Ballasts Technical Info

Introduction

While we focus on metal halide, there are practical uses for other HID technologies. We apply the same level of passion for quality and performance to these ballasts as we do to our metal halide offerings. To assure compatibility, refer to our specification sheets to determine which ballast works with which lamp.

The information below introduces ballast function, terminology and proper usage.

Why do we need ballasts?

For many users, ballasts are a mystery. Electrical distribution systems deliver fixed AC voltage (50 or 60 Hz) and expect connected electrical loads to limit the current drawn from the source. Low pressure and high pressure arc discharge lamps exhibit “negative impedance.” Without a ballast, the arc will extinguish or draw increasing current until some circuit element burns up. Ballasts provide system stability by limiting the current that can be drawn. Ballasts use inductive and capacitive components because they impede alternating current with little power consumption. Resistive components generate high loss and are usually avoided. This is true of conventional electromagnetic ballasts as well as electronic ballasts.

HID ballasts perform the following functions:

- Provide voltage to breakdown the gas between the electrodes of arc lamps and initiate starting.
- Provide voltage and current to heat the electrodes to allow a low voltage, high current arc mode to develop (referred to as glow-to-arc transition, GAT).
- Provide enough current to heat and evaporate the light emitting components after an arc has been established. Provide enough sustaining voltage (see Vss) to maintain the arc during warm-up and operation.
- Set lamp current once all the evaporable materials have reached thermal equilibrium.

Breakdown vs. Glow-to-Arc Transition (GAT)

Traditional metal halide lamps (also called “probe start”), and high-pressure mercury vapor (HPMV) lamps utilize an auxiliary electrode to facilitate starting. These lamps are filled with a relatively low pressure of argon gas. Breakdown occurs when several hundreds of volts are applied. The lower the fill pressure, the lower the breakdown voltage and less electrode heating occurs in the subsequent glow mode. Without enough electrode heat the arc mode will not develop. There is a trade off of breakdown voltage and GAT with fill pressure for these lamps. For most mercury vapor lamps sinusoidal output voltages around 220 Vrms suffice. For most metal halide lamps, highly peaked (distorted) output voltages around 300 Vrms suffice. Failing to attain a GAT will destroy lamp electrodes in less than 100 hours.

Uni-Form® pulse start metal halide and high pressure sodium (HPS) lamps dispense with the auxiliary electrode, but have breakdown voltage requirements in the range of several thousand volts. An “ignitor” adds a narrow (μsec wide) pulse near the peak of the output voltage waveform. Some lamps require more than one pulse per half cycle. The minimum output voltage requirement (min. OCV) assures that a GAT will occur. At room temperature, mercury interacts with argon to reduce breakdown voltage. In cold weather or refrigerated spaces, the breakdown voltage requirement goes up. Standard metal halide and mercury vapor ballasts have to supply sufficient output voltage for low temperature starting. This effect is not present in pulse start metal halide and HPS lamps.

The pulse voltage requirement for pulse start lamps assures low temperature starting.

Warm-up

Unlike low pressure lamps, HID lamps have a low initial arc voltage following GAT and warm up over several minutes to final operating voltage. In HPMV lamps this involves the evaporation of a fixed amount of mercury. In traditional metal halide and *Uni-Form* pulse start lamps, a fixed amount of mercury evaporates and the metal halide salts partially evaporate. For most HPS lamps, this involves the partial evaporation of mercury and sodium as the lamp reaches thermal equilibrium. Traditional and pulse start metal halide lamps have sustaining voltage requirements after GAT to assure the lamp will continue to operate. HPS lamps have a lamp power vs. lamp voltage space (see trapezoid) that has been defined to assure stable warm-up and operation.

Operation

The ballast determines the lamp current in normal operation. by providing the impedance. The combination of lamp current and voltage determines the power consumed by the lamp. The lamp power, in turn, determines light output and color. For example if a 320 watt lamp is accidentally operated on a 350 watt ballast, the lamp will run over wattage at 350 watts because the nominal lamp voltage is the same for both lamps and the ballast delivers the current required for a 350 watt lamp. Color will be warmer, light output will be higher and lamp life will be shorter.

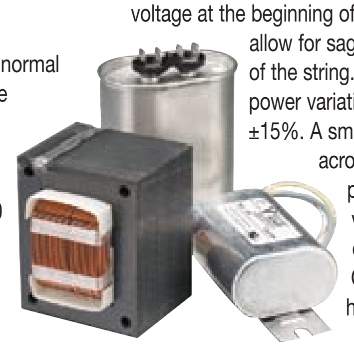
In stable operation, lamp power varies with supply voltage and lamp voltage. Electronic ballasts can be designed to minimize both sources of power variation. On lag and HX ballasts, lamp power varies about 2% for each 1% of line variation. On CWA and CWI ballasts, lamp power varies about 1% for 1% of line variation. These ballasts amplify lamp voltage variations into power variations while lag and HX ballasts minimize the same.

Ballast history

Most of the world uses “lag” type ballasts for the operation of high intensity discharge (HID) lamps. Another common name for the simplest type of lag ballast is “reactor”. These ballasts are constructed from steel laminations and wire coils. The term “lag” derives from the inductive nature of the ballast; the input current lags the input voltage by up to 90 electrical degrees. Several input taps may be provided to accommodate small local variations in nominal voltage. Reactor ballasts provide outstanding lamp performance, with excellent efficiency, at the lowest possible cost.

Lag ballasts that can accommodate a wide range of input voltages are made using an autotransformer stage in front of an inductive element. These use two coils and are referred to as HX or high leakage reactance autotransformers. The losses and material content are higher resulting in higher operating and initial costs. The lamp performance benefits are retained.

The CWA, or constant wattage autotransformer ballast, became popular in North America for mercury vapor lamps after World War II. The primary application was roadway lighting. The circuit delivers relatively constant lamp current, which, in turn, translates to relatively constant lamp power as long as lamp voltage does not vary with power input during life. This is a good assumption for mercury vapor lamps. It allowed utilities to start a roadway circuit with as much as +13% input voltage at the beginning of a string of lights and allow for sag to –13% at the end of the string. The resulting lamp power variation was an acceptable ±15%. A small “peaking” capacitor across the lamp terminals provided enough voltage to start lamps outdoors with modest OCV. The strategy had little to do with



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temporal variations in line voltage, but rather addressed the economics of lighting circuits along long stretches of road.

When HPS lamps were introduced, they were incompatible with CWA ballasts because they required a high starting voltage. The constant current characteristic led to unstable operation. Lag and HX ballasts with electronic ignitors became the preferred circuit types. Later, CWA circuits were developed for HPS lamps that depart from a constant current characteristic and incorporate ignitors.

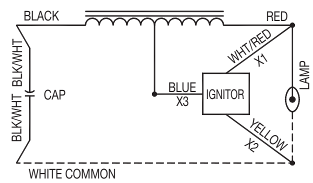
Metal halide lamps were introduced in the 1960's. They required a higher peak starting voltage than mercury vapor lamps, but were incompatible with "peaking capacitors." The lamps would start and promptly "drop out." By adding saturable elements to the magnetic circuit of the ballast, the OCV could be "peaked" to start the lamps. Probe start metal halide lamps and "peaked lead" ballasts launched metal halide lighting in North America. Internationally, the same lamps operated on lag ballasts by adding simple low cost ignitors. Multiple input voltage taps for CWA ballasts were readily accommodated. More ballasts could be operated on a circuit than lag or HX ballasts of the same wattage. However, the current wave shape left little margin for input voltage fluctuations during starting, had poor energy efficiency and provided poor regulation of lamp power with respect to lamp voltage. Evidence suggests that maintained lumens of most metal halide lamps operated on CWA ballasts are worse than those operated on lag circuits.

Ballast Types

Venture makes a full line of high performance ballasts for metal halide, high-pressure sodium and high pressure mercury vapor lamps. Our Opti-Wave™ family of ballasts is designed especially for *Uni-Form* pulse start metal halide lamps.

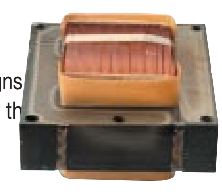
Opti-Wave ballasts

The *Opti-Wave* family of ballasts includes single voltage lag and multi-tap HX circuit designs and incorporates ignitors. They are carefully matched to *Uni-Form* pulse start lamps to provide peak lamp performance. Single voltage designs offer the most overall value to the end user. Quint-Volt™ and CWA designs offer flexibility and lower inventories for distributors, OEMs, and contractors. Venture also offers a full line of multi-tap CWA ballasts for *Uni-Form* pulse start lamps where CWA ballasts have been specified.



Opti-Wave 277V

These are optimized lag/reactor ballasts. The flux density, losses and power factor capacitor are chosen for good circuit loading and modest lamp power variation with respect to lamp voltage variation. These ballasts provide more consistent color from lamp-to-lamp than constant current designs (250W – 875W) is similar to th providing better value and performance without the need for higher capacity circuits.

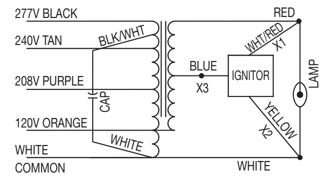


CHOOSING THE RIGHT BALLAST

Characteristic	Opti-Wave™ 277V	Quint-Volt™ *Opti-Wave*	Opti-Wave™ Electronic	CWA	Isolated CWI
Ballast Efficiency	Excellent	Good	Excellent	Good	Fair
Lamp Wattage Regulation (over lamp voltage range)	Excellent	Excellent	Excellent	Good	Good
Lamp Wattage Regulation (over line voltage range)	Good	Good	Excellent	Excellent	Excellent
Circuit Loading	Excellent	Excellent	Excellent	Excellent	Excellent
Current Crest Factor	Excellent 1.5	Excellent 1.5	Excellent 1.0	Good 1.6 – 1.8	Good 1.6 – 1.8
Input Voltage Dip Tol.	Good	Good	Excellent	Excellent	Excellent
Isolation	No	No	Yes or No	No	Yes

High Reactance Autotransformer (HX-HPF)

These are two coil ballasts, consisting of a primary winding that provides the voltage transformation for OCV requirements, coupled with a secondary coil for limiting current. The ballast uses more material and has higher losses than its lag/reactor counterpart. In return, it offers multi-tap capability to serve a wide variety of applications. A capacitor is typically connected to the highest voltage tap to increase input power factor. Lamp performance is excellent.



Quint-Volt™ *Opti-Wave*

Our *Quint-Volt* ballasts are HX circuits that have the same lamp power regulation characteristic as 277V *Opti-Wave* ballasts. These are 5 tap HX autotransformers with all of the common US input voltages. The flux density, losses and power factor capacitor are chosen for good circuit loading. They generate modest lamp power variations, with respect to lamp voltage variations. As a result, these ballasts provide more consistent color from lamp-to-lamp than CWA. *Quint-Volt* ballasts can be used in a wider range of applications than 277V *Opti-Wave* ballasts, while providing the same performance benefits. Circuit loading is similar to comparable CWA ballasts.

Constant Wattage Autotransformer (CWA)

Present day CWA ballasts for metal halide lamps have changed very little from early designs dating back to the 1960's. Versions with ignitors to operate pulse start lamps are available, along with a wide range of wattages. CWA ballasts have a large installed base in the US. Note that low wattage metal halide lamp performance with CWA ballasts has proven to be poor. Most ballasts sold for lamps of 150 watts or less are either lag or HX types.

CWA ballasts have two coils. One acts as an autotransformer with multiple input taps and a second provides inductance that in series with a capacitor controls lamp current. For traditional probe start designs, the capacitor usually connects between the lamp and the secondary coil of the ballast. In pulse start designs, the capacitor usually connects between the primary and secondary coils. A tap near the lamp output on the secondary coil is connected to the ignitor circuit.

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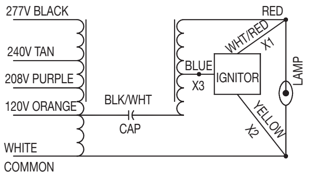
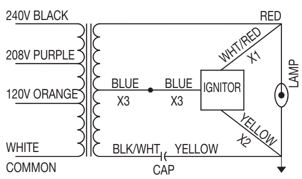


"Constant wattage" is actually a misnomer. The circuit provides more or less constant current to the lamp. This is undesirable for lamp loads that do not provide constant voltage. HPS lamps are unstable when they are operated at constant current. CWA circuits have been modified for HPS lamps, but use more materials and result in higher losses. This is also an issue for metal halide lamps that rise in voltage with aging. The result is lamp-to-lamp power variation that shows up as lamp-to-lamp color variation. As long as demand for CWA ballasts continues, Venture will provide them with the best technology available.

Constant Wattage Isolated Transformer (CWI)



CWI ballasts share the same features as the CWA versions, but have electrically isolated secondary coils to meet the Canadian Electrical Code. These ballasts use slightly more material than CWA types, making them less energy efficient and more costly.

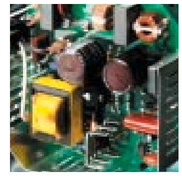
Magnetically Regulated Ballasts (a.k.a. Regulated Lag)

Magnetically regulated ballasts use three coils and saturable magnetic elements to provide a high degree of power regulation to the lamp. From the perspective of the lamp, operation is the same as on a lag ballast with a well-regulated input voltage. These typically have twice the material content of comparable CWA ballasts and higher losses. They are primarily used in heavy industrial settings where switching of large electrical loads impacts lighting circuits (for example, a downlight hanging from a crane in a steel mill). Venture currently does not offer these because demand is small.

Electronic Ballasts

Fluorescent lighting now uses electronic ballasts for essentially all new commercial lighting in the US, largely because of energy legislation. Fluorescent lamps generate more lumens per watt when operated at high frequency and have no compatibility issues. HID lamps have two issues. There is no demonstrable LPW improvement at high frequency and they exhibit acoustic resonances that disturb lamp operation at the frequencies used for fluorescent lamps. As a result, the adoption of electronic HID ballasts has been slow.

The most mature metal halide electronic ballasts operate low wattage (150 watts and less) metal halide lamps. The lower the lamp wattage, the higher the resonant frequency. Designers have opted for low frequency circuits that drive low wattage lamps with square wave current. The small size and light weight of low watt electronic ballasts fit retail track lighting applications very well. High wattage lamps have lower resonant frequencies, so ballast designs that operate lamps in the 100 KHz range and above work quite well. These ballasts have low losses, control/program lamp power, and are small and light. Dimming, in conjunction with the use of natural daylight, is a workable strategy with a shorter payback period.



Venture is investigating a number of exciting performance phenomena. Some lamps operating on electronic ballasts (HF, DC, or square wave) provide higher maintained lumens over life. This is a rapidly evolving topic. Look to our website for new developments.

Ballasts that Venture sells in North America include the following versions:

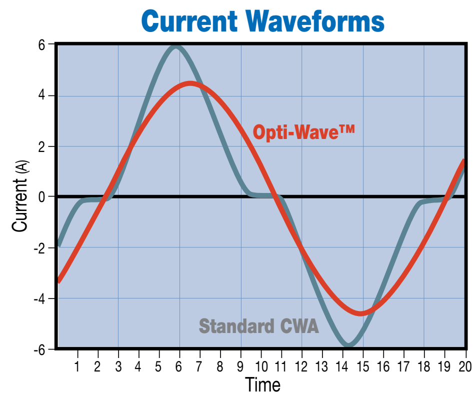
- Quint-Volt: 120V, 208V, 240V, 277V, and 480V.
- Quad-tap: 120V, 208V, 240V and 277V
- Tri-tap: 120V, 277V, 347V (Canada)
- 480V/120T: A 480V ballast with a 120V tap for standby quartz lighting.
- 600V (Canada)
- Most Lag and HX ballasts are rated for supply voltage variations of ±5%.
- CWA and magnetically regulated circuits are rated for supply voltage variations of ±10%.

Ballast Performance

The following performance factors affect ballast specifications:

Current Crest Factor (CCF)

The current crest factor is the ratio of the peak lamp current to the root-mean-square (rms) value of the current. High current crest factors are associated with high lumen depreciation of HID lamps. Lamp specifications set upper limits for CCF. A typical range of current crest factors for lag, HX and regulated lag ballasts is 1.4-1.5. For CWA ballasts CCF ranges from 1.6 to 1.8. Electronic ballasts can can be as low as 1.0.



Open Circuit Voltage (OCV)

The voltage across the output terminals of ballast with no load connected is the OCV. Lamp OCV requirements differ for the various ballast circuit types.

Sustaining Voltage (Vss)

Vss is the instantaneous voltage across the lamp when lamp current crosses zero. If the voltage is not sufficient, the lamp will not ignite on the next half cycle of current, and drop out. Adequate Vss is needed from every ballast type, but is particularly important for CWA ballasts. However, it is difficult to measure without sophisticated lab equipment. ANSI standard values are determined for the condition just following the development of a full arc discharge. This is when the current characteristics of CWA ballasts are most likely to cause lamp drop out. ANSI does not specify Vss for lag or HX circuits.

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AC Line Regulation

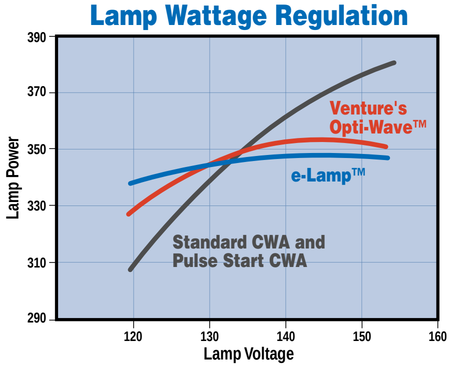
Line regulation is the percent change in lamp wattage per percent change of supply voltage. In the US, Canada and most of Europe, supply voltage can be unreliable (such as a brownout or blackout); however, normal variability is small. An exception might be an industrial application where large electrical loads switching on and off affect lighting circuits. Where supply voltages are steady, HX ballasts provide the best performance at a cost comparable to CWA ballasts. When there is a serious line voltage regulation issue, regulated lag or electronic ballasts are preferred. Lag ballasts dominate HID lighting in Europe, where supply voltage is regulated to ±5%. In North America, lighting circuits wired according to the National Electric Code typically stay within the ±5%.

Lamp Regulation

By definition, lamp voltage regulation is the change in lamp wattage divided by the corresponding change in lamp voltage initially and during life. The ANSI lamp voltage range allowed for a new (100-hour) lamp is typically ±12%. Modern lamp manufacturing processes typically yield metal halide lamps with a much tighter voltage range. However, metal halide lamps typically rise between 1 and 2 V per 1000 hours. At end of life, the metal halide lamp voltage can be more than 25% higher than at 100 hours. With modern AC power lines regulated to within 5%, it is more important to have tight regulation of lamp power with respect to lamp voltage variation than supply voltage regulation. This results in the least lamp-to-lamp color and brightness variations.

The operating characteristics of any ballast can be mapped in a graph of lamp wattage vs. lamp voltage. For lag and HX ballasts, the graph is a parabola where the peak wattage typically occurs when the lamp voltage is about 60% of the OCV. The curve stops when the lamp voltage reaches about 80% of the OCV. At this point, the lamp stops operating. The graph for most CWA or constant current ballasts is relatively straight line. HPS lamps need operating characteristics similar to resistive and lag ballasts, a constant current characteristic is unstable.

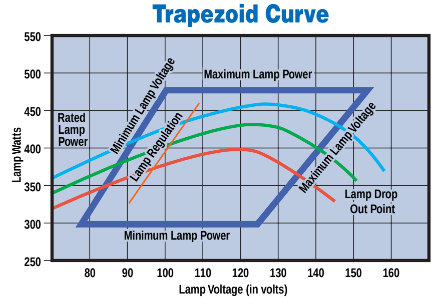
Lamp Wattage Regulation



High pressure sodium lamp "Trapezoids"

The HPS trapezoid is bounded by upper and lower wattage limits. At the low watt limit, the lumens are low; at the high watt limit, life is short. The left side of the trapezoid represents the lowest voltage lamp a user could encounter. The right side represents the highest voltage lamp a user should expect to operate. The sides of the trapezoid slope because increasing power increases the voltage of HPS lamps. Acceptable ballasts chart a path that passes through both sides within the min. and max. wattage limits. The three ballast curves in the graph above illustrate the effect of low, nominal, and high line voltage.

Trapezoid Curve



Minimum ambient temperature for starting

ANSI and IEC write lamp specifications so that lamps will start at –30°C (–22°F) to -40°C (-40°F). Mercury vapor and metal halide lamps will start at lower voltages at room temperature. As temperatures drops below –40°C, not much happens until Xe (HPS) or Ar (metal halide and mercury vapor) starting gases condense to the liquid state. At these temperatures (-160°C/–310°F and lower) we are not aware of lighting opportunities.

Ballast Noise

Magnetic ballasts generate audible noise as a result of magnetically induced mechanical stress. This may be amplified or attenuated depending on fixture design, mounting methods and room acoustics. There are presently no noise standards for HID ballasts. Generally, Opti-Wave™ ballasts are noticeably quieter (greater than 10 dB) than CWA, CWI or regulated lag ballasts.

Lamp Starting

Pulse start metal halide ballasts provide the proper combination of open circuit voltage and high voltage pulses to start the lamp. The pulse is provided by a specially designed ignitor, or starter, that is used in conjunction with the ballast. As soon as the ignitor senses that the lamp has started, it discontinues the pulsing operation. At this point, the ballast sustaining voltage must be sufficient to maintain lamp operation. A positive feature of this system is that the lamp will hot restart in 3-4 minutes following a power interruption. Traditional probe start metal halide ballasts can take as long as 10-15 minutes to restart the lamp.

The ballast open circuit voltage starts traditional probe start metal halide and mercury vapor lamps. Auxiliary electrodes, or probes, aid these lamps in starting. The probe electrode is disconnected after lamp has warmed up. Most of these lamps operate on CWA ballasts that offer a more "peaked" open circuit voltage, to assist lamp starting.

High Pressure Sodium lamps start in a manner similar to pulse start metal halide lamps. The main difference is a slightly less demanding ignitor pulse requirement.

Capacitors

With lag and HX ballasts, capacitors are needed to improve (input) power factor. As a result, the number of lamps that can be operated on a circuit nearly doubles. In large installations, power factor correction is also required to avoid power quality problems and utility penalties. Capacitors are integral components of CWA and regulated lag circuits; they will not operate without capacitors. Both oil-filled (wet) and dry-film capacitor technologies are commonly used with ballasts. A means to discharge capacitors after power is turned off is a safety requirement.

Oil-filled capacitors

Oil-filled capacitors come in metal cases and are filled with a dielectric fluid. They are rated up to 100°C, although 90°C is the most common rating. They usually have two 1/4" spade terminal lugs located on the top for connection with the ballast. Most ballasts come with the mating terminals already attached to the appropriate leads. Oil-filled capacitors are very reliable and available in ratings up to 525V. For some higher wattage HID ballasts, they are the only choice.


Oil-filled capacitor

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Dry-Film capacitors


Dry-film capacitor

Dry-Film capacitors do not use a dielectric fluid. Originally, these capacitors were limited to applications where voltages did not exceed 330V. Recent advances have pushed this to 400V. They are available in temperature ratings of 100°C and have become an attractive alternative to oil-filled capacitors. They are packaged in plastic housings which do not need to be grounded and do not need any special clearances above the terminals.

Ignitors

HID lamp ignitors provide a brief, high voltage pulse or pulse train to breakdown the gas between the electrodes of an arc lamp. Pulses can range from several hundred volts to 5KV. Typical durations are in the µsec range. They are usually timed to coincide with the peak of OCV. If they are timed too early or too late, lamps may not start reliably.

There are three basic ignitor circuits in wide use. The simplest is a capacitor in series with a voltage sensitive switch that connects across the output of a lag ballast. It is used internationally to start traditional metal halide lamps on 220-230V 50 Hz mercury vapor ballasts. It generates 600V pulses and has the virtue of simplicity and low cost.

The second consists of a capacitor charging circuit and a voltage sensitive switch. It connects to a tap on the output inductive element of the ballast and uses it as a high frequency pulse transformer. This circuit works with lag, HX, CWA, or regulated lag circuits. It is the most common type of ignitor used in North America and growing in popularity internationally. It has the virtue of simplicity and low cost. It requires the ballast insulation system to withstand the pulse voltage; because it is tied to the ballast, the distance the lamp can be mounted from the ballast depends on pulse attenuation. Circuits that generate wide pulses permit greater distance. These circuits are generically referred to as "impulsers."

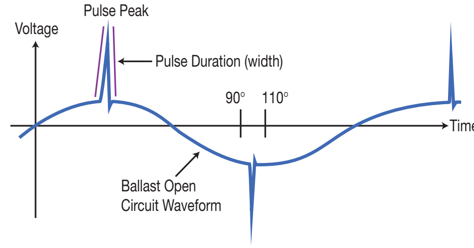
The third circuit is similar to the first except that it contains a pulse transformer. The virtues are that the ballast insulation is not exposed to pulse voltage. The ignitor can be mounted near the lamp while the ballast can be remote. It can be used with any ballast type. This is the most costly circuit to make, but allows the use of a less expensive ballast. It is the most commonly used circuit internationally. The ignitors are referred to as superimposed ignitors (SIP) because the pulse is superimposed on top of the ballast OCV.

There are HID lamps available internationally that incorporate internal ignitors. The pulse voltage appears on the ballast output terminals. These may not work with all ballast circuits, and could damage insulation. Request technical support for help with these.

Venture® ignitors and ballasts are capable of continuous pulsing at maximum rated case temperature.

Prolonged continuous operation (weeks to months) degrades ballast insulation and reduces ballast life. Best practice is the timely replacement of failed lamps to prolong ballast life. Ignitor case temperature limits must be observed. There is little safety margin, so expect short ignitor life if the limits are exceeded.

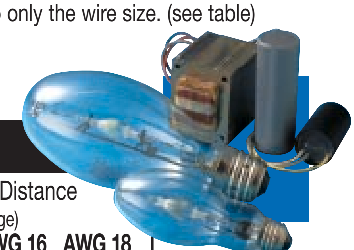
Most Venture pulse start ballasts have distance limitations of 2 to 15 ft with standard ignitors. Longer ballast-to-lamp (BTL) distances can be attained with higher energy ignitors. These should not be used for short range as they may damage ballast insulation and shorten ballast life. Contact Venture for availability and technical support.



Venture's new Smart Ignitor™ products use a microprocessor to limit pulses, detect lamp starting, and shut off the ignitor if the lamp does not start. This control technology is applied to the "impulser" type ignitor to allow longer ballast to lamp (BTL) distances without degradation of the insulation system should prolonged ignitor operation occur.

Remote Mounting

Probe start metal halide and mercury vapor lamp/ballast separation is limited only by adequate wire size as lamp current is the only consideration. Pulse start lamps are distance limited by wire size as well as pulse attenuation. Ballasts with long-range ignitors are offered; but superimposed ignitors, mounted near the lamp, can bring the restriction back to only the wire size. (see table)



Remote Ballast Mounting

Lamp Wattage	Lamp Type: Probe Start MH ANSI	Lamp Type: Mercury ANSI	Maximum Ballast to Lamp Distance (in feet, listed by wire gauge): AWG 10	AWG 12	AWG 14	AWG 16	AWG 18
175	M57	H39	420	250	150	100	65
250	M58	H37	300	200	125	75	50
400	M59	H33	200	125	75	50	25
1000	M47	H36	325	200	125	75	50
1500	M48	N/A	225	125	75	50	35

Lamp Wattage	Uni-Form® MH PS ANSI	Maximum Ballast to Ignitor distance for Pulse Start MH, Ignitor < 6ft from lamp: AWG 10	AWG 12	AWG 14	AWG 16	AWG 18	Remote Ignitor for PS MH
70W	M98/M85	600	360	220	150	95	BVS003REPL (No Medium base)[1,2]
100W	M90	560	340	200	130	80	BVS003REPL (No Medium base)[1,2]
125W	M150	560	340	200	130	80	BVS003REPL (No Medium base)[1,2]
150W	M102/M81	340	220	140	80	55	BVS003REPL (No Medium base)[1,2]
175W	M152	420	250	150	100	65	BVS003REPL (No Medium base)[1,2]
200W	M136	380	260	160	90	60	BVS003REPL[1]
250W	M153/M80	300	200	125	75	50	BVS003REPL[1]
300W	M151	260	160	90	60	30	BVS003REPL[1]
320W	M154	240	150	90	60	30	BVS003REPL[1]
350W	M131	220	140	85	55	35	BVS003REPL[1]
400W	M155	200	125	75	50	25	BVS003REPL[1]
450W	M144	160	100	65	40	22	BVS003REPL[1]
750W	M149	325	200	125	75	35	BVS002REPL[1]
875W	M166	360	220	140	80	55	BVS002REPL[1]
1000W	M141	325	200	125	75	50	BVS002REPL[1]

Note 1: Remote Ignitors require a 5kV pulse rated lampholder socket. Also requires 600V wires at rated temperature which are resistant to cuts .
Note 2: The North American pulse rated medium base lampholder for HID is 4kV rated. The North American pulse rated mogul socket for HID is typically 5kV rated. The BVS003 REPL pulse height is between 4kV and 5kV, so it can not be used with medium based lamps. It can be used with mogul, G12, and double ended lamps.

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Ballasts Technical Info

Grounding and Wiring

Caution: Installation and maintenance should only be performed with the circuit turned off.

Ballasts must be connected to electrical ground to avoid electrical shock or damage to the equipment and facility. The installation and wiring must comply with applicable federal, state or provincial codes and regulations.

Core and coil ballasts are insulated with a varnish-like material. This material must be penetrated at the point where the ground connection is made to ensure a good connection. This connection can be made when mounting the ballast to the luminaire, by using a star washer in combination with one of the mounting bolts.

Grounding of the Lamp Socket Shells

The Canadian Electrical Code (Part 1 (1994) Rule 30-314) requires grounding of lamp socket shells; refer to the connection diagrams. In circuits with two lamps in series, the socket shell is non-hazardous, provided that the removal of the lamp electrically isolates the shell.

Circuit Loading

How many lamps can be operated on a circuit? According the 2002 National Electric Code (NEC), in Section 210-20:

“Where a branch circuit supplies continuous, or any combination of continuous and non-continuous loads, the rating of the over-current device shall not be less than the non-continuous load plus 125% of the continuous load.”

“A non-continuous load is any load that occurs for less than three hours.”

For new installations of CWA and regulated lag ballasts the highest current draw is in continuous operation. The total number of ballasts must draw less than 80% of the circuit breaker rating. A conservative approach would use the current draw of ballasts operating aged lamps. As lamps age, system wattage on CWA ballasts climbs, leading to higher than rated input current. A safety factor of 1.2 times the rated current is a reasonable de-rating factor.

For new installations of lag, HX, and *Opti-Wave* ballasts the highest current draw is when the lamp is off. This occurs for seconds during starting or for minutes following a power interruption. Per the NEC, this is a non-continuous load. Following a lamp failure, power could be applied for a long time. The NEC provides no guidance for dealing with failed lamps that result in an open circuit current draw.

While it is unlikely that a lamp will be replaced in less than three hours, it is equally unlikely that users will tolerate very many lamp outages without replacements on a given circuit. As in the CWA case, a 1.2 safety factor seems reasonable. Divide the circuit breaker rating by the open circuit current draw of the ballast to determine the number of ballasts that can be connected (round down). Next, divide 80% of the circuit breaker rating by the normal operating current (round down) of a ballast. The first is normally the limiting factor in determining the allowable number of a ballasts on a circuit.

In retrofits, higher wattage lamps and ballasts are usually replaced with better performing lower wattage lamps and ballasts. Circuit loading is rarely an issue as long as the circuit was properly loaded initially.

Agency Certifications:

This is one of the most common Underwriters Laboratories marks. If a product carries this mark, it means UL found that samples of this product met its safety requirements. These requirements are primarily based on UL’s own published Standards for Safety.

Consumers rarely see this mark, because it is for components that are part of a larger product or system. These components may have restrictions on their performance or may be incomplete in construction. The Component Recognition marking is found on a wide range of products, including some switches, power supplies, printed wiring boards, some kinds of industrial control equipment and thousands of other products.

The UL Recognized Component Mark, for components certified by UL to meet both Canadian and U.S. requirements, became effective in 1998. Although UL had not originally planned to introduce a combined Recognized Component Mark, the popularity of the Canada/U.S. Listing and Classification Marks among clients with UL certifications for both countries has led to the new mark.

This is one of the most common Canadian Standards Association (CSA) marks. If a product carries this mark, it means CSA found that samples of this product met its safety requirements. These requirements are primarily based on CSA’s own published Standards for Safety.

Circuit Loading Comparison

Lamp Type	277V CWA Operating Current	277V CWA Systems Per Breaker	277V *Opti-Wave* Operating Current	277V *Opti-Wave* Open Circuit Current	277V *Opti-Wave* Systems Per Breaker	277V *Quint-Volt Opti-Wave* Operating Current	277V *Quint-Volt Opti-Wave* Open Circuit Current or Starting Current Max	277V *Quint-Volt* Systems Per Breaker
125W, M150	0.55	29	0.55	0.85	23	Not Available	Not Available	Not Available
175W, M137/M152	0.80	20	0.75	1.05	19	0.80	1.10	18
200W, M136	0.85	18	0.80	1.25	16	0.90	1.15	17
250W, M138/M153	1.10	14	1.10	1.35	14	1.20	1.40	14
300W, M151	1.25	12	1.25	1.55	12	1.30	1.75	11
320W, M132/M154	1.40	11	1.40	1.70	11	1.45	1.80	11
350W, M131	1.55	10	1.50	1.90	10	1.60	2.00	10
400W, M135/M155	1.75	9	1.70	2.10	9	1.75	2.20	9
450W, M 144	1.90	8	1.90	2.30	8	2.00	2.50	8

Note: 16A max continuous load and 20A max short term load used to calculate systems/breaker

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