. That's why it's called a NEGATIVE temperature coefficient thermistor. As its temperature rises, the resistance falls. Eventually, its resistance falls to zero ohms and it is out of the circuit, electrically-speaking. This scheme is referred to as "soft-start."

The thermistor is much more reliable than a ceramic, wirewound resistor in the same application. To date, I have never encountered a bad NTC thermistor in this application.

Before the use of NTC thermistors, monitors often used slow blow (slo-blo) fuses in order to handle the high inrush current without blowing the fuse. The fuse would remain intact during the brief duration of the peak inrush current but would still provide protection when the fuse rating was exceeded continuously (hopefully before much stuff catches fire or vaporizes completely). Including a thermistor in the design allows the use of a faster-acting (and less expensive) fast-blow or normal fuse.

There is a sort of "negative benefit" to this design. If you unplug something, wait about 15 seconds for the filter capacitor to discharge, and plug it back in again before the NTC thermistor has a chance to fully cool, you will hit the input rectifiers with the full inrush current. It's possible that this will damage the rectifiers. It's also possible that this will simply blow the fuse as the still-hot NTC thermistor has eliminated the "soft-start." The typical cool-down time is approximately one minute. In reality, this doesn't seem to be an issue; it's just sort of interesting from an engineering perspective.

-Slot Tech Magazine



The NTC thermistor has a higher resistance when it's cold than when it's hot. This mitigates the destructive effect of "inrush current."

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Slot Tech Magazine is strictly technical. As such, the magazine's contents are not time critical. The repair information and technical data contained in past issues is just as valid today as it was the day it was published.

Additionally, current and future articles more-or-less assume that readers are already familiar with what has been covered in past issues. This editorial policy assures that Slot Tech Magazine's contributing writers are not limited to "writing down" to the level of a novice technician but are free to continue to produce the most comprehensive technical articles in the gaming industry.

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