# The Value of Electronic HID Technology

## The Benefits of Electronic Ballasts with Medium Wattage Quartz Metal Halide Lamps

Metal halide HID lighting has unquestionably experienced an escalating level of market acceptance since its introduction in the 1960's. The first metal halide systems — standard quartz probe start metal halide lamps driven by magnetic ballasts — delivered good-quality white light and high lumen output relative to the energy they consumed. Their energy efficiency coupled with an acceptable light quality enabled these early systems to dominate a variety of commercial and industrial high-bay lighting applications.

Over time, advances such as the development of pulse start technology helped further transform metal halide lighting into the energy-efficient, bright, and long-life option that it represents today. Pulse start metal halide lighting systems offer measurable improvements in lumen efficiency, lamp life, color stability, and lumen maintenance — the ability of a lamp to maintain light output over its lifetime compared to traditional probe start metal halide systems. However, the magnetic ballast technology that has traditionally driven probe start metal halide systems has been unable to completely optimize these performance areas.

Today, optimization of those elements has been enabled through the introduction of revolutionary electronic HID ballast technology, which delivers improved quality of light while substantially lowering the cost of ownership. Just as electronic ballast technology has enhanced fluorescent lighting systems, electronic HID ballasts bring significant performance improvements to metal halide lighting systems in the form of:

1. Enhanced lumen maintenance (up to 60%), and longer dependable service life.
2. Enhanced color control (reduced color shift between lamps).
3. Higher efficiency (10-15% less energy consumption vs. magnetic ballast technology).
4. Reduction in noise (most electronic HID lighting systems are sound class "A" [<24 db]).
5. Enhanced controllability (many systems are dimmable, driving additional energy savings).

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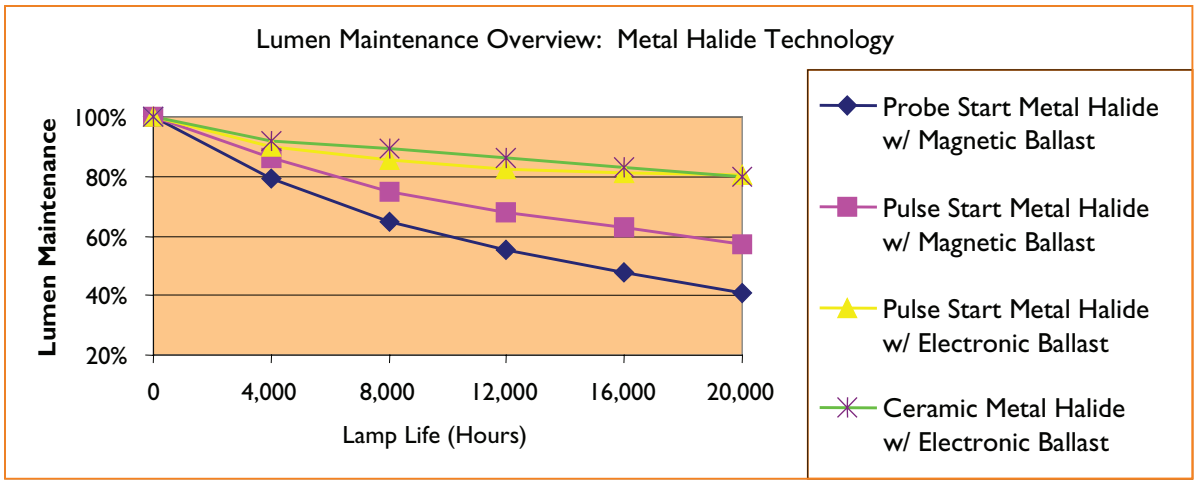
## Greater Lumen Maintenance

Improved lumen maintenance is the most fundamental and significant benefit offered by electronic HID ballasts within medium wattage quartz metal halide lighting systems. Conventional HID lighting systems (magnetic ballasts driving probe start metal halide lamps) typically experience a 50-60% fall-off in light output over the published life of the lamp. The use of solid-state electronic ballasts minimizes this issue, delivering a 20-50% improvement in lumen maintenance over conventional HID systems, and up to a 20% improvement over magnetically-ballasted pulse start systems. On 400W lamps using electronic ballasts, for example, the lumen maintenance rating after 8,000 hours of operation is 86% or higher compared to 65-75% for probe and pulse start lamps operating on magnetic ballasts (see Graph 1).

Graph 1




1 All product-related information has been sourced from the Philips Lighting Specification and Application Guide (2006) and the Advance Atlas (2008-2009) and speaks specifically to Philips and Advance products.

2 Rated average life is the life obtained, on the average, from large representative groups of Philips lamps in laboratory test under controlled conditions at 10 or more operating hours per start. It is based on the survival of at least 50% of the lamps and allows for individual lamps or groups of lamps to vary considerably from line average.

## Enhanced Color Control

Due to their precise starting and run-up characteristics and constant wattage operation, electronic ballasts, compared to their magnetic ballast counterparts, can keep a lamp operating at a true constant wattage regardless of the age of the lamp or input voltage variations to the ballast. The result of such constant wattage operation is the most consistent color and light output possible. In other words, electronic ballasts maximize the superior color properties of metal halide and ceramic metal halide lamps over the entire life of the lamp.

## Higher Efficiency, Longer Dependable Lamp Life, and Reduced Cost of Ownership

With more maintained lumens, the use of electronic ballasts enables the overall fixture count to be significantly reduced. For example, a 400W pulse start HID lighting system driven by electronic ballasts produces up to 56% more mean, or average, lumens compared to a 400W probe start system driven by magnetic ballasts. Taking advantage of this performance benefit, the fixture count can be reduced without sacrificing light levels.

The following chart (Figure 1) highlights the potential reductions in relamping and maintenance costs that electronic ballasts can offer over magnetic ballasts.

Figure 1 Cost of Re-Lamping Over 10 Years: Electronic HID vs. Conventional Magnetic Technology[1]

| | Magnetic HID Pulse Start 400W | Electronic HID Pulse Start 400W | Improvement |
|---|---|---|---|
| Number of fixtures | 400 | 280 | 30% |
| Annual burn hours | 5,000 | 5,000 | N/A |
| Lamps replaced at (hours) | 12,000 | 18,000 | 50% |
| Lamp cost per each re-lamping * ** | $10,000 (at $25/fixture | $7,000 (at $25/fixture) | 30% |
| Fixture cleaning and labor associated with lamp relacement** | $10,000 (at $25/fixture | $7,000 (at $25/fixture) | 30% |
| Number of replacements in 10 years* | 4 | 2 | 50% |
| Total 10-year cost of lamp changes | $80,000 | $28,000 | 65% |

By its very nature, metal halide lamp technology with a rated average lifespan of 20,000 plus hours has a significantly longer life expectancy than many other alternative technologies. In the retail setting, for example, metal halide systems can last up to 7 times longer than halogen incandescent alternatives[1] while delivering the desired white light required to enhance store ambiance and merchandise appeal. Longer dependable service life results in fewer lamp outages and reduces relamping requirements over the system's lifetime, minimizing the maintenance and product costs associated with frequent lamp replacement. In addition, the system's higher efficiency also can help to reduce air conditioning loads (generated by the incremental heat associated with incandescent lamps), and its associated costs.

## Reduction in Noise and Enhanced Controllability

Due to their solid-state nature, electronic ballasts run quieter than magnetic ballasts and are usually sound-rated "A," the quietest rating available. Electronic HID ballasts can also enable dimming and are compatible with lighting controls such as relays, occupancy sensors, daylight-harvesting sensors, and building management systems (BMS).

1 All product-related information has been sourced from the Philips Lighting Specification and Application Guide (2006) and the Advance Atlas (2008-2009) and speaks specifically to Philips and Philips Advance products.

## The Benefits of Electronic Ballasts with Ceramic Metal Halide Technology

One of the most exciting advancements in the HID lighting arena has involved the evolution of ceramic metal lamp halide technology. In 1995, the first HID metal halide lamps with ceramic discharge tubes were introduced in the United States. In the 10 years that followed, millions of ceramic metal halide lamps have been sold, and the market for these products continues to increase.

The success of this technology can be attributed to the valuable benefits that ceramic lamps offer relative to quartz metal halide lamps. Compared to quartz discharge tubes, ceramic discharge tubes are chemically more stable, can resist higher temperature loads, and their dimensions can be more tightly controlled. As a result, ceramic lamps offer better color rendering, a more stable color throughout lamp life, a longer dependable service life, and a more consistent color appearance from lamp to lamp. As with quartz metal halide lamps, the benefits of ceramic lamps are most fully exploited when electronic ballasts are used to drive these lamps.

While the installation of ceramic metal halide systems may involve a higher up-front cost than other incandescent alternatives, ceramic metal halide lamps driven by electronic ballasts deliver higher quality light and greater cost efficiency over the total life of the investment.

In addition, through their energy-efficiency and uncompromised lighting effectiveness in venues such as the retail sector, metal halide systems are uniquely able to deliver the required lighting power densities per square foot that are currently mandated by ASHRAE 90.1-2001 energy standards.

## Applications for Ceramic Metal Halide

Until recently, ceramic metal halide lamp systems were only available for 35-150-watt applications, with lamps offered in several color temperatures and in a variety of outer lamp envelopes. Ongoing development in ceramic metal halide lamp and electronic ballast technology has successfully delivered an expanded array of wattages to the market, extending the benefits of the technology to a wider range of applications. Ceramic metal halide lamps are now not only available in up to 400-watt versions suitable for high bay applications, but also in compact 20W, 22W and 39W models as well. These low profile, low-wattage systems have positioned ceramic metal halide as an ideal replacement for halogen incandescent in retail, hospitality and other settings utilizing accent lighting, as highlighted by the accompanying comparison charts (Figures 2 and 3).

Figure 2 Comparison for "Direct Accent" Lighting Applications, Halogen MR-16 vs. 20W-22W Ceramic Metal Halide System Lamps and eHID

| | Halogen MR-16 Lamp | 20W-22W Ceramic Metal Halide Lamp with eHID Ballast | Improvement |
|---|---|---|---|
| Lamp Wattage | 50W | 22W | 28W |
| System Watts | 50W | 26W | 52% Initial |
| Lumens | 780 - 850 | 1,625 initial - 1,700 initial [3]<br>1,050 mean - 1,200 mean | 25% mean |
| System Efficacy (Lamp & Ballast) | 16-17 lumens per watt | 48 lumens per watt @ mean | 100% |
| Rated Average Life[2] | 3,000 - 4,000 | 12,000 hours | 400% |
| Estimated time between re-lamping* | 0.7 - 0.9 years | 2.7 years | 393% |
| Mean annual Cost of Energy to Operate Lamp** | $17.52 per year per lamp | $9.11 per year per lamp | 52% |
| Other Benefits | | - Reduced product an maintenance cost as a function of up to one-third fewer lamps required<br>- ASHRAE compliant | |

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2 Rated average life is the life obtained, on the average, from large representative groups of Philips lamps in laboratory test under controlled conditions at 10 or more operating hours per start. It is based on the survival of at least 50% of the lamps and allows for individual lamps or groups of lamps to vary considerably from line average.

3 Initial vs. mean lumens = The measured luminious output of a new light source versus the output at 40% of lamp life.

Figure 3 Comparison for "General Accent and Track Lighting" Lighting Applications: Halogen PAR 30 Lamps vs. Ceramic Metal Halide PAR 30 Lamps and eHID Ballasts[1]

| | Halogen PAR 30 | Ceramic Metal Halide PAR 30 Lamp with eHID Ballast | Improvement |
|---|---|---|---|
| Lamp Wattage | 75W | 39W | N/A |
| System Watts | 75W | 45W | 40% |
| Lumens | 1,000 - 1,100 | 2,000 initial - 2,400 initial [3]<br>1,400 mean - 1,600 mean | 45% |
| System Efficacy (Lamp & Ballast) | 13-15 lumens per watt | 31 -36 lumens per watt @ mean | 140% |
| Rated Average Life[2] | 2,500 - 3,000 | 6,000 - 10,000 hours | 233% |
| Estimated time between re-lamping* | 0.6 - 0.7 years | 1.3 - 2.3 years | 230% |
| Mean annual Cost of Energy to Operate Lamp** | $26.28 per year per lamp | $15.771 per year per lamp | 40% |
| Other Benefits | | - Reduced product an maintenance cost as a function of up to one-third fewer lamps required<br>- ASHRAE compliant | |

* Estimate based on 12-hour per day operation.

** This number assumes a $0.08/kWh cost and is provided for reference purposes only. Actual kWh costs will vary based on the location of the installation.

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3. Initial vs. Mean Lumens. The measured luminous output of a new light source versus the output at 40% of lamp life.

## The Benefits of Electronic HID Ballasts with High Pressure Sodium Lamps

One of the most exciting and dynamic areas in the field of lighting, electronic high intensity discharge (eHID) technology has evolved tremendously over the past decade. Today, users of all kinds are capitalizing on the unique technology's expanded range of features, benefits, and capabilities within a wider array of applications than ever before. Increasingly popular in both high pressure sodium (HPS) and metal halide applications, the incorporation of electronic ballast circuitry into these HID systems has been proven to maximize lighting performance while significantly reducing energy and operating costs. Representing a hotbed of new innovation and continuously broadening applications, electronic HID lighting has made revolutionary strides in the lighting arena and offers users a significant value proposition in the areas of:

1. Energy savings — HPS lamps driven by electronic ballasts deliver 5-15% energy savings over HPS systems incorporating magnetic ballasts.
2. Dimming and Control — Unlike their magnetically-ballasted predecessors, electronic HPS systems enable dimming and controllability and can interface with building management systems (BMS).
3. Prevention of Lamp Cycling — Standard HPS systems driven by magnetic ballasts exhibit cycling at their end-of-life, creating an annoying visual effect and making the identification of lamp outages for maintenance purposes difficult. Eletronic ballasts detect lamp end-of-life and automatically shut down in these instances, halting the occurrence of nuisance lamp cycling.

## Future Opportunities for Electronic HID Technology

Conventional and ceramic metal halide technology continues to evolve. New integrated products entering the market represent a direct and flexible replacement for antiquated lighting technologies. The ongoing miniaturization of ceramic metal halide lamp and ballast systems enhances versatility and expands lighting fixture design possibilities. Research and development in ceramic metal halide lamps and electronic ballast technology will emphasize ceramic metal halide lighting systems with higher lumens per watt and improved controllability, allowing for fast switching of light levels, instant start, and dimming.

Microprocessor-based technology provides even more comprehensive lamp and ballast parameter control and represents a solid platform for future development of both lamp and ballast designs.

Delivering heightened energy efficiency, enhanced color control, longer lamp life, greater lumen maintenance, and reduced cost of ownership, electronic HID lighting systems have come of age and are poised to revolutionize the lighting experience.

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A leader in the ballast industry for over 60 years, Philips Lighting Electronics, based in Rosemont, Illinois, offers a full line of Philips Advance branded ballasts and drivers for fluorescent, HID, and LED light sources to the market's broad range of lighting fixture manufacturers and electrical distributors. For more information on Philips Lighting Electronics' complete product line and range of Smart Solutions™, visit our website at www. philips.com/advance or call us at (800) 322-2086.



Form No. WP-8120-R02 07/09

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