T5 versus T8 Fluorescent Lamps

The good, the bad, & the ugly about T8 and T5 lamps

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The Fluorescent Ballast

A control device for fluorescent lamps that perfoms three basic functions

1) supplies power (as required) to preheat lamp filaments
2) supplies sufficient high voltage to initiate an arc through the gas in the lamp
3) limits lamp current to within the given lamp's specifications

BALLASTS

- **Magnetic**
- **Hybrid**
- **Electronic**
  - **T8 and T12**

Ballasts

Various Types of Ballasts: Electronic & Magnetic

- Four important characteristics: (Electronic)
- Ballast Factor; Power Factor; Crest Factor, THD
- Various Magnetic Ballasts:
  - Magnetic Regulator or CWA
  - Lag or Reactor
  - Lead Circuit
  - Two-Level switching
  - Dimming

Ballast Concerns

- Voltage Fluctuations
- Trapezoid Curve: HPS
- HPS: PSU research
- Heat, Heat, Heat

A guide to electronic ballasts

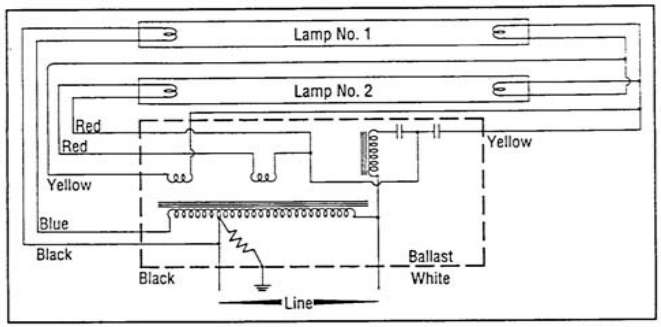


Fig. 2. Typical rapid start ballast circuit

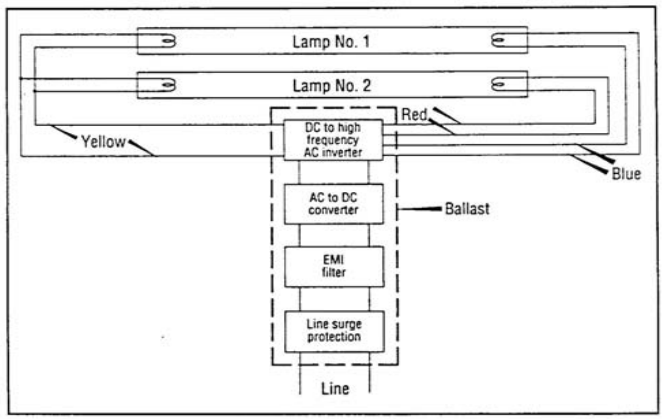
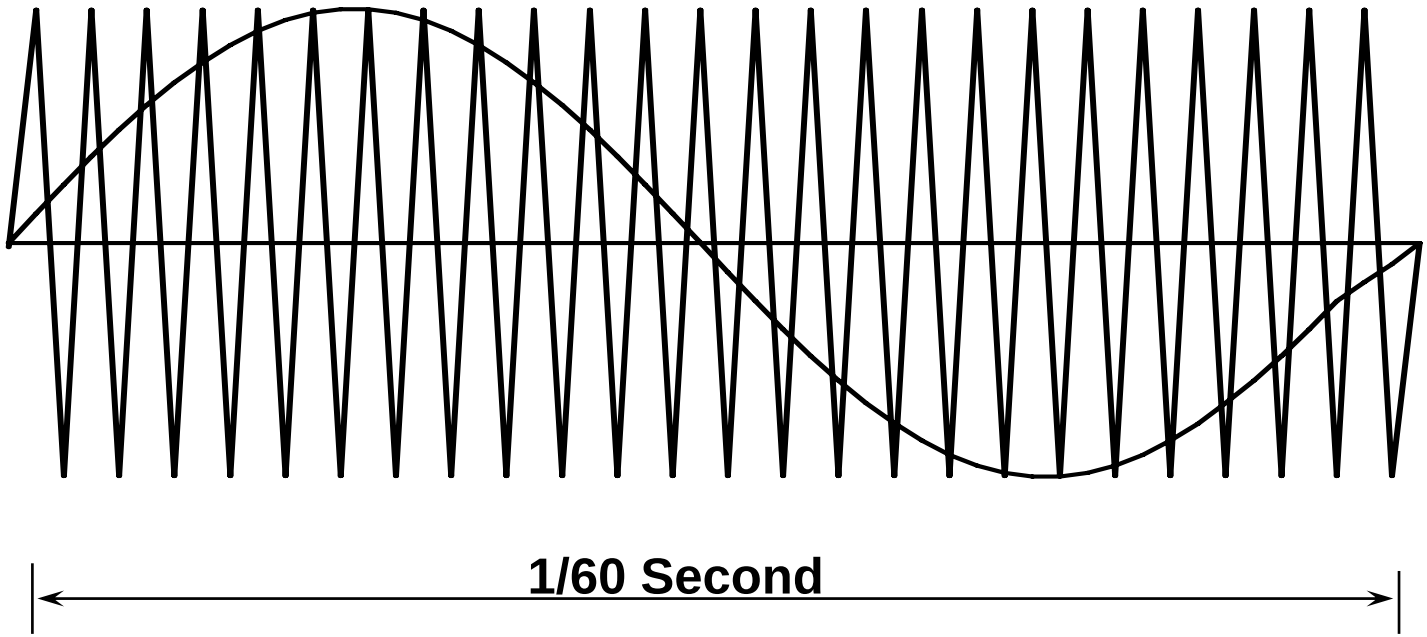


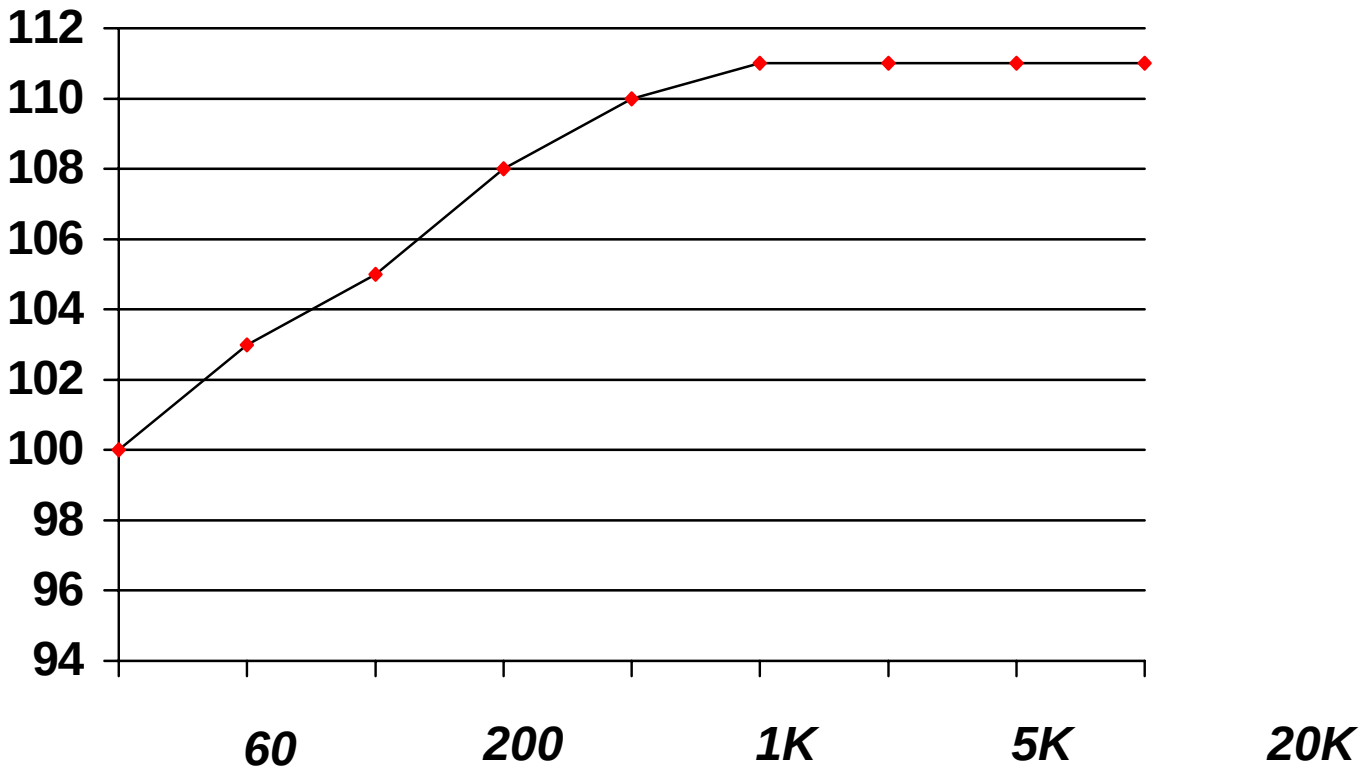
Fig. 3. Typical electronic ballast diagram

60 Hz vs. High Frequency



Actual Frequency Depicted is 1500 Hz

Output Increases with Frequency



Approximately 10% more light per watt at > 20k Hz

Why Ballast Factor is Important

- Performance is based upon BF
- Specifications must be aware of BF
- Electronics must adhere to BF Guidelines

Electronic Ballasts

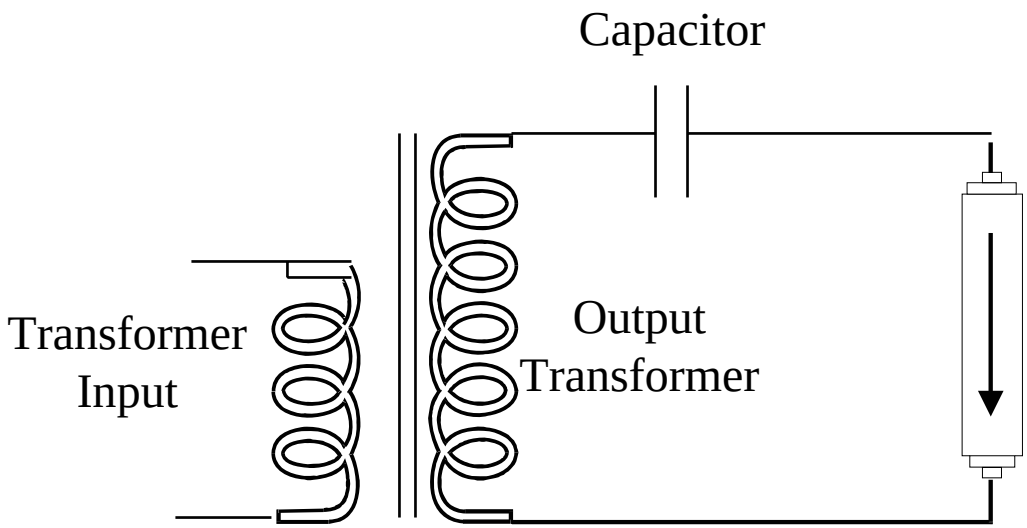
Features

- Very High Power Factor
- Multi-Lamp Capability
- Cooler Operation
- Low Harmonic Distortion
- Parallel Lamp Operation

Benefits

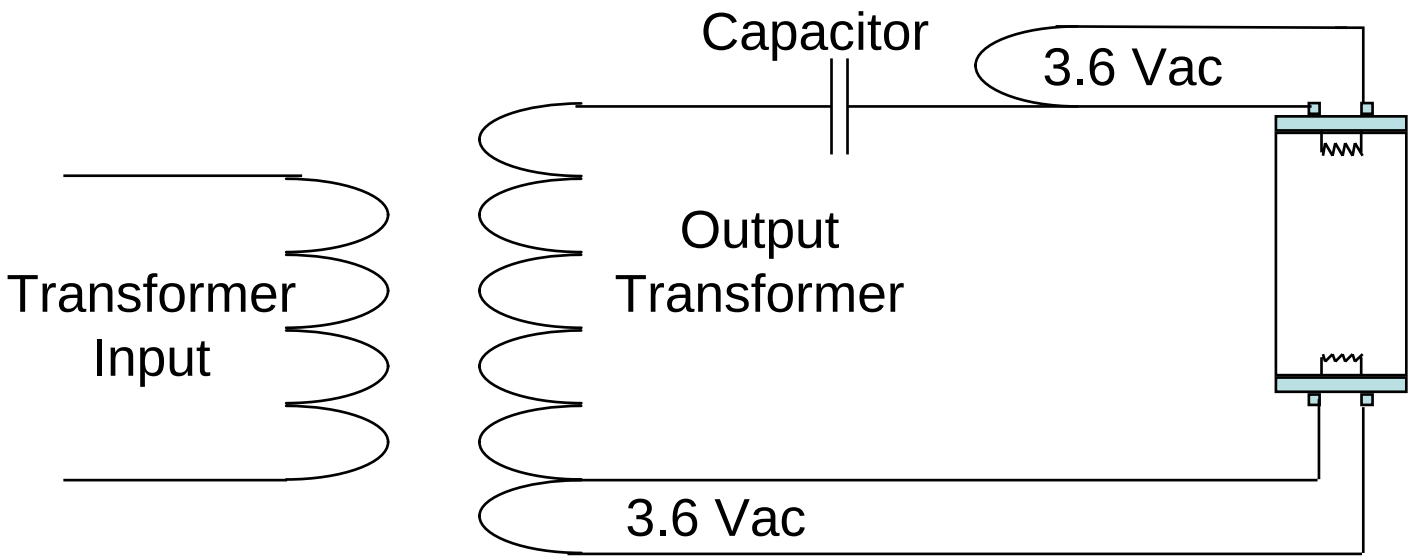
- Minimizes load on system
- Reduces initial cost
- Reduces air conditioning
- Reduces neutral current
- Reduces labor to troubleshoot

Instant Start



- **Voltage supplied for transformer input is high frequency for electronic, 60Hz if electromagnetic**
- **Output of transformer supplies voltage to ignite the lamp without cathode heat.**
- **Capacitor in series with the lamp controls lamp current**

Rapid Start



- **Provides continuous filament heating prior to starting and during operating of lamps.**
- **Output voltage stepped up as required.**
- **Allows lower starting voltage than instant start circuit. Capacitor limits lamp current.**

Rapid Start

- **Defined in ANSI C82.11-1993**
- **Lamp and Cathode Voltage Are Applied Simultaneously**
  - **Glowing Is Visible Prior to Ignition**
- **When the Cathode Temperature Rises to the point of Thermionic Emission, the Lamp Ignites.**
  - **Depending upon the Lamp Voltage, this may not guarantee that the Cathode is sufficiently heated.**
- **Cathode Voltage Remains After the Lamp Has Started Consuming Approximately 2 Watts Per Lamp**
- **Product example: 446LSLHTCP**

Standard system for 4’ F40T12 lamps

Programmed Start

- ☑ Programmed Starting Sequence Provides for Long Lamp Life
- ☑ Reduces Cathode Voltage After Lamp Ignition to Maximize energy savings
- ☑ Over 1 Million Starts in Lab
- ☑ Ideal for Application of < 3 Hours/Start

Technology for Long Lamp Life

T5 and T8 Fluorescent Lamp Performance Comparison			
	T5	**T5HO**	**T8**
Initial rated light output[1]	2,900 lumens	5,000 lumens	2,950 lumens
Nominal lamp watts	28W	54W	32W
Initial lamp efficacy[1]	104 lpw	93 lpw	92 lpw
Initial system efficacy[2]	89 lpw	85 lpw	90 lpw
Lumen maintenance[1]	97%	95%	93%[3]
Maintained system efficacy	86 lpw	81 lpw	84 lpw
Rated life	16,000 hrs	16,000 hrs	20,000 hr
Optimum operating temperature	95°F	95°F	77°F

[1] Based on 4 ft nominal lamp length, 85 CRI lamps

[2] Based on 4 ft nominal lamp length, 85 CRI, 2-lamp rapid-start electronic ballast

[3] This value varies, depending on manufacturer and phosphor coating technology used in the manufacturing process

Table 1. T5 and T8 fluorescent lamp performance comparison.

T8 Electronic Ballasts

Product Options

History of T8 Lamps

- What came first?
- Why did T12 lamps come into being?
- Why did we revert back to T8 lamps?

High Efficiency Electronic Ballasts

- Yield up to an additional 8% savings over standard electronic ballasts
- Dedicated or universal input voltage options
- Instant start technology maximizes energy savings for long cycle operations
- Ballast Factor Options
  - .87 – Standard Light Output (HE) product family
  - .77 – Low Power (EL) product family
- Parallel lamp operation
- Auto-reset upon lamp replacement as a standard feature
- Anti-striation control
- Standard wiring and mounting footprint simplifies installation
- THD <10%

T8 Advantages

- Work horse of the industry
- Less fragile than T5’s
- Available in many lengths, color temperatures, and color renditions
- Good “end of life lumens”
- Less costly now than T5’s
- Easy to replace T12’s
- Saves energy; IS more efficacious
- Use PS if sensors are deployed

Why T8 Lamps Fail

- Lamps are replaced without shutting off power
- Lamp contacts must not come in contact with grounding areas
- Lamps not compatible with ballasts
- Lamps not operating in ambient temperatures for which they were designed
- IS & sensors reduce lamp life

T5 Lamps

- Ballast must contain shutdown circuitry
- Lamps must contain programmed rapid start design
- Heat must be properly dissipated from fixture
- No need to cycle power when replacing
- Beware of application-Heat! Heat! Heat!
- Lamps operate more effectively at higher temperature than T8 lamps

Instant Start T5HO

- Maximum energy savings over standard T5HO systems
  - Saves an additional two watts per lamp
  - 12 Watt savings in a 6-lamp fixture
- Ideal for long cycle applications
- Microprocessor control technology
  - End-of-Lamp Life shutdown circuits for safe operation
- Two voltage range products
  - Universal Voltage: 120 – 277 volt
  - High Range Voltage: 347 – 480 volt
- THD < 10%
- New “E” can for optimum heat dissipation
  - Encapsulated for heat transfer
  - Larger cross section for reduced power/thermal density
- 2-Lamp & 4-Lamp models available
  - UNV & HRV voltage families

ULTim5™ T5 HO Electronic Ballasts

- Instant start technology for maximum energy savings
- Voltage options
  - Universal input voltage (108-305 volts)
  - High range input voltage (347-480 volts)
- Microprocessor control ensures precision performance
- New can design for optimum heat dissipation
  - Encapsulated for heat transfer
  - Larger cross section for reduced power/thermal density
- Low starting temperature (0° F / -18° C)
- End-of-lamp life shutdown circuit for safe operation
- THD <10%

ThinLine T5 and T5HO

NEW!

Performance Parameters

Programmed Rapid Start

- Universal Input Voltage, 50/60 Hz
- Multiple lamp operation
- THD < 10%
- Ballast Factor = 1.0

B228PUNV-C B254PUNV-D
B239PUNV-D B224PUNV-C

Product Dimensions

"C" 1.0" x 1.18" x 13.75"
"D" 1.0" x 1.18" x 16.3"

Product Technology

- Lamp shutdown circuitry
- Extremely small cross section
- *SMT* component technology

Application Recommendations

- Direct/Indirect Lighting
- Under cabinet
- Pendant Mount

Feature	Benefit
• Universal input voltage (108 to 305 volts)	- Installer friendly - Reduces Inventory
• Multiple lamp operation	
- B228PUNV-C	- (1 or 2) F14, F21, F28 or F35T5 Lamps
- B254PUNV-D	- (1 or 2) F54T5HO Lamps
- B239PUNV-D	- (1 or 2) F39T5HO Lamps
- B224PUNV-C	- (1 or 2) F24T5HO Lamps
• Lamp shutdown circuitry	- Meets ANSI/NEMA requirements - Auto-reset for easy re-lamp
• Reduced profile & X-Section	- Increased fixture design flexibility
• Programmed Rapid Start	- Maximizes lamp life
• Lightweight	- Eases installation & transportation
• Plug-in lead connectors	- Easy Installation

AccuStart® 5 T5HO Electronic Ballasts

- Programmed rapid start technology maximizes lamp life
- Optional replacement for traditional HID high bay applications
- Universal input voltage (108-305 volts)
- Provides long lamp life for frequently switched applications where occupancy sensors and wall switches are used
- Feature end-of-lamp life shutdown circuits
- Low profile case dimensions for fixture design flexibility
- 2/1 and 4/3 Lamp product offering
- THD <10%

T5 Lamp Advantages

- Smaller cross section & size
- Better light control
- Better luminous efficacy (Lumens per watt)
- Smaller ballasts
- Good color rendition availability
- Various lengths
- Good color temperature availability
- Better photometric performance
- Should be programmed start technology

Problems with T5 / T5HO Lamps

- Different lumen output among mfgrs.
- Variations of lumens between 25° & 35° (can gain or lose 10% light output)
- Light output changes between direct & indirect luminaires
- Light output changes between bare lamps & enclosed luminaires
- Horizontal vs. vertical burning variables
- Temperature & position sensitive
- Lamp life reduced if PS not used; IS good for long use

Universal Lighting Technologies

End of Lamp Life Shut Down

When lamps with a bulb diameter of T5 or less (i.e. standard 4-pin compact fluorescent lamps) are *operated on high frequency electronic ballasts* without EOL sensing circuitry, one or both of the following scenarios may occur at end-of-lamp-life:

1. Glass cracking near lamp base (the filament opens and touches the glass)

2. Overheating or melting of lamp base or socket (Lamp rectifies at the end of life and generates significant heat at the filaments and socket).

ANSI will publish an addendum to standard C78 requiring electronic ballasts for lamps with a bulb diameter of T5 or less to have a means of discontinuing operation if the lamp operation meets a defined condition that signifies the end of lamp life.

LAMPS

End of life lumens:

F32T8	**91 L/W**
F25T5	**88 L/W**
F54T5HO	**76 L/W**

The best F32T8 lamp has 4000 extra hours life at 1.@ BF

One mfg. BF 1.32 (3765 end of life lumens). This is only 15 % less than the 54T5HO, but consumes 26% less energy

Industrial: Replace 400 watt HPS with 4' 4 lamp hibay fluor. of 4-5000K 54T5HO lamps reduces from 460 watts to 234 watts, + use of photocell, timers, etc.

"Scotopically enhanced lighting saves energy
The color spectrum activates the rods, which reduce pupil size, increase visual acuity & brightness perception

Conclusions

T8’s and T5’s are here to stay!!

In spite of all the advantages
of T5 & T5HO

T8’S ARE STILL YOUR
BEST OVERALL CHOICE!!!