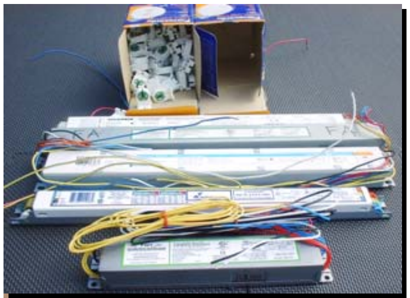
Introduction:

360° Product Testing has been retained to review and evaluate the design specifications and materials of 347-volt fluorescent lamp fixtures (as pictured at right). What follows are the **findings** from our independent analysis:



FWT Brand #4 Model #4

Recommended Lamp Filament Connection: Parallel

Cast T° Rise: sample #1 37.5° C
#2 34.5° C

Wattage at 347 VAC:
Two Lamps 138 to 148 Watts

Average Min. Start Voltage:
140 VAC to 192 VAC **

Construction (Made in China)**:**

(3) Switching FETs, and an International Rectifier IR2153 Control Chip

(2) 400 VDC Power Supply Capacitors in Series, 800 VDC

Protection: 0.39-Ohm resistor used as a fuse

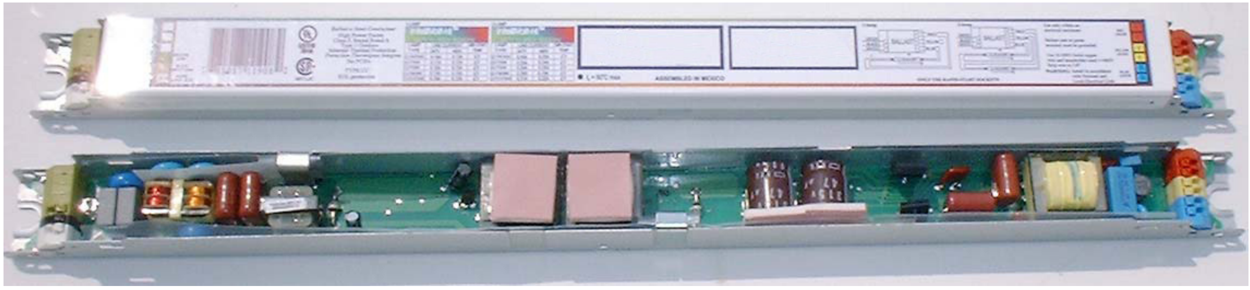
Comments:

- Low grade circuit board material
- Finished unit is filled with tar

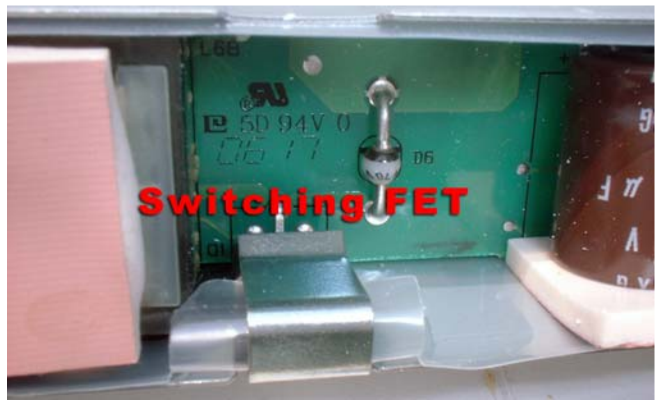
Failure Mode **

If the input voltage drops below 190 VAC the ballast goes into High Current / Low Voltage Mode. Input wattage increases to 240 watts, and the ballast makes a loud buzzing noise. At this point, the lamps are only dimly lit, or not lit at all. After the high current mode starts, raising the voltage to 347 VAC does not always reset the logic circuits in the ballast.

In the lab, failures can be induced by reducing voltage until the ballast starts making a buzzing noise. This noise appears between 140 to 190 VAC on the three tested ballasts. When buzzing, the primary current quickly rises from 1.2 - 1.4 Amps to 3 Amps. If allowed to continue in this buzzing mode for more than 60-seconds, the current rises to 4 or 5 amps and within 90-seconds the unit fails from as the resistor/fuse fails. In photo above right, note how the switching transistor has melted the tar around the transistor in less than 90-seconds.



BRAND #2 Model #2



Recommended lamp filament connection:
Series

Cast T° Rise: sample #1 41.5° C
#2 39.5° C

Wattage at 347 VAC:
Two Lamps   137 to 144 Watts

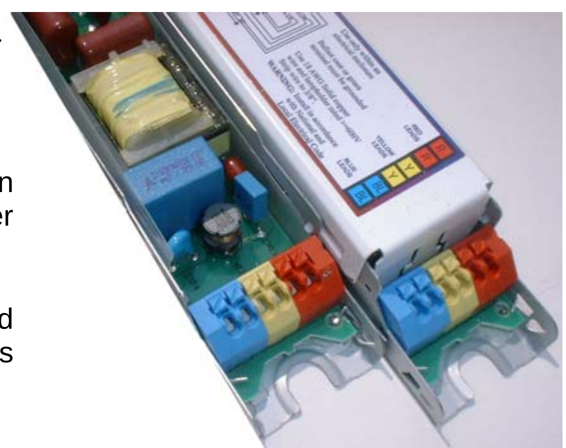
Min. Start Voltage:
Varied between 242 VAC and 271 VAC

Construction:
Made in Mexico

(4) Switching FETs

(1) Transistor, no control IC

(2) 315 VDC Power Supply
Capacitors in Series, 630 VDC



Protection: AC Main is fused with a with a Varistor Resettable Fuse and a conventional 2 Amp fuse.

Comments:

- Well made PC Board with extra insulation added to help isolate the power supply filter capacitors and two of the transformers.
- Label looked busy with all the notes and diagrams on the cover; however, all notations are useful and informative.
- Desirable color-coding for the push-in wiring terminals.

Brand #3 Model #3

Recommended Lamp Filament Connection: Series

Cast T° Rise: sample   #1 35.0° C
#2 39.5° C

Wattage at 347 VAC:
Two Lamps   133.5 to 149 Watts

Min. Start Voltage:
Varied between 198 VAC and 318 VAC

Construction:
Made in China

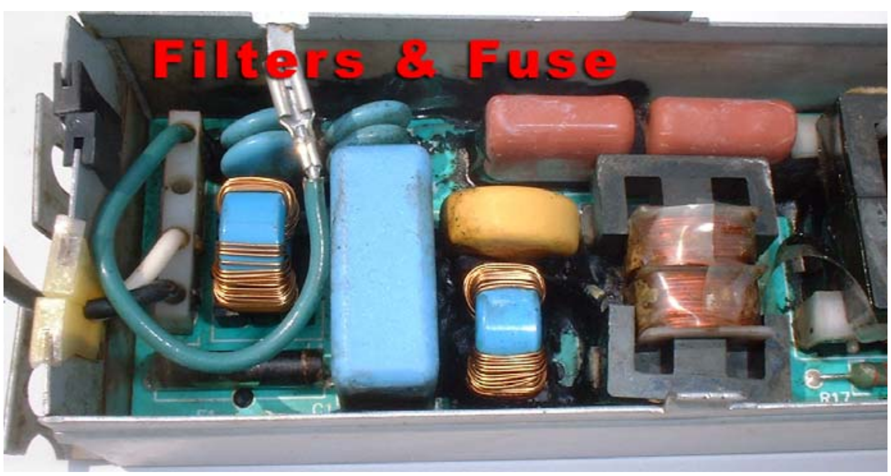
(4) Switching FETs

(1) 15 Volt Regulator, no Control IC is used

(2) 450 VDC Power Supply Capacitors in Series, 900 VDC

Protection: AC Main is fused (value unreadable)

Comments: Finished units are filled with tar



Brand #1 Model #1

Recommended Lamp filament connection:
Series *(connection method is not noted on unit)*

Cast T° Rise: sample #1 22.5° C
#2 31.0° C

Wattage at 347 VAC:
Two Lamps 121 to 128 Watts

Min. Start Voltage:
Varied between 281 and 285 VAC

Note: Very good power regulation -- no variation in input power or lamp brightness when input voltage varied between 300 VAC and 400 VAC

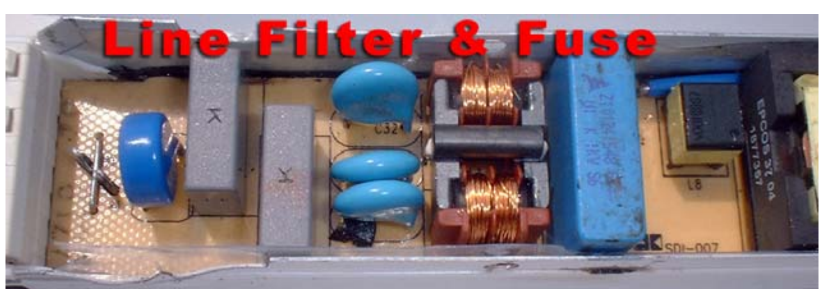
Construction:
Made in China

All switching components housed within a single IC.

That a single IC could be used to switch this much power, at this high a voltage, is surprising. However, the manufacturing technique does allow very high consistency between high voltage components since they all are created in an identical manufacturing process.

Protection: Thermal resettable Varistor Fuse

Comments:



- Recommended wiring and labeling for the lamp connections were poor

- The only unit missing a separate ground / earth wiring connection
- The Brand #1 uses an average of 15 watts less than the other ballasts. In a 24 Hour application, this represents about 130 Kilowatt hours less power used per year per ballast

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Theory of Operation

These electronic ballast are being used as a switch mode power supply. The main's power is switched into three separate power supplies. These three power supplies then power the two lamp heaters and the lamp's main voltage. Short pulses of the main's current are used to control voltages. As main voltage drops, circuits in the switch mode power supply lengthen pulses to the lamp proportionally. As main voltage rises, circuits supply shorter pulses to the lamp. This property is evident when ballasts pull more current at 300 VAC and less current at 400 VAC. In both cases, total watts consumed are virtually unchanged, and power to the lamp remains well regulated.

As main's voltage is lowered, the Brand #2, Brand #3, and Brand #1 ballasts correct for the low voltage with higher current until a threshold point is reached, and then the power supply shuts down. However, the Brand #4' ballast continues increasing current until the current rating for the switching transistor is exceeded. In a matter of seconds, the transistor exceeds its thermal ratings and the power supply fails. This shortcoming is primarily a function of marginal circuit design.

Watts Performance Averaged over 4-Ballasts

Brand	Protection	Power Used	Case T° Rise (Hottest Area)
Brand #4	Resistor	143 Watts	36° C
Brand #2	Resettable Fuse + 2 Amp Fuse	140 Watts	40° C
Brand #3	Fuse	141 Watts	37° C
Brand #1	Resettable Fuse	125 Watts	26° C

As earlier noted, the rule of thumb is that for every additional 10° C of a component's operational temperature, the life of that component is halved. Thus, under identical circumstances, the Brand #1 QTP would be expected to have twice the life expectancy of the tested Brand #2, Brand #3, and Brand #4 ballasts.

Any practical measures, e.g., placement, ventilation, etc., that lower the operating temperature of installed ballasts will help extend their service lives. Improving air circulation around the ballast even slightly can have a significant impact on ballast longevity.

From an electrical engineering perspective, we would rank the ballasts in the following order, and do so for the reasons noted *(1 = Highest)*:

1. Brand #1
    - Highest efficiency
    - Very good construction
    - Very good circuit protection
    - Lowest operating temperature

2. Brand #2
    - Average efficiency
    - Very good construction
    - Very good labeling

3. Brand #3
    - Average efficiency
    - Average construction

4. Brand #4
    - Average efficiency
    - Below average construction
    - Below average components
    - High current failure mode can be induced with a momentary drop in main's voltage below 190 VAC