# Contents

# 2 Precision Illumination with Fluorescents

The fluorescent lamp is a rugged, linear light-source that solves a multitude of lighting requirements without complex reflectors, filters, or lenses, and especially without the heat control risks that often accompany other lamp types. Moreover, they provide a soft light - ideal for Electronic Imaging, and when driven at high power, they generate a desirable light-field with a diffused source, spectral stability, filter-free simplicity, photopic purity, excellent field-depth, and brilliant output. Therefore, fluorescents have become an essential element of Machine Vision Illumination Systems, and the successful use of them is dependent upon precise, electronic control: MERCRON's Regulation - to provide light that is continuous, ripple-free, and of constant brightness.

However, the fluorescent lamp is a complex compromise between competing factors not evident or even significant outside Machine Vision applications. Some very important, additional considerations remain for successful Machine Vision installations. They include the following:

1) Environmental Requirements
2) Lamp Life
3) Lamp Dimensions vs. Illuminated Length
4) Filaments
5) Lamp Operating Voltage
6) Color Temperature Stability
7) Acoustic Resonance
8) Plasma Instability ("Snakes")
9) Thermal Runaway

1) **ENVIRONMENTAL REQUIREMENTS**

Fluorescent lamps are unique in that they operate at - or near - room temperature; consequently the lamps are very dependent on their environment for proper operation. Fluorescent lamps operate best if the lamp body temperature is kept at 105 degrees F. The operator naturally expects the output of the fluorescent lamp to be linear, or "flat" along its length, but the natural heating of the lamp will defeat the linear output-profile unless the lamp is deliberately cooled to restore both linearity and efficacy.

Forced air cooling is recommended especially for lamps with small body diameter and lamps with High Output (HO's), or Very High Output (VHO's). Since the electrodes are in the ends of the lamp, the ends are hotter than at the lamp's center. When the lamp gets hot, the output from the **phosphor near the ends of the lamp will produce less light** than the phosphor near the center of the lamp. This results in a "convex" light-profile rather than a linear or "flat" output-profile that would be ordinarily expected.

To counter this effect...**the ends must be cooled more** than the center. A good way to do this is to force cool air at each end of the lamp and exhaust it at the lamp's center. Turbulent air is best because it provides good coupling to the lamp body and causes the body temperature to be the same everywhere which produces the best linearity. **The closer the common body temperature is to 105 degrees F, the better lamp efficacy and lamp life**. It is not sufficient to simply use a powered exhaust system to evacuate a lamp box. Injected turbulent air is necessary to provide universal cooling to the lamp's body.

2) **LAMP LIFE**

Published lamp life specs are actually half-life values, that is, half of the lamps no longer function at the listed lifetime. In Machine Vision applications where lumen maintenance is so important, usable lifetime is much less. In the first 200 hours, the lamp will lose 15% of its efficacy. In the next 800 hours, a 5% - 10% decline will occur. In the next 1000 hours, another 5% - 10% loss will occur. To preserve a constant output for a predictable number of hours, it is necessary to operate the lamp at less than full output so that a constant output can be obtained over the useful life.

Assuming a 20% decline for the first 1000 hours of operation and allowing 10% for power line variation, setting a new lamp at 70% of maximum initial output will provide about 1000 hours of constant output. If 2000 hours of use is needed, set the lamp at 60% of maximum initial output. Setting the lamp at 50% of maximum, initial output will permit about six months of useful life with constant light level.

3) **LAMP DIMENSIONS vs. ILLUMINATED LENGTH**

The lamp's diameter and the type of sockets used affect the usable ILLUMINATED LENGTH...

**Actual Length**: Lamp length is usually measured out-to-out, including the sockets, and since bipin sockets are about 1/4" thick, standard output, T8 (1 inch diameter) lamps and T12 (1.5 inch diameter) lamps are cut slightly short to account for the sockets. In other words, an F40/T12 lamp, expected to be 48" long, is actually only 47.25" long, and will fit into a 48" bay - with its sockets.

**Illuminated Length**: Fall-off in lamp light invariably occurs near the ends of the lamp; therefore, 4 lamp diameters should be allowed on <u>each end</u> of a lamp with mini or medium bipin sockets, e.g., An F40/T12 lamp, 48" long, will lose 6" (1.5" X 4) on each end of the lamp and can be used to scan a web only 36" wide; a T8 lamp would lose 4" on each end; and a T5 lamp would lose 2.5" on each end.

RDC sockets are used with HO/1000 mA, T12 lamps, and VHO/1500 mA T12 lamps. These sockets are about 1.5" thick. This means an F48/T12/VHO lamp is only 44.5" long. So lamps with RDC sockets will lose about 5 lamp diameters on each end in so far as illuminated length is concerned. (RSC sockets are similar to RDC sockets, but are not frequently used in high-frequency lamp applications).

4) **FILAMENTS**

There are three basic filament types in fluorescent lamps:

1) Rapid Start Filaments: These filaments are expected to be electrically-powered continuously during lamp operation. They are usually operated at 6 volts.

2) Preheat Filaments: These filaments are electrically powered prior to lamp ignition and are not powered during lamp operation. Ballast current will usually drive these filaments at 8-10 volts.

3) Instant Start (single-contact / cold-cathode) Filaments: These filaments are not electrically powered at all and depend on "anode bombardment" to heat the filaments. Usually, high frequency operation of the lamp does not provide enough anode bombardment for proper heating of this type filaments. For this reason, MERCRON does not recommend the use of "Instant Start", "cold cathode", or "single contact" fluorescent lamps in Machine Vision applications.

MERCRON lamp controllers are usually made for rapid start filaments; however, many T8 and T5 lamps will be found with preheat filaments, and oftentimes, differences between the two begin to "blur". But since many different types of filaments are available, MERCRON recommends testing your lamps to determine which type your lamps actually have.

A simple way to test the lamp uses voltage to find the red-hot operating condition of the filament. *A measurement of the cold filament resistance is NOT a reliable method of determining operating voltage*; the following test is more indicative, and therefore, preferred.

Use a low voltage power supply with adjustable output voltage and at least 3 amps of output current. Attach the lamp filament to be tested to the power supply by hooking up both pins on one end of the lamp. Slowly increase the voltage from 0 volts and carefully observe the lamp filament as it begins to glow. (In this test, current is not important as long as it is not restricted). If the filament turns orange or bright red when 6 volts is applied, it is a rapid start filament. If it takes 8 volts or greater to tun the filament bright red or orange, then it is a preheat filament. In summary, rapid-start filaments are important because proper filament heat is critical in a high-frequency regulated lamp. *If the filaments are not hot enough, the lamp will be difficult to start; it will blacken on the ends quickly, and it will have a short lamp life.*

5) **LAMP-OPERATING ARC VOLTAGE (Not filament voltage)**

The operating voltage of a fluorescent lamp is affected by lamp length and lamp diameter. Smaller lamp diameters require proportionally greater operating voltage. That is to say, a T8 lamp will require exactly 12/8 more voltage than a T12 lamp of the same length. (Recall: lamp diameters are classified in terms of "T", which = 1/8"; a T8 lamp equals 1" in diameter; at 12 = 1.5"). So, for example, a MERCRON lamp controller capable of driving 120" of T12 lamps, can regulate only 80" of T8 lamps. This is a handy formula to have since ***all MERCRON Lamp Controllers of 600 mA or greater are rated in terms of T12 lamps***.

6) **COLOR TEMPERATURE STABILITY**

Essentially, a fluorescent lamp is a mercury lamp that is "doped" with several phosphors for color. Both the mercury output-spectrum and the phosphor output-spectrum are visible in the output light. *As the lamp ages, it is the phosphor that decays, changing the combined output spectrum*. The resultant color temperature change follows the aging pattern discussed above, changing most rapidly when the lamp is new and slowing as the lamp ages. The temperature of the lamp affects the efficacy of the phosphor, so that a change in lamp temperature changes the color temperature. This is a good reason to keep the lamp temperature constant BOTH over time AND along the length of the physical lamp.

In recent years the fluorescent lamp universe has been flooded with high performance phosphors to market very efficient replacements for household tungsten lamps. The laptop computer market has forced the production of this type of lamp. The problem is that some of the phosphors used are so sensitive to temperature that their use in Machine Vision is risky. Newer designs, especially T5 and smaller lamps, should be checked for color temperature stability.

To test...

Ignite a cool lamp and hold your thumb on the lamp surface while the lamp warms to operating temperature. When the lamp is warm, remove your thumb from the lamp and observe the sur face uncovered. **IF it is a different color from the surrounding lamp**, pink for example, reconsider using this lamp.

This test shows that the several phosphors in the lamp respond very differently to a small change in surface temperature. This lamp will be very hard to regulate properly because the output spectrum will change radically to changes in surface temperature.

7) **ACOUSTIC RESONANCE (Bubbles in the Light)**

Fluorescent lamps driven at high frequency have a tendency to resonate at acoustic frequencies. The smaller the lamp diameter, the greater the risk of resonance. The condition may come and go as a function of lamp current, gas temperature, lamp age, etc. MERCRON believes that the risk of resonance is extremely great when a lamp diameter less than T5 is used. In many cases, the resonance is not visible to the human eye, but is easily seen by the camera.

To check for acoustic resonance...

> Look at the lamp and roll your eyes, keeping the lamp in view with peripheral vision. The lamp will appear to be a single row of balls or bubbles of light which are moving along the lamp. They may come and go, speed up or slow down, and might appear only on one end.

8) **PLASMA INSTABILITY ("SNAKES")**

New lamps will sometimes display a winding arc that sweeps around inside, causing the lamp's brightness to pulsate on the lamp's surface. This is a so-called "snake", and it is caused by impurities in the gas charge in the lamp.

To remove snakes...

> Operate the lamp at full power for two hours. This is a "gettering" process. Allow the lamp to cool, and turn it back on. With a MERCRON lamp controller, take the power to minimum (idle), and look for snakes. If the lamp is cured, no snakes will occur, even at idle. **If the snakes are still present, discard the lamp**; the impurities cannot be corrected. (Note: When lamps are very cold, snakes during warm-up is a common occurrence). If a lamp cannot generate enough power to fully warm up, use a clear plastic lamp "jacket" to help retain enough heat to achieve operational temperature.

9) **THERMAL RUNAWAY**

Thermal runaway is a condition that occurs because the ability of the lamp phosphor to generate light declines sharply as the lamp temperature increases. Suppose that a lamp was installed in an environment that did not completely dispose of the heat generated by the lamp. As lamp temperature climbed past 105 degrees F, the light output would decline unless more power was applied to the lamp to maintain the desired light output; but, the extra power would further heat the lamp, resulting in less light, and so on. The thermal runaway condition occurs when an increase in power results in a decrease in light.

Ultimately, each lamp installation is capable of disposing a limited amount of heat; **that limit determines the maximum power at which the lamp can operate**. Operation above that power / heat level will always result in a thermal runaway - which actually results in less light.

Normal lamp aging can also result in a thermal runaway condition. A new lamp can deliver the necessary light with relatively little power, perhaps satisfying the heat limits of the installation. As the lamp ages, more power is applied to maintain the light level. If the increase power exceeds the heat limits of the installation, thermal runaway will occur. In this case, the "All's Well" circuit in the MERCRON lamp controller informs the operator when the lamp controller can no longer maintain the required light level. If the "All's Well" signal is the result of a thermal runaway, the remedy is either, an improved cooling system for the lamp, or maybe just more frequent lamp replacement.

# 6 Our Problem-Solvers for Fluorescents

Following is a brief description of the five common problematic areas for Machine Vision designers when using fluorescent lamps; more specifically, when considering the usage of fluorescent lamps in conjunction with the MERCRON lamp controllers, and how immediately the employment of the MERCRON lamp controller can directly help to "control the costs". It was for this "set of problems", in 1986, that the first MERCRON lamp controller was designed to address.

Needless to say, the ultimate objective of any QA/QC Inspection System is optimum image quality. And there exists a direct correlation between image quality and cost effectiveness. Below is a demonstration of how MERCRON technology maximizes the desired quality while minimizing the costs, especially the longer-termed, eventual costs of maintenance for this type of system.

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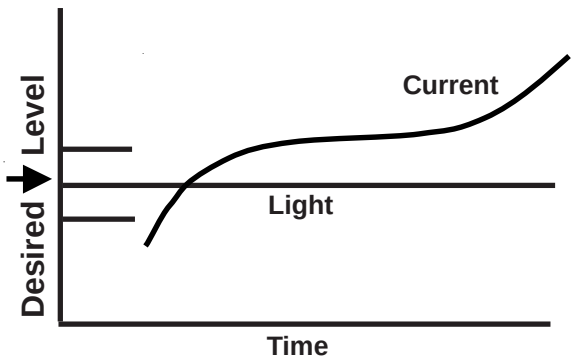
**I. PROBLEM**: In the past, when problems in image quality arose, the light level could not be used as a standard of maintenance because light sources were not stable enough, nor were they regulated.
However, since there are instances when replacement with newer and brighter lamps can help remedy the severity of image decay. Service personnel (naturally not as familiar with all the intricacies involved as are the original Design Engineers) often call for early, but technically unnecessary, lamp replacement. This practice is quite costly in terms of field service alone, not to mention the customer's agitation with extremely expensive downtime.

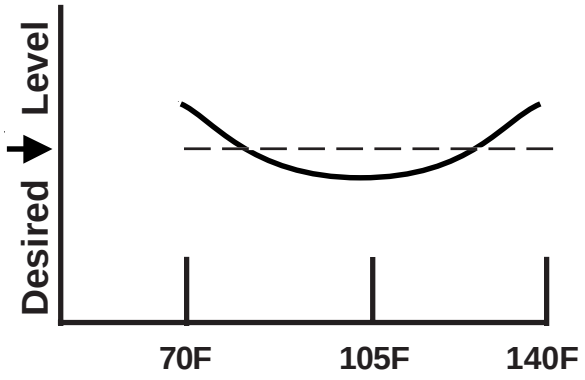
**SOLUTION: MERCRON's lamp controllers send a signal, an "All's Well" signal, to the operator at the first hint that the light level is falling below the original design level, so there is never a question of whether the lamp is at fault and therefore needs replacing. This feature dispensed with field guesswork and rework; more significantly, MERCRON's early warning of imminent lamp failure means that lamps are replaced as infrequently as possible, thereby reducing those high costs associated with lamp replacement.**

**II. PROBLEM**: Fluorescent lamps are brightest when the ambient temperature is about 105 degrees F. Higher temperatures reduce the light level so that lamps, bright enough in the morning, for example, are not bright enough in the afternoon when surrounding temperatures have risen.
Voltage drops, due to nearby heavy equipment, can also cause light level irregularities, which in turn, cause unacceptably intermittent image quality.



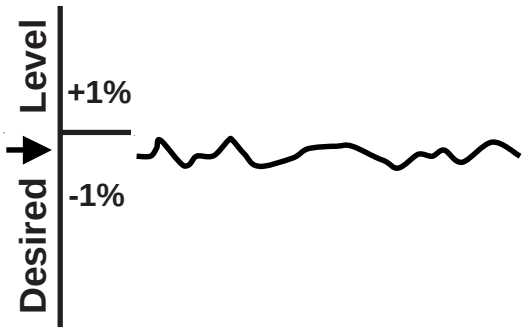

**SOLUTION: MERCRON's "Set-It-and-Forget-It" regulation feature maintains the light level within 1% of the original setting, compensating completely for inevitable voltage fluctuations and thermal drift, guaranteeing quality image consistency.**

**III. PROBLEM**: Fluorescent lamps decay very rapidly during the first 100 hours, usually as much as 15% with a consequential decrease in light level (see Fluorescent Lamp Considerations, sub section 2: "Lamp Life", p. 3 of this catalog). Even high quality camera systems have difficulty providing enough AGC to compensate for this additional bias. Moreover, field service calls are often made for the sole purpose of adjusting the system to counteract this decay.




**SOLUTION: MERCRON's Light Level Control automatically corrects the current to hold the light level constant, thereby eliminating this problem and offering real savings in greatly reduced service calls; moreover, it would enable the immediate installation of brand new lamps without the commonly necessary, and expensive, "burn-in" preliminary.**

**IV. PROBLEM**: Fluorescents steadily decay from day to day. System updates to the black and white thresholds are perpetually needed to circumvent the consequential degradation in light level; however, the original image quality with the initial, much higher light level is never fully restored, and the image quality continues to decay until some quality barrier is finally reached.




**Any Time Frame**

**SOLUTION: MERCRON's Light Level Control mechanism eliminates this problem by enforcing the original light level designed and adjusted into the system in the beginning. This means that there is no decay in image quality from the lamp's first use until its exhaustion. This certainty and consistency in image quality is of inestimable value to your customers.**

**V. PROBLEM**: With ordinary solid-state ballasts, there is no protection against the anode erosion that shortens lamplife considerably. (see Fluorescent Lamp Considerations, subsection 2: "Lamp Life", p. 3 of this catalog).

**SOLUTION: MERCRON's patented regulation circuitry protects against this erosion, and as a result, offers 60% improvement in lamplife. Obviously, extending the lamp's life lessens the overall cost of lamps and simultaneously minimizes the fieldtime involved in replacing exhausted lamps.**

**With the ability of the MERCRON lamp controller to "underdrive" the lamp when it is new and "overdrive" it when the lamp is nearing exhaustion, the maximum possible lamplife is derived with no special handling or selection of lamps.**

# 8 Fluorescent Lamp Controller Correlation Index

**THE APPROPRIATE MERCRON LAMP CONTROLLER IS DETERMINED BY THE SIZE AND TYPE OF LAMP TO BE USED, WHICH, IN TURN, IS DETERMINED BY THE AREA TO BE ILLUMINATED.**

The Lamp Index on the facing page shows the most popular fluorescent lamps and which lamp controllers are used to operate them. Technical details of the lamps: **wattage**, **length**, **diameter**, and **socket types** are shown. In many cases, one controller can operate multiple lamps. This information is shown in the "**Number of Lamps Regulated**" column.

NOTE: If the lamp you are considering is not listed in the Index or within a lamp controller series, do not hesitate to contact our technical department to determine which lamp/controller combination best meets your needs. MERCRON can generally "customize" or modify a controller for a specific lamp for a onetime engineering fee.

In order to make the Index and Series pages more meaningful, the basic principles (per the lamp manufactures themselves) of lamp classifications, terminology, and abbreviations are explained below.

Fluorescent Power Categories: Milliamps (**mA**) is a term used to express the power level of the various classifications. Since fluorescent lamps are linear light sources, milliamp rating gives a better idea of the lamps illumination **per unit length**, rather than a total wattage figure.

**Wattage will change with lamp length alone, but milliamperage will not.**

Fluorescent (Tube) Sizes: There are three common sizes of fluorescents based upon the tube's diameter: T5's, T8's, and T12's; T9's are primarily Circline/Ring lamp diameters.
Lamp diameters are expressed are expressed in terms of "**T**". Each "T" equals 1/8" , such that T5 equals 5/8" diameter.

Within each size are power categories based upon operating current expressed in terms of milliamperage (**mA**):

**Standard Output** (**Std** @ 400 mA)
**High Output** (**HO** @ 800 mA)
**Very High Output** (**VHO** @ 1500 mA)

Fluorescent Power Limitations: The amount of power a fluorescent lamp can absorb is limited by two factors:

1) How much current the electrodes will tolerate
2) How much heat the lamp's wall can dissipate

Fluorescent Abbreviations:

**F** - Fluorescent
**FA** - Fluorescent Aperture
**FC** - Fluorescent Circline
**FO** - Fluorescent Octron
**FT** - Fluorescent Compact (High Lumen) / DL
**DL** - Dulux
**OS** - Osram
**PL** - Phillips
**S&Y** - Stocker & Yale
**T5** - 5/8" (1.6 cm)
**T8** - 1" (2.54 cm)
**T9** - 1 1/8" (2.87 cm)
**T12** - 1 1/2" (3.81 cm)

| LAMP TYPE | WATTS | ACTUAL LENGTH (w/ Sockets in Inches) | ILLUMINATED LENGTH (w/ Sockets in Inches) | SOCKET TYPE | NUMBER OF LAMPS REGULATED PER MODEL | | | | MODEL SERIES |
|---|---|---|---|---|---|---|---|---|---|
| **Standard Performance/OUTPUT - 400mA** T5's: All are 5/8th (.63) inches in Diameter) | | | | | 1 | 2 | 3 | 4 | |
| F4/T5 | 4 | 6 | 1 | Mini | FN0416-2 | FN0416-2 | FN0424-4 | FN0424-4 | 400 |
| F6/T5 | 6 | 9 | 4 | Mini | FN0416-2 | FN0416-2 | FN0436-4 | FN0436-4 | 400 |
| F8/T5 | 8 | 12 | 7 | Mini | FN0416-2 | FN0436-4 | FN0436-4 | FN0448-4 | 400 |
| F10/T5 | 10 | 17 | 12 | Mini | FN0416-2 | FN0436-4 | FN0464-4DV | FN0464-4DV | 400 |
| F13/T8 | 13 | 21 | 16 | Mini | FN0424-4 | FN0448-4 | | | 400 |
| **T8's**:: All are 1.0 inch in Diameter... | | | | | | | | | |
| F15/T8 | 15 | 18 | 10 | Med. | FN0624-1 | FN0648-2 | FN0696-4 HNP0480-3 | FN0696-4 HN06120-4 | 400, 600 |
| F30/T8 | 30 | 36 | 28 | Med. | FN0648-2 | HN06120-4 | | | |
| FO40/T8 | 40 | 60 | 52 | Med. | FN0696-4 | | | | |
| **T12's**: All are 1.5 inches in Diameter... | | | | | | | | | |
| F14/T12 | 14 | 15 | 3 | Med. | FN0624-1 | FN0648-2 | | | 600 |
| F15/T12 | 15 | 18 | 6 | Med. | FN0624-1 | FN0648-2 | | FN0696-4 | |
| F20/T12 | 20 | 24 | 12 | Med. | FN0624-1 | FN0648-2 | | FN0696-4 | |
| F30/T12 | 30 | 36 | 24 | Med. | FN0648-2 | FN0696-4 | HN06120-4 | FN06144-4 | |
| F40/T12 | 40 | 48 | 36 | Med. | FN0648-2 | FN0696-4 | FN06144-4 | FN06192-4 | |
| **High Performance/OUTPUT - 800mA** **T8's**: All are 1.0 inch in Diameter... | | | | | | | | | |
| F15/T8/HO | 30 | 18 | 10 | Med. | HN1024-1 FN1124-1 | | FN1096-4 | | 1000, 1100 |
| **T12's**: All are 1.5 inches in Diameter... | | | | | | | | | |
| F24/T12/HO | 32 | 35 | 6 | RDC | HN1024-1 FN1124-1 | FN1048-2 | | FN1096-4 | 1000, 1100 |
| F36/T12/HO | 44 | 36 | 18 | RDC | FN1048-2 | FN1096-4 | FN10120-4 | FN10144-4 | 1000 |
| F48/T12/HO | 60 | 48 | 30 | RDC | FN1048-2 | FN1096-4 | FN10144-4 | FN10192-4 | 1000 |
| F72/T12/HO | 85 | 72 | 54 | RDC | FN1096-4 | FN10144-4 | | | 1000 |
| F96/T12/HO | 110 | 96 | 78 | RDC | FN1096-4 | FN10192-4 | | | 1000 |
| **Very High Performance/OUTPUT - 1500mA** **T12's**: All are 1.5 inches in Diameter... | | | | | | | | | |
| FA20/T12/VHO | 57 | 24 | 12 | Med. | FN2024-1 HN2024-1 | FN2048-2 HN2048-2 | | FCC1696-2 FN1896-4 | 1600, 1800, 2000 |
| FA28/T12/VHO | 68 | 28 | 13 | Med. | FN2048-2 | FN1872-2 | FCC1696-2 FN1896-4 | FN23120-4 HN23120-4 | 1600, 1800, 2000, 2300 |
| FA30/T12/VHO | 57 | 36 | 24 | Med. | FN2048-2 | FN1872-2 | FN18120-4 FN23120-4 HN23120-4 | FN16144-4 | 1600, 1800, 2000, 2300 |
| F48/T12/VHO | 115 | 48 | 30 | RDC | FN2048-2 HN2048-2 | FCC1696-2 FN1896-4 FN2396-4 HN2396-4 | FN16144-4 | FN16192-4 FCC16192-2 | 1600, 1800, 2000, 2300 |
| F60/T12/VHO | 135 | 60 | 42 | RDC | FN1872-2 | FN18120-4 FN23120-4 HN23120-4 | FN16192-4 FCC16192-2 | | 1600, 1800, 2300 |
| F72/T12/VHO | 165 | 72 | 54 | RDC | FN1872-2 | FN16144-4 | | | 1600, 1800 |
| F96/T12/VHO | 215 | 96 | 78 | RDC | FCC1696-2 FN1896-4 FN2396-2 HN2396-2 | FN16192-4 FCC16192-2 | | | 1600, 1800, 2300 |
| **TYPE: TWIN TUBES** **All are RAPID START** | | | | | | | | | |
| GE F18 BIAX | 18 | 9 | | 2G11 | FN0648-2 | FN0696-4 | | | 600 |
| 0S 24W Dulux | 24 | 11 | | 2G11 | FN0648-2 | FN0696-4 | | | 600 |
| OS 40W Dulux | 40 | 21 | | 2G11 | FN0664-4 | HN06120-4 | | | 400, 600 |
| OS 36W Dulux | 36 | 14.75 | | 2G11 | FN0664-4 | HN06120-4 | | | 400, 600 |
| GE F40 BIAX | 40 | 21 | | 2G11 | FN0664-4 | HN06120-4 | | | 400, 600 |
| OS 55W Dulux | 55 | 19.5 | | 2G11 | FN0696-4 | FN06144-4 | | | 600 |
| PL-L 80W | 80 | 21 | | 2G11 | FN0696-4 | FN06144-4 | | | 600 |
| **TYPE: CIRCULAR** | | | | | | | | | |
| FC6/T9 | 20 | n/a | 6 | 4-PIN | FN0624-1 | FN0648-2 | | FN0696-4 | 600 |
| FC8/T9 | 22 | n/a | 8 | 4-PIN | FN0516-1 | FN0664-2 | | | 500, 600 |
| FC12/T9 | 38 | n/a | 12 | 4-PIN | FN0648-2 | FN0696-4 | FN06144-4 | | 600 |
| S&Y RING | 8 | n/a | 3 | Mini | FN0516-1 | FN0424-4 | FN0436-4 | | 400, 500 |

# 10 Fluorescent Lamp Controllers - 400 Series

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| FN0416-2/**120**<br>FN0416-2/**230** | 120<br>230 | 60<br>50 | 0.30<br>0.15 | 165 | 53 | 70 - 450 | 6.5 : 1 | 3.25 : 1 | 0.25% |
| FN0424-4/**120**<br>FN0424-4/**230** | 120<br>230 | 60<br>50 | 0.30<br>0.15 | 205 | 53 | 70 - 450 | 6.5 : 1 | 3.25 : 1 | 0.25% |
| FN0436-4/**120**<br>FN0436-4/**230**<br>FX0436-4/**120 (UL)**<br>FX0436-4/**230 (UL)** | 120<br>230<br>120<br>230 | 60<br>50<br>60<br>50 | 0.50<br>0.25<br>0.50<br>0.25 | 270 | 53 | 70 - 450 | 6.5 : 1 | 3.25 : 1 | 0.25% |
| FN0448-4/**120**<br>FN0448-4/**230** | 120<br>230 | 60<br>50 | 0.80<br>0.40 | 360 | 60 | 70 - 450 | 6.5 : 1 | 3.25 : 1 | 0.25% |
| HN0448-4/**120**<br>HN0448-4/**230** | 120<br>230 | 60<br>50 | 0.80<br>0.40 | 360 | 60 | 30 - 450 | 15 : 1 | 7.5 : 1 | 1.0%***** |
| FN0464-4/**120**<br>FN0464-4/**230**<br>FNC0464-4/**120****<br>FNC0464-4/**230**** | 120<br>230<br>120<br>230 | 60<br>50<br>60<br>50 | 0.90<br>0.50<br>0.90<br>0.50 | 450 | 47 | 50 - 350<br>50 - 350<br>130 - 350<br>130 - 350 | 7 : 1<br>7 : 1<br>2.7 : 1<br>2.7 : 1 | 3.5 : 1<br>3.5 : 1<br>1.4 : 1<br>1.4 : 1 | 0.25%<br>0.25%<br>0.50%<br>0.50% |
| FN0464-4**DV (UL)** | 120<br>230<br>Switch | 60<br>50<br>Selectable | 0.90<br>0.50 | 450 | 47 | 50 - 350 | 7 : 1 | 3.5 : 1 | 0.25% |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

** Current Control only

# 400 Series



Below is an **itemization of lamps** successfully **regulated by the corresponding** [illegible] **Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| 2<br>2<br>1 | F4/T5/Std **or**<br>F6/T5/Std **or**<br>F10/T5/Std | 6"<br>9"<br>16" | 5/8"<br>5/8"<br>5/8" | 8 > 19<br>12 > 30<br>10 > 20 | 1 |
| 4<br>2<br>2<br>1 | F4/T5/Std **or**<br>F8/T5/Std **or**<br>S&Y Ring **or**<br>F13/T5/Std | 6"<br>12"<br>---<br>21" | 5/8"<br>5/8"<br>3"<br>5/8" | 16 > 38<br>16 > 44<br>16 > 20<br>13 > 32 | 1 |
| 4<br>3<br>3<br>2 | F6/T5/Std **or**<br>F8/T5/Std **or**<br>S&Y Ring **or**<br>F10/T5/Std | 9"<br>12"<br>---<br>16" | 5/8"<br>5/8"<br>3"<br>5/8" | 24 > 60<br>24 > 66<br>24 > 30<br>20 > 40 | 1 |
| 4 | F8/T5/Std | 12" | 5/8" | 32 > 88 | 1 |
| 4 | F8/T5/Std | 12" | 5/8" | 32 > 88 | 1 |
| 4<br>4<br>4 | F6/T5/Std (Pre-heat) **or**<br>F8/T5/Std **or**<br>F10/T5/Std | 9"<br>12"<br>16" | 5/8" | 24 > 60<br>32 > 88<br>40 > 80 | 1 |
| 4<br>4<br>4 | F6/T5/Std (Pre-heat) **or**<br>F8/T5/Std **or**<br>F10/T5/Std | 9"<br>12"<br>16" | 5/8" | 24 > 60<br>32 > 88<br>40 > 80 | 2 |

## Notes:

* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 12 Fluorescent Lamp Controllers - 400 & 500 Series

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| **400 Series (Continued)** | | | | | | | | | |
| HNP0480-3/**120**<br>HNP0480-3/**230**<br>(For Pre-Heat Lamps) | 120<br>230 | 60<br>50 | 295 | 60 | 0.8 | 28 - 400 | 14.3 : 1 | 7.1 : 1 | 0.25% |
| HN0480-3/**120**<br>HN0480-3/**230** | 120<br>230 | 60<br>50 | 295 | 60 | 0.8 | 28 - 400 | 14.3 : 1 | 7.1 : 1 | 1.0%* |
| **500 Series** | | | | | | | | | |
| FN0516-1/**120**<br>FN0516-1/**230** | 120<br>230 | 60<br>50 | 165 | 53 | 0.3 | 70 - 500 | 7.2 : 1 | 3.6 : 1 | 0.25% |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

Below is an **itemization of lamps** successfully **regulated by the corresponding** [illegible] **Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| **400 Series (Continued)** | | | | | |
| 3 | F18/T8/Std (Pre-heat Lamps Only) | 18" | 1" | 45 > 59 | 1 |
| 3 | F18/T8/Std | 18" | 1" | 45 > 59 | 1 |
| **500 Series** | | | | | |
| 1 | FC8/T9 **or** | -- | 8" | 22 > 29 | 1 |
| 1 | S&Y Ring | -- | 3" | 8 > 12 | |

**Notes:**

* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 14 Fluorescent Lamp Controllers - 600 Series

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| FN0624-1/**120**<br>FN0624-1/**230** | 120<br>230 | 60<br>50 | 0.30<br>0.15 | 120 | 53 | 150 > 600 | 4 : 1 | 2 : 1 | 0.25% |
| FN0648-2/**120**<br>FN0648-2/**230** | 120<br>230 | 60<br>50 | 0.6<br>0.3 | 165 | 53 | 150 > 600 | 4 : 1 | 2 : 1 | 0.25% |
| FN0664-2/**120**<br>FN0664-2/**230** | 120<br>230 | 60<br>50 | 0.70<br>0.35 | 205 | 57 | 150 > 600 | 4 : 1 | 2 : 1 | 0.25% |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

# 600 Series



Below is an **itemization of lamps** successfully **regulated by the corresponding [illegible] Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| 1 | FC6/T9 **or** | -- | 6" | 20 > 30 | |
| 1 | F14/T12/Std **or** | 15" | 1.5" | 14 > 22 | |
| 1 | F15/T8/Std **or** | 18" | 1.5" | 15 > 30 | 1 |
| 1 | F15/T12/Std **or** | 18" | 1.5" | 15 > 27 | |
| 1 | F20/T12/Std | 24" | 1.5" | 20 > 32 | |
| 1 | FT/18/DL **or** | 9" | 5/8" | 18 > 23 | |
| 1 | FT/24/DL **or** | 9" | 5/8" | 24 > 28 | |
| 2 | FC6/T9 **or** | -- | 6" | 40 > 59 | |
| 1 | FC12/T9 **or** | -- | 12" | 32 > 45 | |
| 2 | F14/T12/Std **or** | 15" | 1.5" | 28 > 44 | |
| 2 | F15/T8/Std **or** | 18" | 1" | 30 > 59 | 1 |
| 2 | F15/T12/Std **or** | 18" | 1.5" | 30 > 55 | |
| 2 | F20/T12/Std **or** | 24" | 1.5" | 40 > 63 | |
| 1 | F30/T8/Std **or** | 36" | 1" | 30 > 51 | |
| 1 | F30/T12/Std **or** | 36" | 1.5" | 30 > 42 | |
| 1 | F40/T12/Std | 48" | 1.5" | 40 > 56 | |
| 1 | FT/36/DL **or** | 16.6" | 5/8" | 36 > 41 | |
| 1 | FT/40/DL **or** | 22.6" | 5/8" | 40 > 45 | 1 |
| 2 | FC8/T9 | -- | 8" | 44 > 69 | |

## Notes:

* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 16 Fluorescent Lamp Controllers - 600 Series

All models in this series have the following...

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| FN0696-4/**120**<br>FN0696-4/**230** | 120<br>230 | 60<br>50 | 1.70<br>0.85 | 295 | 56 | 150 > 600 | 4 : 1 | 2 : 1 | 0.25% |
| HN0696-4/**120**<br>HN0696-4/**230** | 120<br>230 | 60<br>50 | 1.70<br>0.85 | 295 | 60 | 30 > 600 | 20 : 1 | 10 : 1 | 1.0%***** |
| HN06120-4/**120**<br>HN06120-4/**230** | 120<br>230 | 60<br>50 | 1.80<br>0.90 | 295 | 60 | 30 > 550 | 18.3 : 1 | 9.1 : 1 | 1.0%***** |
| FN06144-4/**120**<br>FN06144-4/**230** | 120<br>230 | 60<br>50 | 2.50<br>1.25 | 450 | 60 | 70 > 600 | 8.6 : 1 | 4.3 : 1 | 0.25% |
| FN06192-4/**120**<br>FN06192-4/**230** | 120<br>230 | 60<br>50 | 2.4<br>1.3 | 560 | 60 | 120 > 600 | 5.3 : 1 | 2.7 : 1 | 0.25% |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

# 600 Series (Continued)



Below is an **itemization of lamps** successfully **regulated by the corresponding** [illegible] **Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| 2 | FT/18/DL **or** | 9" | 5/8" | 36 > 45 | 2 |
| 2 | FT/24/DL **or** | 9" | 5/8" | 48 > 55 | |
| 1 | FT/55/DL **or** | 21.1" | 5/8" | 55 > 60 | |
| 1 | PLL/80/W **or** | 22.5" | 5/8" | 80 > 90 | |
| 2 | FC12/T9 **or** | -- | 12" | 64 > 89 | |
| 3 | F15/T8/Std **or** | 18" | 1" | 45 > 89 | |
| 4 | F15/T8/Std **or** | 18" | 1" | 60 > 118 | |
| 4 | F15/T12/Std **or** | 18" | 1.5" | 60 > 109 | |
| 4 | F20/T12/Std **or** | 24" | 1.5" | 80 > 126 | |
| 1 | FO40/T8 **or** | 60" | 1" | 40 > 63 | |
| 2 | F40/T12/Std **or** | 48" | 1.5" | 80 > 112 | |
| 1 | Osram Dulux | 21" | 5/8" | 55 > 60 | |
| 2 | FT/18/DL **or** | 9" | 5/8" | 36 > 45 | 2 |
| 2 | FT/24/DL **or** | 9" | 5/8" | 48 > 55 | |
| 1 | FT/55/DL **or** | 21.1" | 5/8" | 55 > 60 | |
| 1 | PLL/80/W **or** | 22.5" | 5/8" | 80 > 90 | |
| 2 | FC12/T9 **or** | -- | 12" | 64 > 89 | |
| 3 | F15/T8/Std **or** | 18" | 1" | 45 > 89 | |
| 4 | F15/T8/Std **or** | 18" | 1" | 60 > 118 | |
| 4 | F15/T12/Std **or** | 18" | 1.5" | 60 > 109 | |
| 4 | F20/T12/Std **or** | 24" | 1.5" | 80 > 126 | |
| 1 | FO40/T8 **or** | 60" | 1" | 40 > 63 | |
| 2 | F40/T12/Std **or** | 48" | 1.5" | 80 > 112 | |
| 1 | Osram Dulux | 21" | 5/8" | 55 > 60 | |
| 2 | FT/36/DL **or** | 16.6" | 5/8" | 72 > 82 | 4 |
| 2 | FT/40/DL **or** | 22.6" | 5/8" | 80 > 90 | |
| 4 | F15/T8 **or** | 18" | 1" | 60 > 118 | |
| 2 | F/30/T8 **or** | 36" | 1" | 60 > 103 | |
| 3 | F30/T12 | 36" | 1.5" | 90 > 126 | |
| 2 | FT/36/DL **or** | 16.6" | 5/8" | 72 > 82 | 2 |
| 2 | FT/55/DL **or** | 21.1" | 5/8" | 110 > 120 | |
| 2 | PLL/80/W **or** | 22.5" | 5/8" | 160 > 180 | |
| 4 | F30/T12 **or** | 36" | 1.5" | 120 > 167 | |
| 3 | F40/T12 **or** | 48" | 1.5" | 120 > 167 | |
| 2 | Osram Dulux | 21" | 5/8" | 55 > 60 | |
| 4 | F40/T12/Std | 48" | 1.5" | 160 > 240 | 3 |

## Notes:

* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 18 Fluorescent Lamp Controllers - 1000 Series

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| HN1024-1/**120** | 120 | 60 | 0.60 | 185 | 60 | 50-1000 | 20 : 1 | 10 : 1 | 1.0%***** |
| HN1024-1/**230** | 230 | 50 | 0.30 | | | | | | |
| FN1048-2/**120** | 120 | 60 | 1.20 | 165 | 60 | 200-1000 | 5 : 1 | 2.5 : 1 | 0.25% |
| FN1048-2/**230** | 230 | 50 | 0.60 | | | | | | |
| FN1072-2/**120** | 120 | 60 | 1.80 | 205 | 60 | 200-1000 | 5 : 1 | 2.5 : 1 | 0.25% |
| FN1072-2/**230** | 230 | 50 | 0.90 | | | | | | |
| FN1096-4/**120** | 120 | 60 | 2.70 | 270 | 60 | 200-1000 | 5 : 1 | 2.5 : 1 | 0.25% |
| FN1096-4/**230** | 230 | 50 | 1.35 | | | 200-1000 | 5 : 1 | 2.5 : 1 | 0.25% |
| FNC1096-4/**120**** | 120 | 60 | 2.70 | | | 275-1000 | 3.6 : 1 | 1.8 : 1 | 0.50%***** |
| FNC1096-4/**230**** | 230 | 50 | 1.35 | | | 275-1000 | 3.6 : 1 | 1.8 : 1 | 0.50%***** |
| FN10120-4/**120** | 120 | 60 | 3.10 | 295 | 60 | 200-1000 | 5 : 1 | 2.5 : 1 | 0.25% |
| FN10120-4/**230** | 230 | 50 | 1.55 | | | 200-1000 | 5 : 1 | 2.5 : 1 | 0.25% |
| FNC10120-4/**120**** | 120 | 60 | 3.10 | | | 275-1000 | 3.6 : 1 | 1.8 : 1 | 0.50%***** |
| FNC10120-4/**230**** | 230 | 50 | 1.55 | | | 275-1000 | 3.6 : 1 | 1.8 : 1 | 0.50%***** |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

** Current Control only

# 1000 Series



Below is an **itemization of lamps** successfully **regulated by the corresponding** [illegible] **Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| 1 | F15/T8/HO **or** | 18" | 1.0" | 30 > 38 | 1 |
| 1 | F24/T12/HO | 24" | 1.5" | 32 > 40 | |
| 2 | F24/T12/HO **or** | 24" | 1.5" | 64 > 80 | 2 |
| 1 | F48/T8/HO | 48" | 1.5" | 60 > 75 | |
| 2 | F36/T12/HO **or** | 36" | 1.5" | 88 > 110 | 2 |
| 1 | F72/T12/HO | 72" | 1.5" | 85 > 106 | |
| 3 | F15/T8/HO **or** | 18" | 1.0" | 90 > 112 | 2 |
| 2 | F24/T8/HO **or** | 24" | 1.0" | 64 > 80 | |
| 4 | F24/T12/HO **or** | 24" | 1.5" | 128 > 160 | |
| 2 | F36/T12/HO **or** | 36" | 1.5" | 88 > 110 | |
| 2 | F48/T12/HO **or** | 48" | 1.5" | 120 > 150 | |
| 1 | F72/T12/HO **or** | 72" | 1.5" | 85 > 106 | |
| 1 | F96/T12/HO | 96" | 1.5" | 110 > 138 | |
| 4 | F28/T12/HO **or** | 28" | 1.5" | 152 > 192 | 3 |
| 2 | F60/T12/HO | 60" | 1.5" | 140 > 170 | |

## Notes:

* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 20 Fluorescent Lamp Controllers - 1100-1600 Series

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| FX1124-1/**120 (UL)** | 120 | 60 | 0.40 | | | | | | |
| FN1124-1/**120** | 120 | 60 | 0.40 | 140 | 58 | 200-1100 | 5.5 : 1 | 2.8 : 1 | 0.25% |
| FN1124-1/**230** | 230 | 50 | 0.20 | | | | | | |
| FCC1696-2/**120 (UL)**, **(TUV)**** | 120 | 60 | 3.1 | 400 | 60 | 530-1600 | 3 : 1 | 1.5 : 1 | 0.50%* |
| FXC16144-4/**120 (TUV)** | 120 | 60 | 4.40 | | | | | | |
| FN16144-4/**120** | 120 | 60 | 4.40 | 360 | 60 | 250-1600 | 6.5 : 1 | 3.3 : 1 | 0.25% |
| FN16144-4/**230** | 230 | 50 | 2.20 | | | | | | |
| FCC16192-2/**120 (UL)**, **(TUV)**** | 120 | 60 | 6.5 | 550 | 60 | 530-1600 | 3 : 1 | 1.5 : 1 | 0.50%* |
| FN16192-4/**120** | 120 | 60 | 6.5 | 550 | 60 | 300-1600 | 5.3 : 1 | 1.7 : 1 | 0.25% |
| FN16192-4/**230** | 230 | 50 | 3.3 | | | | | | |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

** Current Control only; Chassis length = 11 inches; uses wire leads to connect to AC power.

# 1100-1600 Series



Below is an **itemization of lamps** successfully **regulated by the corresponding [illegible] Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| 1<br>1 | F15/T8/HO **or**<br>F24/T12/HO | 18"<br>24" | 1.0"<br>1.5" | 30 > 41<br>32 > 44 | 1 |
| 2<br>1 | F48/T12/VHO **or**<br>F96/T12/VHO | 48"<br>96" | 1.5"<br>1.5" | 230 > 245<br>215 > 229 | 4 |
| 4<br>2 | FA30/T12/VHO **or**<br>F72/T12/VHO | 36"<br>72" | 1.5"<br>1.5" | 228 > 243<br>330 > 352 | 4 |
| 4<br>2 | F48/T12/VHO **or**<br>F96/T12/VHO | 48"<br>96" | 1.5"<br>1.5" | 460 > 491<br>430 > 459 | 4 |
| 4<br>2 | F48/T12/VHO **or**<br>F96/T12/VHO | 48"<br>96" | 1.5"<br>1.5" | 460 > 491<br>430 > 459 | 4 |

## Notes:

* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 22 Fluorescent Lamp Controllers - 1800 Series

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| FN1872-2/**120**<br>FN1872-2/**230** | 120<br>230 | 60<br>50 | 2.30<br>1.15 | 200 | 60 | 400-1800 | 4.5 : 1 | 2.3 : 1 | 0.25% |
| FN1896-4/**120**<br>FN1896-4/**230** | 120<br>230 | 60<br>50 | 3.50<br>1.75 | 195 | 60 | 450-1800 | 4 : 1 | 2 : 1 | 0.25% |
| FN18120-4/**120**<br>FN18120-4/**230** | 120<br>230 | 60<br>50 | 4.30<br>2.15 | 295 | 60 | 250-1800 | 7 : 1 | 3.5 : 1 | 0.25% |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

# 1800 Series



Below is an **itemization of lamps** successfully **regulated by the corresponding** [illegible] **Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| 2 | FA28/T12/VHO/TB1 **or** | 28" | 1.5" | 136 > 163 | 3 |
| 2 | FA30/T12/VHO/TB1 **or** | 36" | 1.5" | 114 > 137 | |
| 1 | F60/T12VHO **or** | 60" | 1.5" | 135 > 162 | |
| 1 | F72/T12/VHO | 72" | 1.5" | 165 > 198 | |
| 4 | FA20/T12/VHO/TB1 **or** | 24" | 1.5" | 228 > 274 | 3 |
| 4 | F24/T12/VHO **or** | 24" | 1.5" | 228 > 274 | |
| 3 | FA28/T12/VHO/TB1 **or** | 28" | 1.5" | 204 > 245 | |
| 2 | F48/T12/VHO **or** | 48" | 1.5" | 230 > 276 | |
| 1 | F96/T12/VHO | 96" | 1.5" | 215 > 258 | |
| 3 | FA30/T12/VHO **or** | 36" | 1.5" | 171 > 205 | 4 |
| 2 | F60/T12/VHO | 60" | 1.5" | 270 > 324 | |

## Notes:

* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 24 Fluorescent Lamp Controllers - 2000 Series

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| FN2024-1/**120** | 120 | 60 | 1.0 | 120 | 60 | 350-2000 | 5.7 : 1 | 2.8 : 1 | 0.25% |
| FN2024-1/**230** | 230 | 50 | 0.5 | | | | | | |
| HN2024-1/**120** | 120 | 60 | 1.1 | 140 | 60 | 100-2000 | 20 : 1 | 10 : 1 | 1.0%***** |
| HN2024-1/**230** | 230 | 50 | .55 | | | | | | |
| FN2048-2/**120** | 120 | 60 | 1.9 | 150 | 60 | 350-2000 | 5.7 : 1 | 2.8 : 1 | 0.25% |
| FN2048-2/**230** | 230 | 50 | 0.95 | | | | | | |
| FXC2048-2/**120 (TUV)** | 120 | 60 | 1.9 | | | | | | |
| HR2048-2/**120 (UL)(CSA)(TUV)** | 120 | 60 | 2.2 | 165 | 60 | 100-2000 | 20 : 1 | 10 : 1 | 1.0%***** |
| HN2048-2/**120** | 120 | 60 | 2.2 | 165 | 60 | 100-2000 | 20 : 1 | 10 : 1 | 1.0%***** |
| HN2048-2/**230** | 230 | 50 | 1.1 | | | | | | |
| HRC2048-2/**120 (TUV)** | 120 | 60 | 2.2 | | | | | | |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

# 2000 Series



Below is an **itemization of lamps** successfully **regulated by the corresponding** [illegible] **Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| 1 | FA20/T12/VHO/TB1 **or** | 24" | 1.5" | 57 > 76 | 1 |
| 1 | F24/T12/VHO | 24" | 1.5" | 57 > 76 | |
| 1 | FA20/T12/VHO/TB1 **or** | 24" | 1.5" | 57 > 76 | 3 |
| 1 | F24/T12/VHO | 24" | 1.5" | 57 > 76 | |
| 2 | FA20/T12/VHO/TB1 **or** | 24" | 1.5" | 114 > 152 | 2 |
| 2 | F24/T12/VHO **or** | 24" | 1.5" | 114 > 152 | |
| 1 | FA28/T12/VHO/TB1 **or** | 28" | 1.5" | 68 > 91 | |
| 1 | FA30/T12/VHO/TB1 **or** | 36" | 1.5" | 57 > 76 | |
| 1 | F48/T12/VHO | 48" | 1.5" | 115 > 153 | |
| 2 | FA20/T12/VHO/TB1 **or** | 24" | 1.5" | 114 > 152 | 4 |
| 2 | F24/T12/VHO **or** | 24" | 1.5" | 114 > 152 | |
| 1 | FA28/T12/VHO/TB1 **or** | 28" | 1.5" | 68 > 91 | |
| 1 | FA30/T12/VHO/TB1 **or** | 36" | 1.5" | 57 > 76 | |
| 1 | F48/T12/VHO | 48" | 1.5" | 115 > 153 | |
| 2 | FA20/T12/VHO/TB1 **or** | 24" | 1.5" | 114 > 152 | 4 |
| 2 | F24/T12/VHO **or** | 24" | 1.5" | 114 > 152 | |
| 1 | FA28/T12/VHO/TB1 **or** | 28" | 1.5" | 68 > 91 | |
| 1 | FA30/T12/VHO/TB1 **or** | 36" | 1.5" | 57 > 76 | |
| 1 | F48/T12/VHO | 48" | 1.5" | 115 > 153 | |

## Notes:

* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 26 Fluorescent Lamp Controllers - 2300 Series

All models in this series have the following...

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| FN2372-2/**120** | 120 | 60 | 3.10 | 205 | 60 | 400-2300 | 5.8 : 1 | 2.9 : 1 | 0.25% |
| FN2372-2/**230** | 230 | 50 | 1.60 | | | | | | |
| FXC2372-2/**120 (TUV)** | 120 | 60 | 3.10 | | | | | | |
| FN2396-4/**120** | 120 | 60 | 4.30 | 120 | 60 | 400-2300 | 5.8 : 1 | 2.9 : 1 | 0.25% |
| FN2396-4/**230** | 230 | 50 | 2.15 | | | | | | |
| FXC2396-2/120 (**TUV)** | 120 | 60 | 4.30 | | | | | | |
| HN2396-4/**120** | 120 | 60 | 4.30 | 245 | 60 | 110-2300 | 21 : 1 | 10.5 : 1 | 1.0%* |
| HN2396-4/**230** | 230 | 50 | 2.15 | | | | | | |
| HR2396-2/**120 (UL)(CSA)(TUV)** | 120 | 60 | 5.00 | | | | | | |
| HRC2396-2/**120 (TUV)** | 120 | 60 | 4.30 | | | | | | |
| FN23120-4/**120** | 120 | 60 | 5.50 | 295 | 60 | 260-2300 | 9 : 1 | 4.5 : 1 | 0.25% |
| FN23120-4/**230** | 230 | 50 | 2.90 | | | | | | |
| FXC23120-4/**120 (TUV)** | 120 | 60 | 5.50 | | | | | | |
| HN23120-4/**120** | 120 | 60 | 5.30 | 295 | 60 | 60-2600 | 44 : 1 | 22 : 1 | 1.0%* |
| HN23120-4/**230** | 230 | 50 | 2.65 | | | | | | |
| HR23120-4/**120(UL)(CSA)(TUV)** | 120 | 60 | 6.20 | | | | | | |
| HRC23120-4/**120 (TUV)** | 120 | 60 | 5.30 | | | | | | |

Letters in the parentheses that follow the model number indicate agency approval: **(UL)** - Underwriters Laboratories, **(CSA)** - Canadian Standards Association, and **(TUV)** TUV Rhineland.

# 2300 Series



Below is an **itemization of lamps** successfully **regulated by the corresponding** [illegible] **Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

**All controllers** not only drive, but **regulate** as many lamps as the digit after the dash in the model number indicates. The first two digits (after the alphas) denote peak milliamp output; the last two/three reference **total** lamp inches that can be controlled. The models are numericalized accordingly.

| LAMP(S) REGULATED | | LAMP'S INDIVIDUAL | | TOTAL **WATTAGE** Before > After* | PRICE GROUP |
|---|---|---|---|---|---|
| Qty | Type | Length | Diameter | | |
| 2 | FA30/T12/VHO **or** | 36" | 1.5" | 114 > 175 | 4 |
| 1 | F72/T12/VHO | 72" | 1.5" | 165 > 253 | |
| 2 | FA30/T12/VHO **or** | 36" | 1.5" | 114 > 175 | 4 |
| 2 | F48/T12/VHO **or** | 48" | 1.5" | 230 > 353 | |
| 1 | F60/T12/VHO **or** | 60" | 1.5" | 135 > 207 | |
| 1 | F72/T12/VHO **or** | 72" | 1.5" | 165 > 253 | |
| 1 | F96/T12/VHO | 96" | 1.5" | 215 > 330 | |
| 2 | FA30/T12/VHO **or** | 36" | 1.5" | 114 > 175 | 4 |
| 2 | F48/T12/VHO **or** | 48" | 1.5" | 230 > 353 | |
| 1 | F60/T12/VHO **or** | 60" | 1.5" | 135 > 207 | |
| 1 | F72/T12/VHO **or** | 72" | 1.5" | 165 > 253 | |
| 1 | F96/T12/VHO | 96" | 1.5" | 215 > 330 | |
| 4 | FA28/T12/VHO **or** | 28" | 1.5" | 272 > 417 | 4 |
| 2 | FA30/T12/VHO **or** | 36" | 1.5" | 114 > 175 | |
| 2 | F60/T12/VHO | 60" | 1.5" | 270 > 414 | |
| 4 | FA28/T12/VHO **or** | 28" | 1.5" | 272 > 417 | 4 |
| 2 | FA30/T12/VHO **or** | 36" | 1.5" | 114 > 175 | |
| 2 | F60/T12/VHO | 60" | 1.5" | 270 > 414 | |

## Notes:

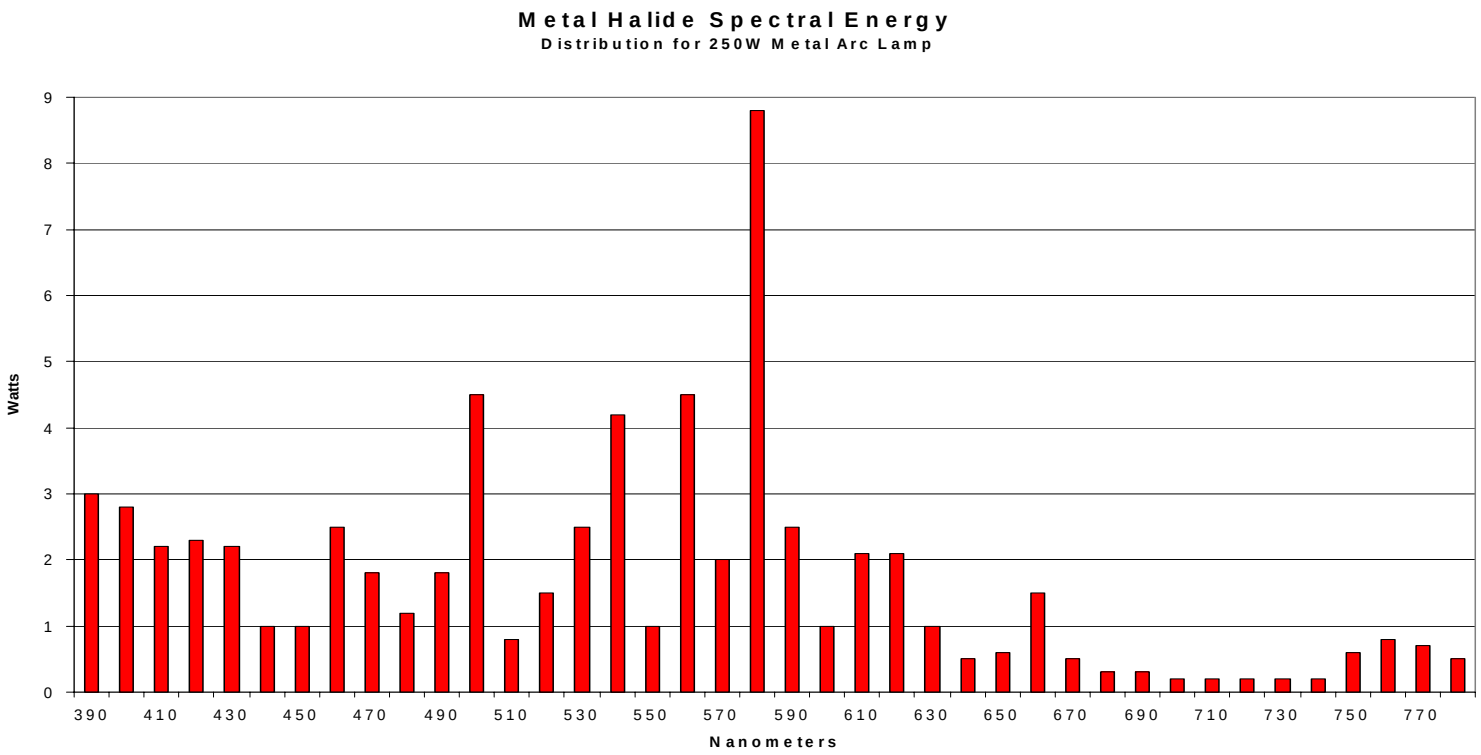
* One of [illegible]'s unique features is its "overdrive" capability, by which, it not only increases the light's output, but extends the lamp's life/utility without causing the lamps to blacken.

# 28 Precision Illumination of Metal Halide Lamps

Metal Halide lamps are rugged and powerful, and emit white light; however, the spectrum is not continuous. It is composed of discrete color segments that combine to give the appearance of "white" light, but the color rendition is not the best. Nevertheless, cameras can be adjusted to work well with these lamps as is demonstrated by the successful televising of sporting events.

It is important to remember that the colors in a Metal Halide lamp are spatially distributed. There is a central arc of blue (mercury) surrounded by a cylinder of green (thallium) and successive concentric cylinders of orange and red. The separation of colors means that focusing the light will result in a variation of color temperature across the projected light field. Diffusers should be used to mix the colors for a consistent color temperature. Noteworthy: The lamp should also be operated horizontally to keep internal color mixing at an optimum.

The light is sensitive to the operating power level of the lamp itself. As the lamp approaches full power, reddish color is added to the lamp. As the power is reduced, the reds and greens fall away so that at half power, the lamp becomes simply a mercury lamp because the arc tube is not hot enough to vaporize the colored salts and bring them into the arc stream. MERCRON's light feedback system keeps the arc lamp operating at a steady output, and in doing, fixes the color for the selected power level.



# Metal Halide Lamp Considerations 29

Metal Halide lamps are available in many package sizes that are especially useful in compact installations. Lamps are available from 250 watts to 1000 watts. But even though Metal Halide lamps come in a variety of shapes and sizes, only some can be used in Vision Systems...

Generally, the shorter the arc and the greater the ignition-voltage that is required, the less suitable the lamp is for Vision System applications. As a rule of thumb, *if the arc length is short and the ignition voltage exceeds 5000 volts, the lamp cannot be used.*

Moreover, only (H.I.D.) High Intensity Discharge type lamps greater than 250 watts can be driven to emit **continuous, ripple-free light** to meet MERCRON's standards for precision illumination. The high pressure HMI, HQI, and HTI lamps cannot be operated to emit continuous light with *one excellent exception: the Osram HQI 400* lamp works well. It has a Color Rendering Index (CRI) of 93. The HQI 400 is also unique in that **MERCRON's Sodium lamp controller must be used** to operate this lamp.

**METAL HALIDE SERIES**

**3 Power Levels Regulating at Least 4 Different Lamps:**
**250W, M400, HQI 400, and 1000W**

**Note:** Since the **HQI 400** is classified as a Metal Halide lamp, it is appropriately listed in the following MH series as being regulated by a Sodium Lamp Controller. This is due to its having the voltage and current rating of a Sodium Lamp; hence, the interjection of a Sodium model number in this particular series.

# 30 Metal Halide / Mercury Lamp Controllers

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| HX250/**120** | 120 | 60 | 4.0 | 240 | 53 | 500-2100 | 4.2 : 1 | 2.1 :1 | 0.25% |
| HX250/**230** | 230 | 50 | 2.0 | 240 | 53 | 500-2100 | 4.2 : 1 | 2.1 : 1 | |
| S250H/**120 (UL)**** | 120 | 60 | 3.8 | 180 | 50 | 500-2700 | 5.4 : 1 | 2.7 : 1 | |
| HX400/**120** | 120 | 60 | 5.8 | 240 | 53 | 800-2800 | 3.5 : 1 | 1.7 : 1 | 0.25% |
| HX400/**230** | 230 | 50 | 2.9 | | | | | | |
| S400/**120** | 120 | 60 | 3.8 | 180 | 50 | 500-2700 | 5.4 : 1 | 2.7 : 1 | 0.25% |
| S400/**230** | 230 | 50 | 1.9 | | | | | | |
| S400TB/**120 (UL)*** | 120 | 60 | 3.8 | | | | | | |
| S400TB/**230 (UL)*** | 230 | 50 | 1.9 | | | | | | |

* Circuit Board Only, No enclosure, External Forced- air Cooling Required

**No fan. Convection cooled up to 65 degrees Celsius. Chassis length = 11". Uses wire leads to connect to AC power.

# Metal Halide / Mercury Series



Below is an **itemization of lamps** successfully **regulated by the corresponding** [illegible] **Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

| LAMP(S) REGULATED | | GENERAL TYPE | TOTAL WATTAGE | PRICE GROUP |
|---|---|---|---|---|
| Qty | Mfg. # | | | |
| 1<br>1 | MVR250 **or**<br>R250 | Metal Halide<br>Mercury Vapor | 250 | 3 |
| 1<br>1 | M400 **or**<br>R400 | Metal Halide<br>Mercury Vapor | 400 | 4 |
| 1<br>1 | HQI 400 **or**<br>KRC400 | Metal Halide | 400 | 4 |

## Notes:

**Sodium's Desirability**

The Sodium Lamp is the most powerful of all practical light sources. The light is a bronze or tawny color. The spectral output complements the sensitivity of silicon for demanding applications. It is a very rugged lamp and it has a very long service life. It retains its spectral output over a wide range of power levels and can be operated in any position without compromising arc stability, unlike some other H.I.D. / High Intensity Discharge lamps.

**Thermal Runaway**

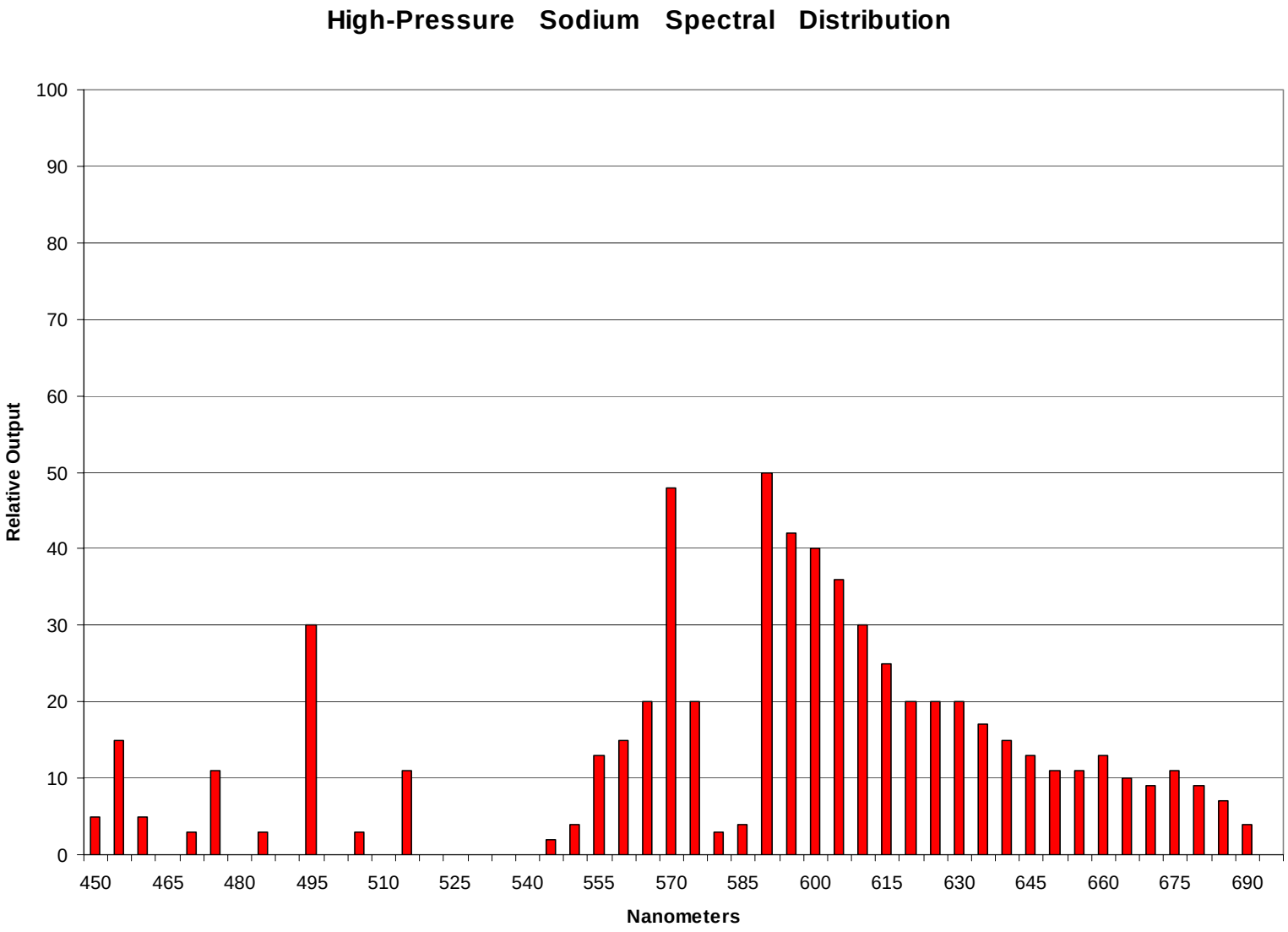
Sodium lamps have two idiosyncracies that need to be recognized. First, it has a tendency toward thermal runaway. If the current remains fixed and the arc tube is allowed to heat up, the arc voltage will climb, increasing the lamp's output wattage. *MERCRON lamp controllers limit the maximum wattage with both optical feedback and electronic wattage limiters, so the runaway is curbed.*

However, efficient reflectors can force so much light back through the arc tube that the arc voltage can be driven up despite wattage limits. In this case the lamp will extinguish and restart when it cools. Close attention should be paid to optical systems to avoid Sodium thermal runaway.

**Thermal Hysteresis**

Sodium lamps also have a strong thermal hysteresis. This means that efficacy is tied to arc tube temperature and the temperature is not quickly changed. Lamp brightness can be lowered quickly, but the arc tube must heat up before the lamp output can be increased. For this reason, Sodium Lamps cannot be idled between duty cycles, unless 30 seconds or more is available for the heating cycle to return to a brighter working condition. In other words, depending upon how long the lamps have been idling, it takes anywhere from 20 seconds to 1 minute to bring them back up to the desired intensity level. It is significant then, that, *If idling at a low ouptut is desirable, MERCRON Sodium Lamp Controllers can idle the lamp indefinitely without damaging the lamp.*

Sodium lamps are available in a variety of glass envelope packages which can be used readily in compact installations.




# Metal Halide and High-Pressure Sodium Lamps

# Sodium Lamp Controllers

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| S150-55/**120** | 120 | 60 | 2.50 | 120 | 53 | 700-3100 | 4.4 : 1 | 2.2 : 1 | 0.25% |
| S150-55/230 | 230 | 50 | 1.25 | | | | | | |
| S150-100/**120** | 120 | 60 | 2.30 | 200 | 53 | 500-1800 | 3.6 : 1 | 1.8 : 1 | 0.25% |
| S150-100/**230** | 230 | 50 | 1.15 | | | | | | |
| S250/**120** | 120 | 60 | 3.80 | 180 | 50 | 500-2700 | 5.4 : 1 | 2.7 : 1 | 0.25% |
| S250/**230** | 230 | 50 | 1.90 | | | | | | |
| S400/**120** | 120 | 60 | 5.80 | 200 | 59 | 1100-4600 | 4.1 : 1 | 2.1 : 1 | 0.25% |
| S400/**230** | 230 | 50 | 3.00 | | | | | | |
| S400TB/**120 (UL)**** | 120 | 60 | 5.80 | | | | | | |
| S400TB/**230 (UL)**** | 230 | 50 | 3.00 | | | | | | |
| S570/**120** | 120 | 60 | 6.40 | 200 | 58 | 1100-4600 | 4.1 : 1 | 2.5 : 1 | 0.25% |
| S570/**230** | 230 | 50 | 3.20 | | | | | | |
| S570TB/**120 (UL)**** | 120 | 60 | 6.40 | | | | | | |
| S570TB/**230 (UL)**** | 230 | 50 | 3.20 | | | | | | |

**Circuit Board Only, No Enclosure, External Forced-air Cooling Required

# High-Pressure Sodium Series 35

Below is an **itemization of lamps** successfully **regulated by the corresponding [illegible] Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

| LAMP(S) REGULATED | | GENERAL TYPE | TOTAL WATTAGE | PRICE GROUP |
|---|---|---|---|---|
| Qty | Mfg. # | | | |
| 1 | LU150-55 | HP Sodium 150W/50V | 150 | 3 |
| 1 | LU150-100 | HP Sodium 150W/100V | 150 | 3 |
| 1 | LU250 | HP Sodium 250W | 250 | 4 |
| 1 | LU400 | HP Sodium 400W | 400 | 4 |
| 1 | LU400 | HP Sodium 400W | 570 | 4 |

## Notes:

# 36 Precision Illumination of Tungsten / Halogen Lamps

Tungsten lamps are ideal for some applications because they are simple, small, and have continuous spectral output. However, these lamps generate high levels of infrared light, that actually "snow-blinds" the CCD cameras; therefore, systems using Tungsten require extra filtering and generally do not have much blue output. Tungsten lamps are perfect for small target illumination and fiber optic bundle light sources.

Two other significant shortcomings that affect tungsten lamp performance are short lamp life and erratic light output in Machine Vision applications. MERCRON lamp controllers offer solutions in both areas.

MERCRON lamp controllers drive the tungsten lamp with a high frequency, sinusoidal waveform. This type of current reduces both start-up shock, and long term filament erosion and results in a 50% - 100% increase in usable lamp life.

Tungsten light sources cannot be trusted to maintain constant light output because heated sockets and loose connections are all too common, even in well designed Machine Vision Systems. Tungsten / Halogen lamps become so hot that even the "best" sockets will corrode and expand with heat. Vibrations of the lamp in its socket will periodically scrub away the corrosion, causing small changes in socket resistance. These seemingly minute changes produce intermittent light output that is visible to the Vision System. Current controlled DC power supplies can compensate, but are usually too slow to be effective. **MERCRON's tungsten lamp controllers use light feedback and AC drive to instantly correct any deviation so that the light remains perfect.**

When MERCRON's temperature compensated photodiode (see PD section, following, for more detail) is used with our tungsten lamp controller, the light can be held to within a few degrees Kelvin. This is no small achievement. Discriminating scientists and engineers have responded with enthusiasm when they have experienced the performance of these lamp controllers.

# Tungsten / Halogen Lamp Considerations 37

The tungsten / halogen lamp changes color temperature as its brightness or power level is changed. The correlation of color temperature to brightness is nonlinear and varies from one lamp type to another. The designer should keep these characteristics in mind when developing an Illumination System to be used in a color dependent application.

MERCRON's tungsten lamp controllers can drive more than one lamp IF multiple lamps are connected in series AND the total voltage and wattage of the series' lamps equals the rated voltage and wattage of the lamp controller.

In the following table, MERCRON's tungsten lamp controller models are shown with listed lamps to indicate just how many lamps can be regulated - as long as the lamps are connected in series. The TX300-72 (model) can regulate different quantities of lamps as shown below. In each case, the total lamp wattage equals 300, and the total lamp voltage equals 72.

| | |
|---|---|
| 1 | 300 watt / 72 volt lamp |
| 3 | 100 watt / 24 volt lamps |
| 4 | 75 watt / 18 volt lamps |
| 6 | 50 watt / 12 volt lamps |
| 12 | 24 watt / 6 volt lamps, etc. |

Moreover, MERCRON allows this 300 watt lamp load, for example, to operate over a range of 60 - 84 volts, rather than just at the voltage of 72 as specified.

## TUNGSTEN - HALOGEN SERIES

**4 Power Levels regulating at least 22 different Lamps:**

20W/12V, 25W/6V, 25W/60V, 34W/8.5V, 42W/10.8V, 50W/12V, 50W/20V, 75W/10V, 75W/12V, 75W/48V, 75W/50V, 80W/19V, 100W/12V, 100W/24V, 150W/20V, 150W/25V, 240W/144V, 250W/120V, 300W/50V, 300W/72V, 300W/120V, 500W/120 (or NUMEROUS combinations thereof).

# Tungsten / Halogen Lamp Controllers

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| TXC50-12/**120**<br>TXC50-12/**230** | 120<br>230 | 60<br>50 | 0.90<br>0.45 | 16 | 60 | Rd Glo-71W | 100 : 1 | 100 : 1 | 0.25% |
| TXC50-20/**120**<br>TXC50-20/**230** | 120<br>230 | 60<br>50 | 0.90<br>0.45 | 22 | 60 | Rd Glo-60W | 100 : 1 | 100 : 1 | 0.25% |
| TXC75-50/**120**<br>TXC75-50/**230** | 120<br>230 | 60<br>50 | 1.30<br>0.65 | 50 | 60 | Rd Glo-81W | 100 : 1 | 100 : 1 | 0.25% |
| TXC100-12/**120**<br>TXC100-12/**230** | 120<br>230 | 60<br>50 | 1.60<br>0.80 | 30 | 60 | Rd Glo-110W | 100 : 1 | 100 : 1 | 0.25% |
| TXC150-20/**120**<br>TXC150-20/**230** | 120<br>230 | 60<br>50 | 2.50<br>1.25 | 32 | 60 | Rd Glo-176W | 100 : 1 | 100 : 1 | 0.25% |
| TXC240-144/**120**<br>TXC240-144/**230** | 120<br>230 | 60<br>50 | 3.90<br>1.95 | 200 | 60 | Rd Glo-285W | 100 : 1 | 100 : 1 | 0.25% |
| TXC250-120/**120** | 120 | 60 | 4.0<br>2.0 | 120 | 60 | Rd Glo-285W | 100 : 1 | 100 : 1 | 0.25% |

# Tungsten / Halogen Series



Below is an **itemization of lamps** successfully **regulated by the corresponding [illegible] Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

| LAMP(S) REGULATED | | GENERAL TYPE** | TOTAL WATTAGE | PRICE GROUP |
|---|---|---|---|---|
| Qty | Mfg. # | (Please see note below) | | |
| 1<br>2 | 50W - 12V **or**<br>25W - 6V | Extra Bright / Halogen | 50 | 1 |
| 1 | 50W - 20V | Extra Bright / Halogen | 50 | 1 |
| 1<br>4 | 75W - 50V **or**<br>20W - 12V | Extra Bright / Halogen | 75 | 1 |
| 1 | 100W - 12V | Extra Bright / Halogen | 100 | 2 |
| 1<br>1<br>1<br>2 | 150W - 18V **or**<br>150W - 20V(DLL) **or**<br>150W - 24V(EKE) **or**<br>75W - 10V | Extra Bright / Halogen | 150 | 2 |
| 1<br>3 | 240W - 144V **or**<br>75W - 48V | Extra Bright / Halogen | 240 | 3 |
| 1 | 250W - 120V | Extra Bright / Halogen | 250 | 4 |

## Notes:

** Lamp wattage is specific; however, lamp driver will tolerate a range of lamp voltages.

# Tungsten / Halogen Lamp Controllers

All models in this series have the following…

| Precision Control: **REGULATION** | Real Time **LIGHT FEEDBACK** | Response Interval | **REMOTE CONTROL** Capability | Drive Frequency | All's Well **SIGNAL** | Efficiency |
|---|---|---|---|---|---|---|
| Within 1/4% of selected intensity* | YES | .5 mS | YES | Sinusoidal | YES | 95%+ |

| **MODEL** | **INPUT** | | | **ADJUSTABLE OUTPUT** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | VAC | Hz | Amps | Volts | kHz | mA Range | mA Ratio | Intensity Ratio | Intensity **Regulation** within % +/- of Set Value |
| TXC300-50/**120**<br>TXC300-50/**230** | 120<br>230 | 60<br>50 | 4.50<br>2.25 | 50 | 60 | Rd Glo - 356W | 100 : 1 | 100 : 1 | 0.25% |
| TXC300-72/**120**<br>TXC300-72/**230** | 120<br>230 | 60<br>50 | 4.40<br>2.20 | 120 | 60 | Rd Glo - 360W | 100 : 1 | 100 : 1 | 0.25% |
| TXC300-120/**120**<br>TXC300-120/**230** | 120<br>230 | 60<br>50 | 4.40<br>2.20 | 120 | 60 | Rd Glo - 360W | 100 : 1 | 100 : 1 | 0.25% |
| TXC500-120/**120** | 120 | 60 | 6.70 | 130 | 60 | Rd Glo - 550W | 100 : 1 | 100 : 1 | 0.25% |

# Tungsten / Halogen Series (continued)



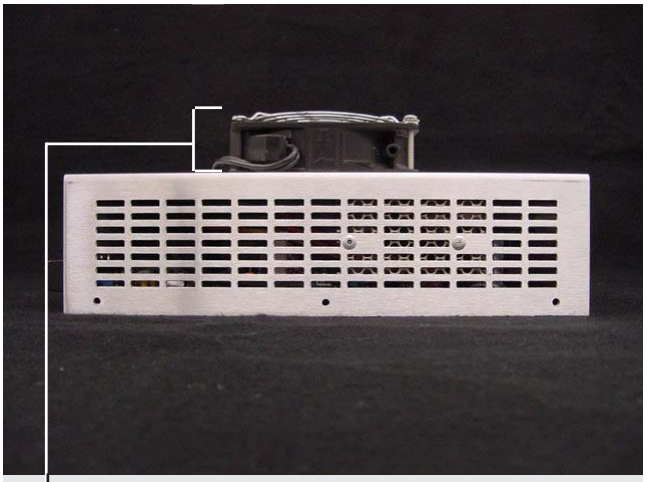
Below is an **itemization of lamps** successfully **regulated by the corresponding [illegible] Controller** on the facing page. The same lamp could conceivably appear in another series as well as with another model within this particular series.

| LAMP(S) REGULATED | | GENERAL TYPE** | TOTAL WATTAGE | PRICE GROUP |
|---|---|---|---|---|
| Qty | Mfg. # | (Please see note below) | | |
| 1<br>2<br>4 | 300W - 50V **or**<br>150W -25V **or**<br>75W - 12V | ExtraBright / Halogen | 300 | 4 |
| 1<br>3<br>6<br>12 | 300W - 72V **or**<br>100W - 24V **or**<br>50W - 12V **or**<br>25W - 6V | ExtraBright / Halogen | 300 | 3 |
| 1 | 300W -120V **or** | ExtraBright / Halogen | 300 | 3 |
| 1<br>2<br>5<br>6<br>12<br>14<br>20 | 500W - 120V **or**<br>25W - 60V **or**<br>100W - 24V **or**<br>80W - 19V **or**<br>42W - 10.8V **or**<br>34W - 8.5V **or**<br>25W - 6.1V | ExtraBright / Halogen | 300 | 4 |

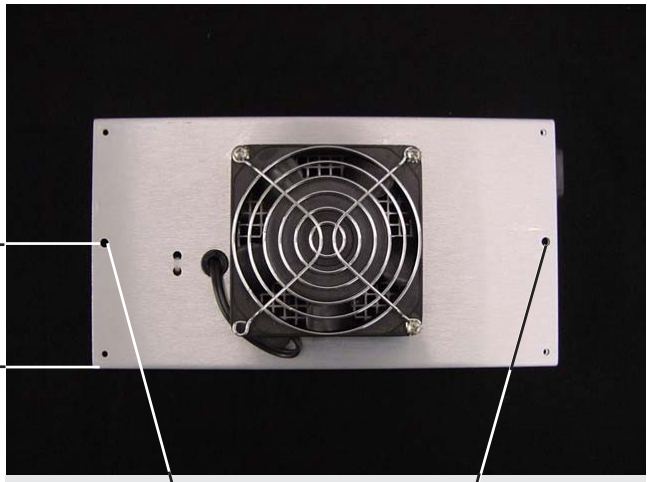
## Notes:

** Lamp wattage is specific; however, lamp driver will tolerate a range of lamp voltages.

# Lamp Controller Dimensions & Descriptions



Side View



Top View

Fan
Length: 3 1/2" (89 mm)
Width: 3 1/2" (89 mm)
Height: 1" (26 mm)
Note: Fan is centered on chassis

Mounting Holes
(Use 3/16" or 10-32 X 3" Bolts)
Distance between Holes: 9.0" (229 mm)
Distance from Hole to Side: 2.5" (64 mm)

| Lamp Controller Dimensions | | |
|---|---|---|
| Length* | 9 1/2" | 242 mm |
| Width | 5" | 127 mm |
| Height (w/o fan) | 2 1/2" | 64 mm |

Terminal Strip for Control Leads

1: Remote Control, 0-4 VDC
2: All's Well Signal, 5.6 V 20Ma
3: Light Sensor Input Terminal
4: Chassis Ground, DC Return
5: Precision Voltage for Photodiode

Fuse

AC Input**

Front View

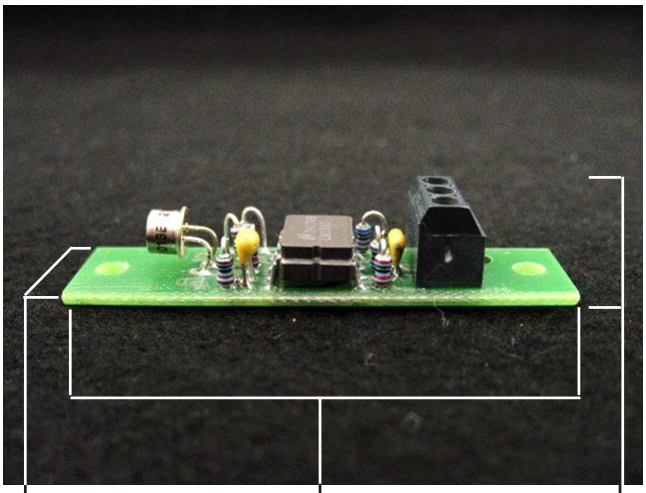

Brightness Adjustment Port**

Exit Port for Lamp Power Leads

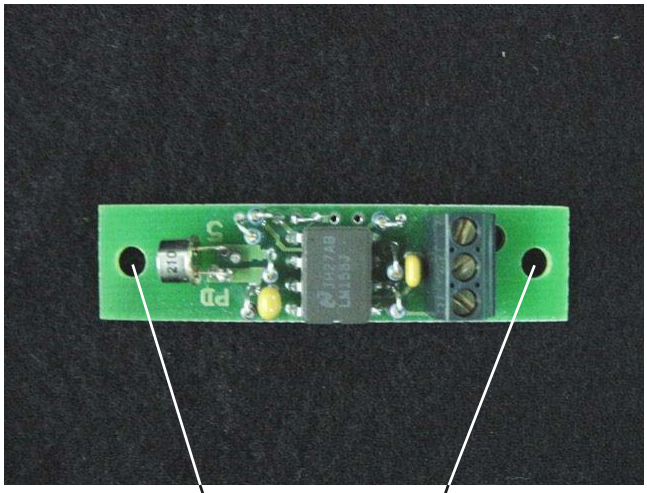
Rear View


* Certain lamp controller models use a chassis which is identical to those pictured except in length, which measures 11". The respective mounting holes are 10.5" apart. The fan is centered on the 11" chassis.
** Some lamp controller models, identified throughout the catalog, use individual wire leads to connect to AC power and do not feature the brightness adjustment port.

# Temperature-tolerant “PD” Dimensions & Descriptions



Length = 2.0” (51 mm)
Height = 3/8” (10 mm)
Width = 1/2” (13 mm)



Mounting Holes
1.75” (45 mm) apart
Use #6 Screws & 1/4” Standoffs for Mounting

The “PD” is a photodiode based light sensor that is temperature stabilized and can be used in place of the photoresistor normally supplied with MERIDIAN lamp controllers.

MERIDIAN lamp controllers are capable of extremely precise light control when the PD is used to sense the light and provide optical feedback to the lamp controller. The PD is so stable with respect to temperature that an excursion from room temperature to 100 degrees Celsius will result in less than 1% change in light sensitivity. The PD does not have a memory like the photoresistor, and with such excellent temperature stability, the PD permits true “instant on” capability for machine vision systems.

The PD is sensitive to all colors - even UV. The PD has approximately the same spectral band pass that the CCD camera has, which means that the light sensor will compensate correctly for color changes due to lamp aging as seen by the camera.

The high-speed response of the PD combined with the high frequency drive of the MERIDIAN lamp controllers means that the ouptut light-level of the lamp will not change at all, even when lamp contacts become loose or resistive due to heat or vibration. If any change occurs in the light level, the MERIDIAN All’s Well circuit will report the aberration to the operator.

Photodiode light detectors are available on a small circuit board for operator convenience. All models can vary the light level over a 3:1 range and provide a linear relationship between lamp brightness and control voltage. Also, the photo-diode can be positioned to sense light along the main axis of the circuit board or perpendicular to it.

| IMPORTANT PARAMETERS | |
|---|---|
| Operating Temperature | 20 degrees Celsius - 100 degrees Celsius |
| Temperature Sensitivity | Sensitivity to light changes less than 0.1% per 10 Degrees Celsius |
| Regulation | +/- 0.3% of Set Point |
| Connector Cable | Dual Conductor-shielded Cable (Equivalent tothe Belden #83317)<br>( Ready-made PD connector cables are available in 1m, 2m, or 3m lengths) |

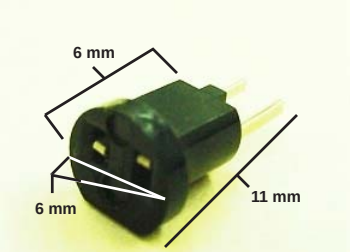
| Tungsten | Sodium, Metal Halide, UV Light | Fluorescent Lamps |
|---|---|---|
| PDT-20T | PDS-20T | PDR-47T |
| PDT-47T | PDS-47T | |
| PDT-100T | PDS-100T | |
| PDT-200T | PDS-200T | |

# 44 Accessories: Detectors & Sockets

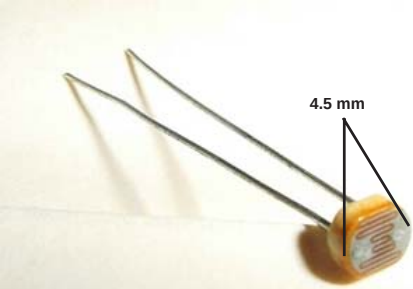
**PARTS SUPPLIED**: With every lamp controller ordered, MERCRON supplies one light sensing kit which includes a Photoresistor Detector, Mounting Socket, and Washer (Note: two kits are included with UV/IR systems). The customer is free to order additional kits - reference part number: **CL9 KIT**. For the Photoresistor only, reference part number **VT93N1**. The Mounting Sockets can also be ordered separately.

Due to variations in application requirements, the following may be purchased separately from any vendor of your choice; however, MERCRON will gladly assist in supplying any of these upon request. Several types of lamp sockets can be ordered through MERCRON.

**The CL9 Kit:**



**Socket Mount**



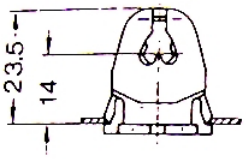
**Photoresistor Detector**

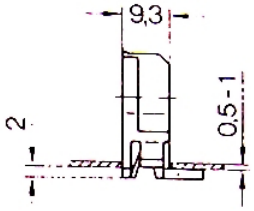
**Retaining Ring**

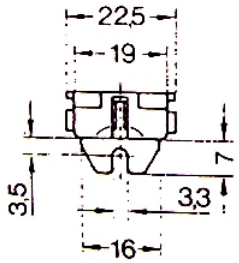
| ITEM | GENERAL DESCRIPTION | TO BE USED WITH: |
|---|---|---|
| **SOCKETS**: (Fluorescent) | | |
| Mini BiPin | Slotted support | All T5 |
| Medium BiPin | With screw terminals | All T8, T9, & T12 Standard |
| RDC | Recessed Double Contact, screw terminals | All T12 HO & T12 VHO |
| **SOCKETS**:<br>RSC | Recessed Single Contact, with "pigtails" | Tungsten, Arc lamps, &<br>H.I.D. Lamps (Double-ended) |
| **SOCKETS**:<br>Mogul | Varying sizes, large threads | Tungsten, Arc lamps, &<br>H.I.D. Lamps with Large-threaded Base |
| **DETECTORS**: (Photocell)<br>Photodiode (several types)<br>Photoresistor | <br>Temperature tolerant light sensor<br>Light sensor with mounting socket | <br>All Controllers<br>All Controllers |
| **RESISTORS**:<br>10 Ohm<br>10 K Ohm | <br>10 or 25 Watt noninductive resistor<br>.5 Watt, 15 turn potentiometer | <br>Output leads longer than 10 ft. (FX Models)<br>Remote Control |
| **VOLTAGE SOURCE** | Variable, 0-4 Volts DC | Remote Control |
| **CABLE**, Coax<br>**CABLE, PD**(1m, 2m & 3m)<br>**WIRE**, 0.81 mm, Insulation | RG174 (Coax)<br>2 Conductor Shielded Wire<br>ALPHA 3070-3075 (UL type 1015)<br>ALPHA 5410/2-5430/2 (UL type 1015)<br>ALPHA 5502/5522 (UL type 1015) | Photo Resistor, Remote Control<br>Photo Diode Sensor<br>Unshielded wire<br>Shielded foil wire<br>Shielded braid wire |
| **BOLTS**, Mounting | #8/32 or #10/32 X 3" | All Controllers |

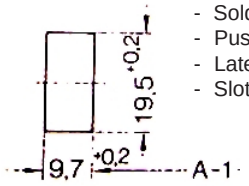
# Sockets: Types & Descriptions





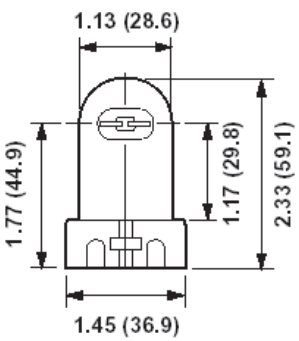



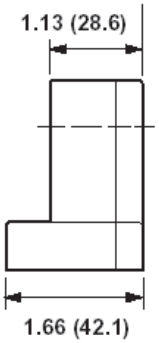

## Mini Bipins:

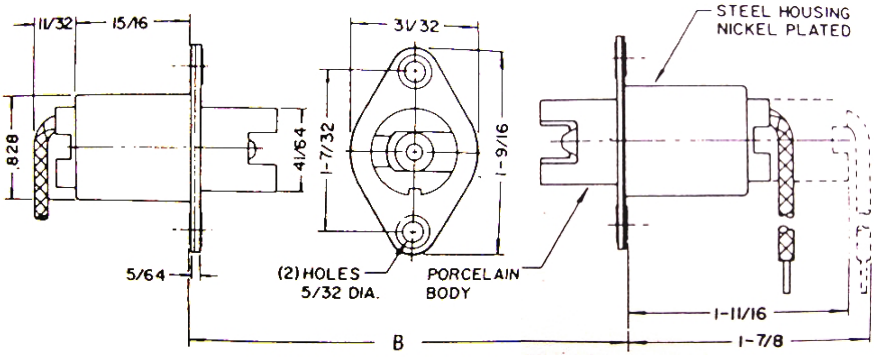
- Sold in pairs
- Push-through lampholder
- Lateral fixing clips for wall thickness 0.5 - 1 mm
- Slotted support for screw fixing

## Medium Bipins:

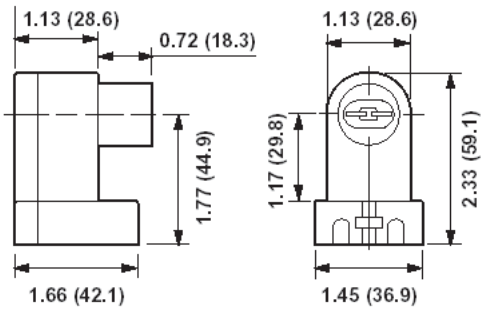
- Available in white only
- Screw terminals on bottom with wireways for straight mounting, through slotted hole
- Grooves in slot for retaining square nut
- Insulating cover
- (1) round head #6-32 screw by 7/8" long and 1/4" square nut furnished
- For flush or surface mounting

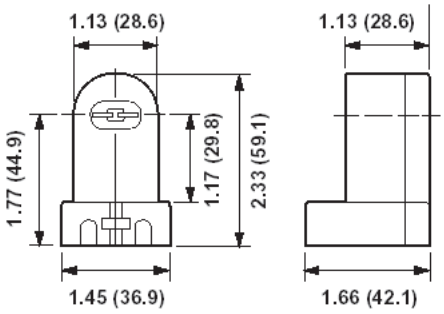



## RSC: Recessed Single Contact:




## RDC: Recessed Double Contact:

**APERTURE DEFINED...**

The aperture lamp is a fluorescent lamp that is manufactured by first coating the inside of the lamp with a white reflective material such as Titanium Oxide. A particular phosphor* material is then coated INSIDE the reflective layer. A “Slot” of varying dimensions is scraped down the side of the lamp end-to-end. In this way, the reflector is able to force the light to escape through the opening or aperture; hence, its name. (Some lamp manufacturers refer to this as “controlled lighting”, but it is NOT to be confused with MERCRON’s patented Control technology. For purposes of distinction, the former is more a case of “directed lighting”).

**APERTURE WIDTHS...**

There are varying degrees of aperture widths with 30 degrees (of lamp circumference) being the most applicable; 60 degree apertures are the next most ordered, and 15 degree apertures are NOT recommended at all. However, apertures of almost any size can be / must be custom ordered. Different orientations, relative to an axis on the lamp’s base, can and should be specified as well as the lamp’s base type.

**APERTURES’ RELATIVE BRIGHTNESS...**

Apertures are generally 5 times brighter on the surface than a similar lamp without an aperture. In fact, regular fluorescents yield 1400 candle power; apertures yield approximately 6500. The sun produces 14,000 footcandles, and the MERCRON driven aperture generates as many as 20,000. But, since the light diverges rapidly when it leaves the opening, aperture lamps should be positioned very close to the target. Distances of less than one lamp diameter are desirable.

**GENERAL APERTURE APPLICATIONS...**

A single aperture lamp is ideal for illuminating a transparent target by projecting the light from the aperture THROUGH the target into a line scan camera. Two parallel aperture lamps can be used to illuminate a common area so that light will be reflected from the target into the scanner. Two aperture lamps can generate a lighted zone with very good depth of field.

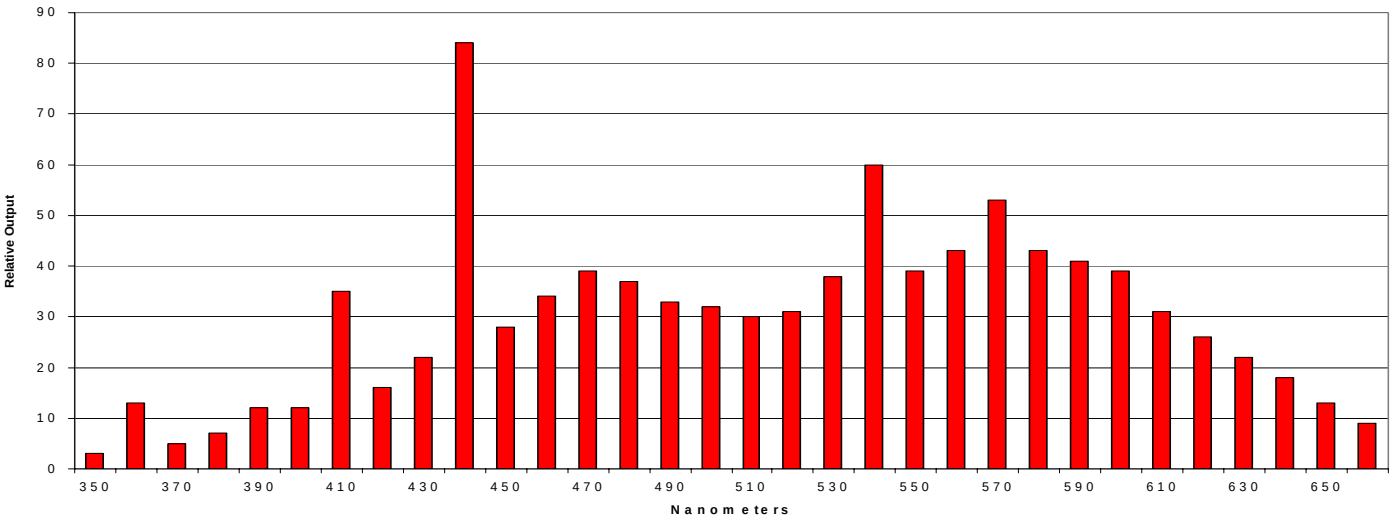
Because of these above mentioned facts, apertures play an important role in Machine Vision; therefore, for the convenience of its customers, MERCRON maintains an inventory of the more popular aperture lamps in order to expedite delivery of otherwise custom ordered lamps...

| Lamp Designation | Actual Length | Illuminated Length | T-Type | Base | Aperture | Phosphor |
|---|---|---|---|---|---|---|
| F6T5/D/30 | 9" | 4" | T5 | Mini | 30° | Daylight |
| FA15/T8/CW/30 | 18" | 10" | T8 | Medium | 30° | Cool White |
| FA20/T12/TB1/VHO-1/30 | 24" | 12" | T12 | Medium | 30° | RGB |
| FA30/T12/TB1/VHO-1/30 | 36" | 24" | T12 | Medium | 30° | RGB |
| F48/T12/CW/VHO/30 | 48" | 30" | T12 | RDC | 30° | Cool White |
| FA60/T12/TB1/VHO-1/30 | 60" | 42" | T12 | RDC | 30° | RGB |
| FA72/T12/TB1/VHO-1/30 | 72" | 54" | T12 | RDC | 30° | RGB |

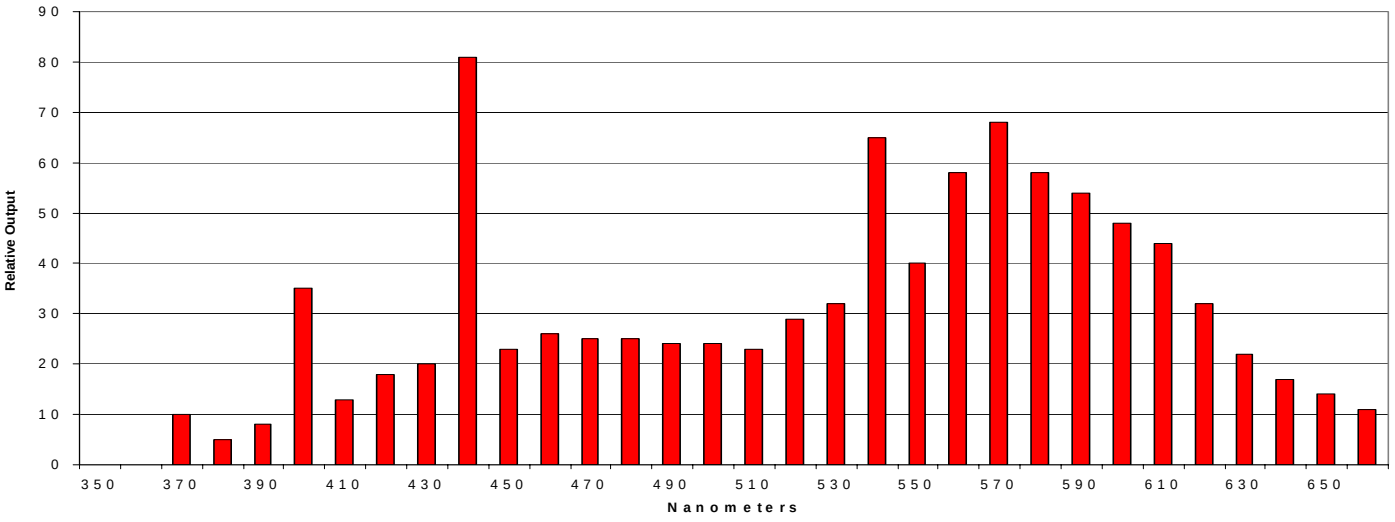
The center of the aperture is basically perpendicular to a line through the filament pins.
The edge of the aperture on the F48 filament lamp is positioned such that it is perpendicular to a line through the filament pins.

It is the phosphor that is responsible for the color and “power level” of the lamp. Each kind of phosphor has a different “power level” associated with it, and combinations of colored phosphors can be made to produce any spectrum desired. Below are the depictions of the **3 most typical Fluorescent Color Spectrums**: 1) Daylight, 2) Cool White, and 3) TB1 - so called for a tri-band phosphor: red, green, and blue.

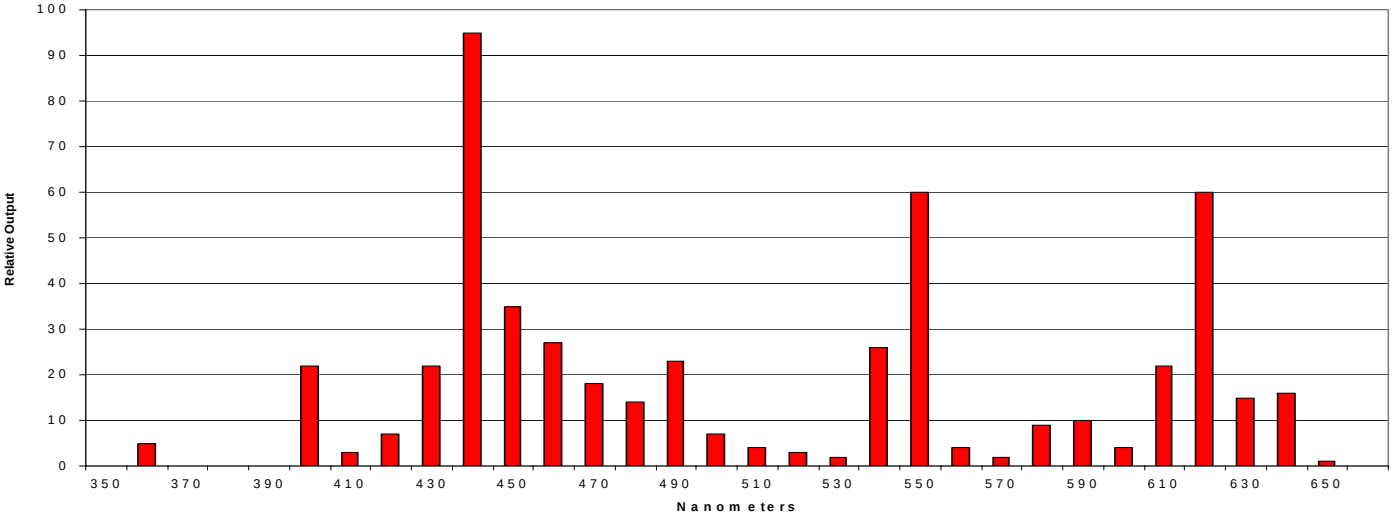
**Daylight Color Spectrum**




**Cool White Color Spectrum**




**TB-1 Color Spectrum**



# Power Factor Corrector

**The MERCRON Power Factor Corrector**:
What is it? And how does it affect the lamps and their controllers?

Power Factor is a term used to describe the relationship between line current and line voltage. Normally, when the power line is driving a resistive load, peak voltage and current are coincident- with a power factor of 1. When the load is an electrolytic capacitor, such as the MERCRON lamp controller presents to the power line, the power factor is less than one, because the capacitor charges only during short intervals when the line voltage is above capacitor voltage.

In other words, the capacitor pulls power only when the line voltage is climbing toward peak. The charging current is heavy and of short duration. Whereas a resistor will pull current during the 8 millisecond half wave of a 60 cycle voltage excursion, the capacitor will pull current for only 2 milliseconds, and this current pulse will occur before peak line voltage occurs. The effect is that the lamp controller draws a heavy line current and acts as though the line voltage is low.

**If the total load on the power line is less than 600 watts, this effect can be largely ignored**. Also, if the lamp controller is installed in a plant with many large inductive motors, the 600 watt limit can be increased somewhat because the capacitive input of the MERCRON lamp controller will offset the inductive effect of the motors.

I**f the total load is larger than 600 watts, you must use a Power Factor Corrector (PFC) between the lamp controller and the power line**.

MERCRON manufactures two PFC models, one each for 50 and 60 hz service:
120 VAC / 60 hz @ 10 amps, weight = 15 lbs, and
230 VAC / 50 hz @ 10 amps, weight = 15 lbs.

One PFC can supply several lamp controllers, provided the total input current is less than 10 amps. The AC power leads between the PFC and each lamp controller must be less than 8 feet long.

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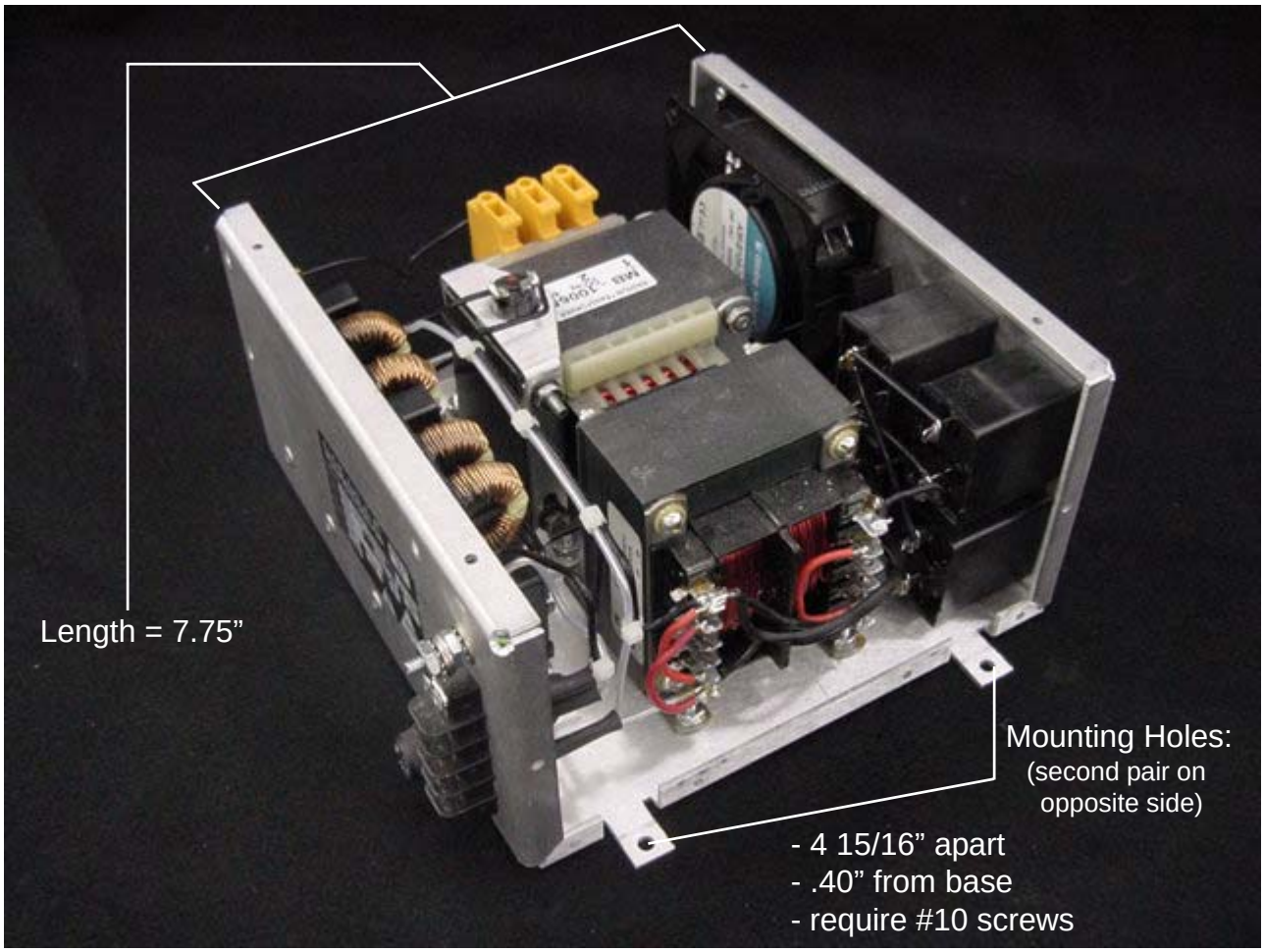
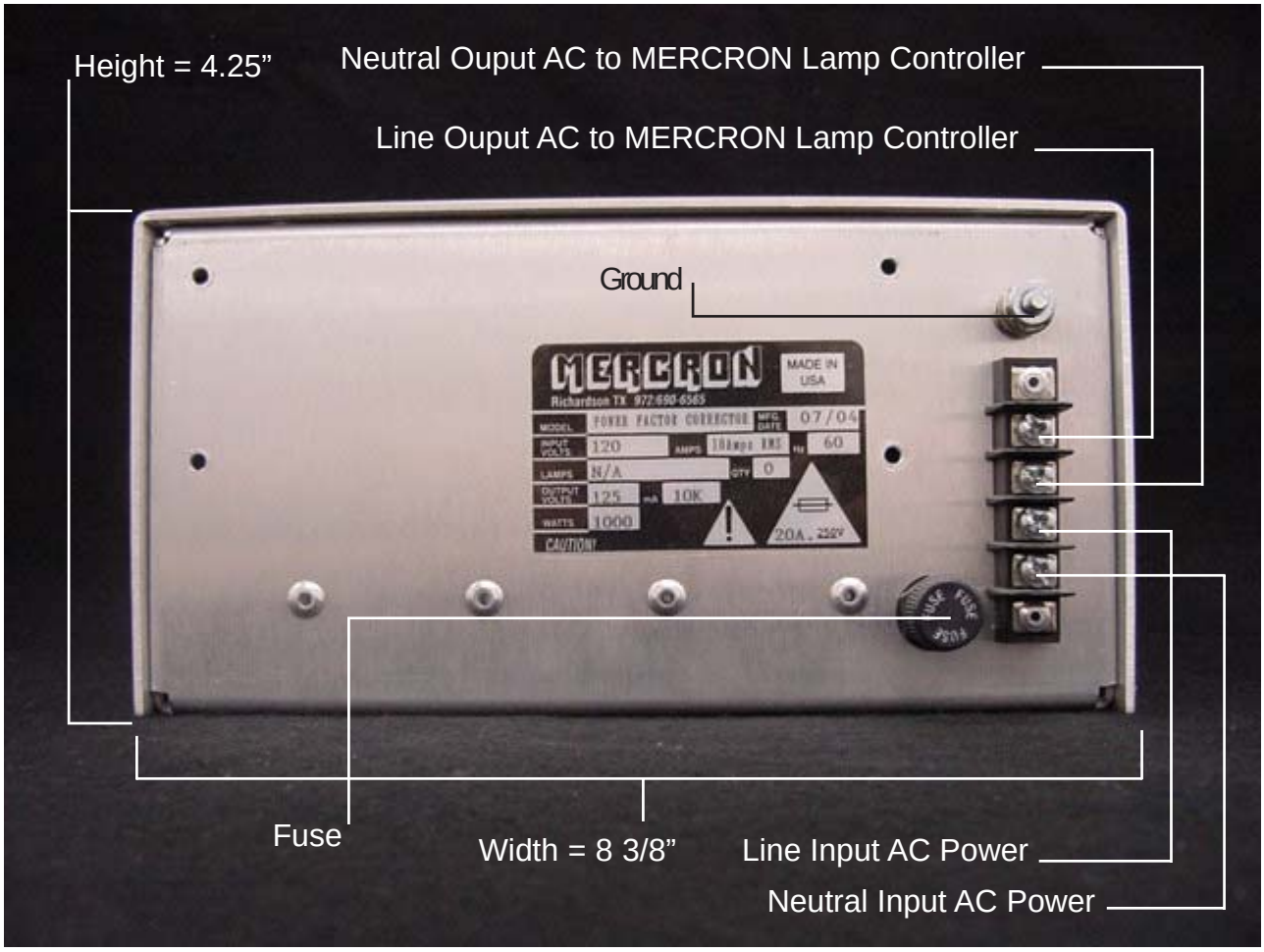
**INPUT POWER REQUIREMENTS**:
Sizing power lines and transformers **without** a Power Factor Corrector

In a related matter, input-power wiring and transformer windings must be rated for triple the expected average current draw. This is due to the fact that the capacitors draw all the current in short intervals, and the wiring must handle the peak currents involved, rather than merely the average current.

The following points will help in the design of input wiring:

- For a nonrepetitive, single pulse start up current: 10 times the rated operating current is needed
- For a repetitive peak, operating current: 3 times the rated operating current is needed
- Fuses: 1 time the rated operating current, but with some allowance for fuse fatigue


Length = 7.75”
Mounting Holes:
(second pair on
opposite side)
- 4 15/16” apart
- .40” from base
- require #10 screws


Height = 4.25”
Neutral Ouput AC to MERCRON Lamp Controller
Line Ouput AC to MERCRON Lamp Controller
Ground
MERCRON
Richardson TX 972/690-6565
MADE IN USA
POWER FACTOR CORRECTOR
07/04
120
60
N/A
0
125
10K
1000
20A., 250V
CAUTION
Fuse
Width = 8 3/8”
Line Input AC Power
Neutral Input AC Power

# Ordering Information

## ORDERS

Orders may be placed via phone, fax, or email @ info@mercron.com. Customers are asked to fax confimations of phone orders. When ordering, customers should reference both the model number as well as the unit's input voltage (120 or 230 VAC). Upon receipt of the order, MERCRON will schedule the customer's shipment for the earliest possible date, at the most economical rate, unless otherwise specified.

## RETURN POLICY

Lamp controllers are "made to order"; therefore, units which were purchased in error may not be returned. It is **most important** that you order the correct lamp controller. If some time has elapsed since your last order, or if you have changed applications, or if you have changed lamp type or size, please consult with our Technical Department to verify the appropriate lamp controller.

## SHIPPING

Shipping charges are **Prepaid & Additional F.O.B. Richardson (Dallas), Texas, U.S.A.** MERCRON ships all F.O.B. orders via United Parcel Service (UPS) by default. Customers may receive Freight Collect shipments via UPS, Federal Express, or DHL only if they provide their own valid account number with their preferred server. Also, please specify the level of service preferred (next day, standard, etc.). MERCRON charges a $2.00 per box shipping/handling fee; some lamp shipments require a "Glass Breakage Release" form to be signed and a $10.00 charge per lamp for added protective wrapping. MERCRON insures all orders, regardless of shipper.

## PAYMENT TERMS

MERCRON's standard terms for Accounts Receivable are Net 30/USD. Until credit has been established, new and international customers will be put on 100% Prepay terms. Credit is established by placing 3 orders within a 6 month period and by providing the following information: 1) number of years in business; 2) line of business; 3) company size; and 4) written confirmation that payments will be made within Net 30/USD terms. If open invoices are not paid within 30 days from the invoice date, VOLUME DISCOUNTS MAY BE FORFEITED.

## PAYMENT METHODS

The acceptable methods of payment are as follows: 1) a COMPANY CHECK drawn on a U.S. bank in terms of U.S. dollars. A foreign bank check must have, on the face of the check, the name of the U.S. city in which its correspondent branch office is located; 2) a MONEY ORDER, domestic or international, purchased from a bank, expressed in terms of U.S. dollars; 3) an ELECTRONIC FUNDS TRANSFER (please call for the necessary information); 4) a VISA, MASTERCARD, DISCOVER, or AMERICAN EXPRESS credit card. Please note that emailed invoices are payable securely online via credit card.

## WARRANTY

MERCRON lamp controllers are warranted to be free from defects in material and workmanship for a period of ONE YEAR from the date of manufacture. MERCRON lamp cotnrollers are NOT warrantied against failure due to misuse or improper installation; therefore, it is imperative that the operation manual be followed. MERCRON's liability is limited to the factory repair or replacement of the failed item and return freight to the customer.

## PATENT INDEMNIFICATION

MERCRON currently holds patents on all of its lamp controllers; however, due to the nature of patent litigation, MERCRON does not indemnify the Purchaser, its affiliates, and their respective directors, officers, employees, and agents from any liability, claim, legal action or proceeding, judgment, loss or expense, inclulding counsel fees, resulting from any claim or any suit against the Purchaser.

# Price List & Volume Discounts



Prices are base on formally scheduled and fully released purchase orders. Prices are subject to change without notice. Discounted prices based on increased quantity have been rounded up to the next whole dollar.

Prices shown below relate to existing models as listed in the catalog. The customizing of MERCRON's basic design may incur a onetime Special Engineering fee. Volume discounts do not apply to Accessories.

| Application | Quantity | Discount | Price Group | | | |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| FLUORESCENT | 1-4 | 0 | $439 | $516 | $549 | $626 |
| | 5-9 | 5% | $417 | $493 | $521 | $595 |
| | 10-24 | 10% | $395 | $464 | $494 | $563 |
| | 25-49 | 15% | $373 | $439 | $466 | $532 |
| | 50-99 | 20% | $351 | $414 | $439 | $502 |
| | 100-249 | 25% | $329 | $387 | $411 | $470 |
| | 250 + | Request a Quote | | | | |
| METAL HALIDE<br>MERCURY | 1-4 | 0 | Not Applicable | | $549 | $633 |
| | 5-9 | 5% | | | $521 | $602 |
| | 10-24 | 10% | | | $494 | $570 |
| | 25-49 | 15% | | | $466 | $538 |
| | 50-99 | 20% | | | $439 | $506 |
| | 100-249 | 25% | | | $411 | $475 |
| | 250 + | Request a Quote | | | | |
| HIGH PRESSURE SODIUM<br>TUNGSTEN | 1-4 | 0 | $468 | $523 | $578 | $633 |
| | 5-9 | 5% | $444 | $497 | $549 | $602 |
| | 10-24 | 10% | $421 | $470 | $520 | $570 |
| | 25-49 | 15% | $398 | $444 | $492 | $538 |
| | 50-99 | 20% | $374 | $418 | $462 | $506 |
| | 100-249 | 25% | $350 | $392 | $433 | $475 |
| | 250 + | Request a Quote | | | | |

| Accessories | | | | | |
|---|---|---|---|---|---|
| **Detectors** | CL-9 Kits: 1 Photoresistor Sensor & Sockets: $3.00 | | | PD's: $40.00 | |
| **Lamps** | $40.00----------(Depending on Size)----------$200.00 | | | | |
| **Lamp Sockets** | Mini BiPin<br>$1.50 / pair | Medium BiPin<br>$3.00 / pair | RDC<br>$7.00 / pair | RSC<br>$40.00 / pair | Mogul<br>$15.00 / pair |

MERCRON INC

## Physical Address

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U.S.A.

## Mailing Address

P.O. Box 831466
Richardson, TX 75083-1466
U.S.A.

## Internet

| | |
|---|---|
| mercron.com | Website |
| info@mercron.com | Email Address |

## Departments

| | |
|---|---|
| (01) 972-690-6565 | General Information, Orders & Customer Support |
| (01) 972-690-1150 | Fax |
| (01) 970-264-6761 | Technical Support / Inquiries |
| (01) 972-690-0802 | Production |

***Control the Lamp...Control the Light...Control the Quality***