D-ILA® Projector

with

BLU-Escent

Technology

DLA-VS2300G/ VS2500G

D-ILA Projector with BLU-Escent Light Source (without Lens)

DLA-VS2300ZG/VS2500ZG

D-ILA Projector with BLU-Escent Light Source (with Lens)

Table of Contents

Why are Solid State Projectors Needed?

Projectors have historically been illuminated by lamps, but the technology to replace these with solid state sources is here today and offering benefits for end users. Lamps need to be replaced with some frequency, they vary somewhat in light output levels, they can't be modulated to deliver deep black levels of high contrast and their use in different orientations and environments is limited. Solid state light sources address these issues.

Solid state light sources can be used using four different architectures:

1) All-laser – uses red, green and blue lasers
2) Laser Phosphor – uses blue lasers and a phosphor wheel to create white or yellow light
3) All LED – uses red, green and blue LEDs
4) Hybrid – uses a combination of LED and lasers

Each of these approaches has its strengths and weaknesses – and each can have variations on the implementation to differentiate the product. Solid state light sources can replace lamps in projectors using DLP, LCOS or LCD imagers.

In this paper, we will focus on the BLU-Escent projector developed by JVC. This features an LCOS (D-ILA) light engine with a Laser Phosphor solid state source. The DLA-VS2300 and DLA-VS2500, with their proprietary D-ILA technology, deliver high contrast images with outstanding functionality, making them the perfect LCOS laser projector solution for simulators.

What is BLU-Escent?

The BLU-Escent JVC projector is similar to a lamp-based JVC projector except that the lamp, which produced white light, is replaced with a solid state light module consisting of a laser block and a phosphor wheel (Figure 1).

Figure 1: Key Elements of the BLU-Escent Light Source

The laser block consists of 16 high power blue lasers. These are highly reliable and stable for tens of thousands of hours. The blue laser light excites the phosphor which re-emits yellow light, which is later separated into red and green components. These components, along with the blue laser light, provide the illumination needed for the imaging block of the projector.

The BLU-Escent light source is differentiated by its architecture from some competitive approaches. The BLU-Escent engine features a reflective phosphor wheel rather than a transmissive one. As shown in Figure 2, a reflective approach reduces optical loss and increases luminance efficiency. The result is higher contrast as well as high brightness (and increased reliability which we will discuss shortly).

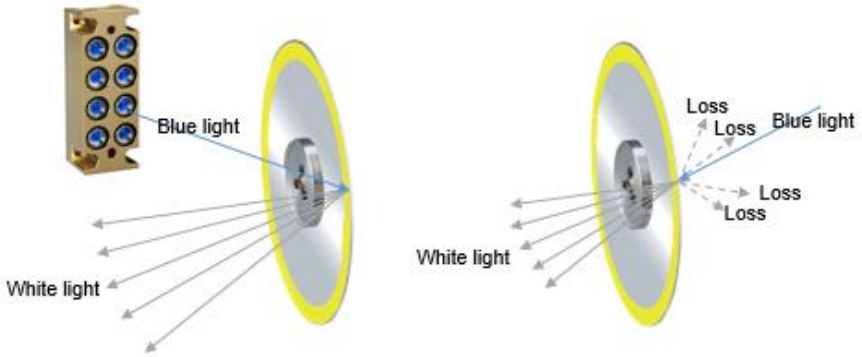

Figure 2: Reflective vs. Transmissive Laser Phosphor Wheel Designs

Figure 3 shows the full block diagram of the BLU-Escent projector. The blue light is captured, collimated and passed through a partially reflecting filter. This filter reflects some of the blue light to illuminate the blue D-ILA panel. The rest of the blue laser light passes through the filter to illuminate the phosphor wheel. The re-emitted yellow light contains the red and green components and they are combined with the blue light to be input into the imaging part of the engine. Some simple despeckling of the blue laser light is needed, but the yellow light from the phosphors is speckle free.

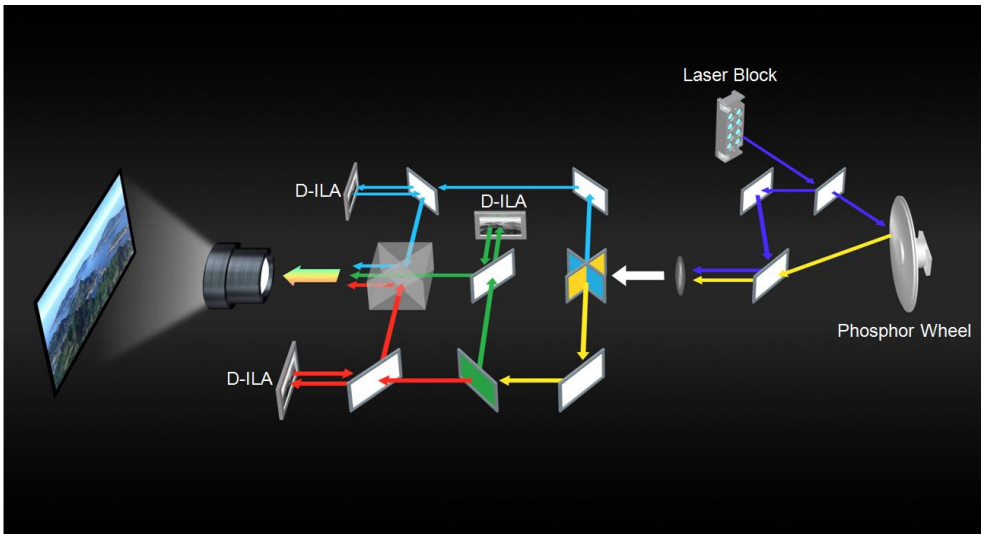

Figure 3: BLU-Escent Block Diagram

The imaging engine block consists of optics and three D-ILA (LCOS) reflective panels that are illuminated by red, green and blue light. After modulation at each panel, the three components are combined and projected through the lens. D-ILA panels are known for their high performance and ability to create very high contrast images.

Ideally Suited for the Simulation Market

The training and simulation markets are very demanding in terms of performance for the visual system. These systems need to:

- Provide high reliability over long operating hours
- Remain stable and calibrated in brightness and color gamut
- Offer sufficient brightness and resolution
- Provide very high contrast and dynamic range for low light or NVG operation
- Be flexible in their mounting orientation
- Offer good efficiency and cost of operation
- Provide a great performance-value offering

The DLA-VS2300 and DLA-VS2500 build upon JVC's long legacy of providing projection solutions that meets these needs – but they raise the bar in several key areas. That's why these projectors represent the very best product that JVC has yet offered to this community. Let's take a look at each of these requirements to show how the DLA-VS2300 and DLA-VS2500 meets the needs of this market.

High Reliability over Long Operating Hours

Projectors used in a simulation or training environment are routinely used over 20 hours a day, 7 days a week. That means all components, including the projector, need to have very high reliability to be operational with minimal downtime. The BLU-Escent DLA-VS2300 and DLA-VS2500 projectors meet this requirement.

In a lamp-based projector, the lamp is the component that requires constant maintenance and regular replacement. In the laser-phosphor design of the BLU-Escent projectors, there are different lifetime concerns. These are the lifetime of the blue lasers and the phosphor coating on the wheel.

The phosphor material can see reduced conversion efficiency over time, but the main degradation mechanism is heat. Therefore, the key to longevity is proper thermal management. JVC uses an aluminum substrate for the phosphor wheel for two reasons. One, a reflective mode offers fewer optical losses for higher efficiency, and two, it offers high thermal conductivity to quickly

remove heat generated in the phosphor. In addition, JVC uses a dedicated fan to keep air blowing over the phosphor wheel to maintain a nearly constant temperature. This reduces phosphor aging but also helps to maintain stable light output levels. Finally, JVC has designed a robust phosphor wheel using ball bearings to ensure vibration-free spinning. This means mechanical failure is unlikely, allows operation in any orientation, and even helps to maintain color balance of the light output.

The blue lasers are semi-conductor devices that generally degrade slowly over time. But, if one device should fail catastrophically, there are several blue lasers still operating so the projector can still continue to output light (Figure 4).

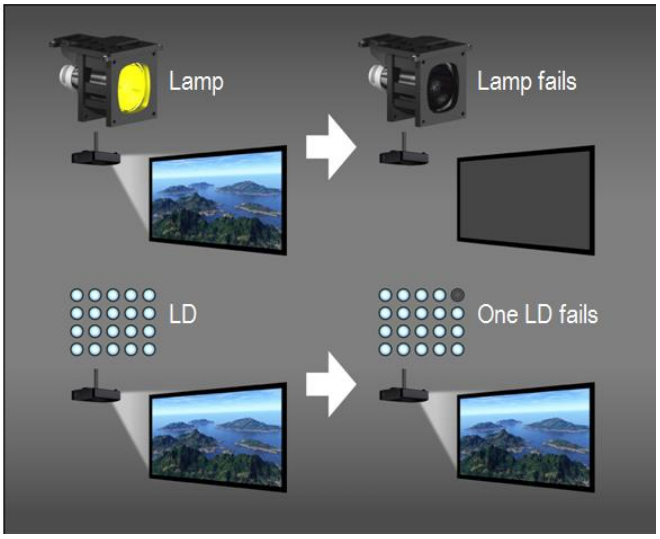

Figure 4: A Lamp Failure Causes a Dark Screen but a Laser Diode Failure only Reduces Brightness

During its long service life, in the unlikely event that the laser itself suffers an outage, our professional maintenance staff will simply swap out the LD (Laser Diode) engine for a new one, with no need for any adjustment or recalibration.[1]

These new units feature a highly efficient heat sink, which is not affected by projector orientation and is resistant to vibration. Compared with the heat pipe approach, which is dependent on orientation, the new approach offers much more stable cooling performance.

Overall, JVC guarantees the light source (lasers plus phosphor wheel) will last over 20K hours to 50% of brightness in the most demanding operating environments. That's high reliability.

Resolution Options

Resolution is also an important factor in projector choice. It turns out that the vast majority

[1] *The cost of replacement will be in accordance with your service agreement and/or warranty*

of simulation systems today use about three channels with 1920x1080 resolution. Therefore, a projector with 1920x1080 resolution will satisfy the needs of most projects.

The BLU-Escent DLA-VS2300 offers this 1920x1080 resolution while the DLA-VS2500 offers the same resolution panels, but with JVC's e-shift technology. This technology works by having the IG create optimized 1920 x 1080 A and B sub-frames from a 3840x2160 image buffer. The subframes are projected sequentially, optically shifted ½ pixel in both horizontal and vertical directions, alternating at a rate of 120Hz for 30Hz or 60Hz content. The viewer's eyes blend the A & B subframes together to create an enhanced resolution image. This image gives less jaggy edges, round circles and circular light points and reduces anti-aliasing.

Very High Contrast and Dynamic Range

The JVC BLU-Escent projectors offer very high contrast and dynamic range. For simulators, that can be the difference between usable and unusable. For example, one key application is landing in fog or low light levels where pilots key on seeing runways or other lights to aid in landing. If the contrast is not high enough, the pilots cannot distinguish the lights from the background, making it difficult to see the landing lights in a CAT III scenario, compromising the simulation. The high dynamic range allows the lights to punch through the fog, giving a realistic, calligraphic like image.

For nighttime or night vision goggle (NVG) operations, you must have a very low black level in your projector to provide decent contrast. And, for multi-projector applications, it is critical to have the same black level across the projectors.

The BLU-Escent projector meets this need by offering a guaranteed on/off contrast ratio of 20,000:1 and a typical level of 30,000:1. The absolute black level will vary based upon the lens, lens shift and other factors, but can be matched with proper attention. And, with such high native contrast, the black levels will be very, very low.

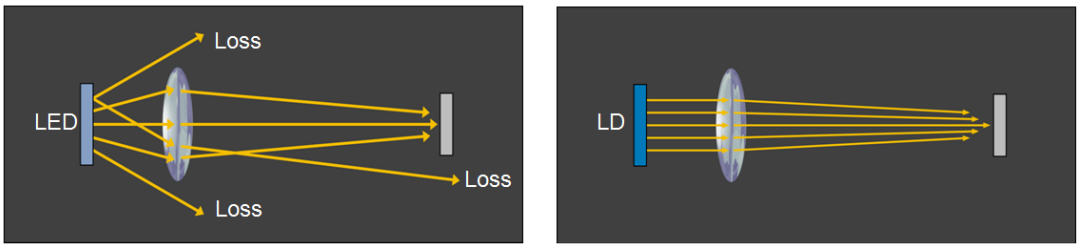

Figure 5: Collection of Light from an LED vs. a Laser Diode

Part of the reason for the high native contrast is the D-ILA panels, but the second benefit derives from the use of lasers as a light source. Lasers output light in a very narrow cone compared to LEDs or lamps, and they do so in a much smaller emitting area. That means it is much easier to capture all of the light emitted from a laser than from an LED or lamp. The result is greater efficiency in delivering light to the D-ILA panels and higher contrast due to less stray light. Figure 5

illustrates this concept.

The laser-phosphor source also emits into the infrared (Figure 6) allowing the projector to display infrared images in addition to visible band images. This is ideal for use of night vision goggles.

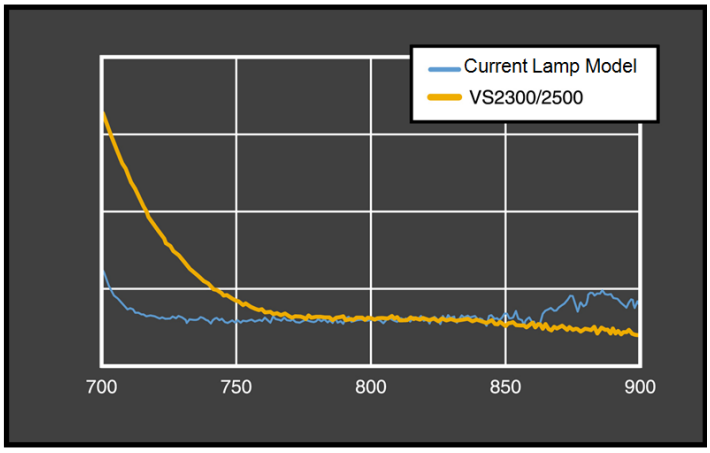

Figure 6: IR Response of JVC's BLU-Escent and Lamp-Based Projectors

Stable Brightness

Offering higher brightness in a projector for a simulation application is not necessarily a good thing. Too much brightness can create cross-screen light contamination, reducing contrast and image quality. Too little light creates a dim environment that can compromise contrast and color perception. Therefore, just the right amount of light is needed for best contrast and color performance.

The BLU-Escent DLA-VS2300 and DLA-VS2500 projectors offer a typical max brightness of 1,200 lumens, which end users have found when setup for long life and performance, is about the right level of illumination for current simulation applications. In addition to the long light source lifetime, these projectors feature Auto Intensity Mode that employs 3 dedicated sensors to adjust the light source power and color to maintain stable brightness. All light sources lose output over time, but by setting the output power to the 50% point in the beginning, end users can maintain this level for the full lifetime of the light source. This is done by slight increases in the laser current over time to overcome efficiency losses, Figure 7 illustrates the concept. The result is that simulator training runs will not be negatively affected due to a lack of on-screen brightness.

An added side benefit is the lower electrical power use, which reduces operating costs as well.

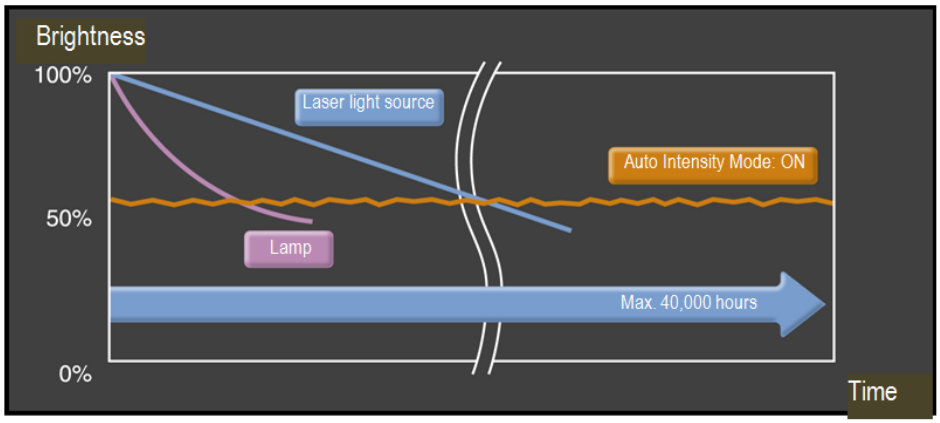

Figure 7: Light Source Brightness vs. Time

Stable and Calibrated Color Gamut

Lamp-based projectors are notorious for changes in color performance over time. As the arc gap in the lamp expands, the white point and color primaries can change, requiring frequent color calibration.

With the BLU-Escent projectors, the blue laser light and yellow phosphor light is very consistent and stable over time. They are also stable with fluctuations in ambient temperatures. This means they do not experience the changes that lamp-based projectors do.

In addition, the BLU-Escent projectors are able to exceed the sRGB color gamut, a main requirement for most simulation applications (Figure 8). This wide color response allows for even greater saturation of colors, if needed.

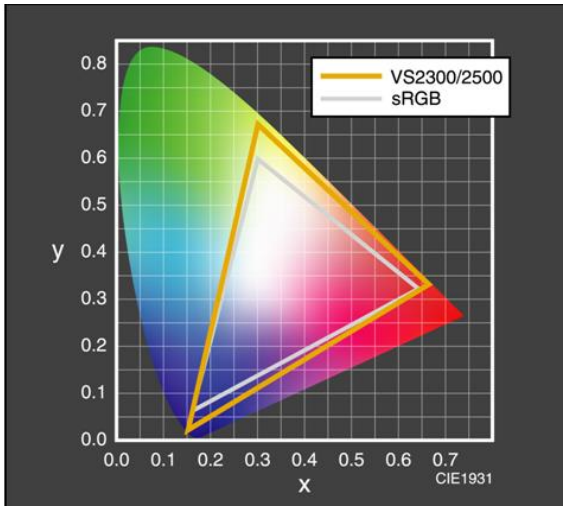

Figure 8: Color Gamut of VS2300/2500 vs. sRGB

Further, because JVC uses 3-chip architecture, there is no potential for color break up as may be possible in 1-chip DLP projectors. This can have a very negative impact on simulator performance.

Flexible Mounting Orientations

Compared with conventional lamp projectors with a tilt angle limitation, BLU-Escent projectors have no limitations on orientation or tilt angle. They can be installed at any orientation through 360-degrees and even vertically (Figure 9), which is ideal for helicopter simulators which require higher vertical resolution. The rotation of the phosphor wheel remains unaffected regardless of the install angle.

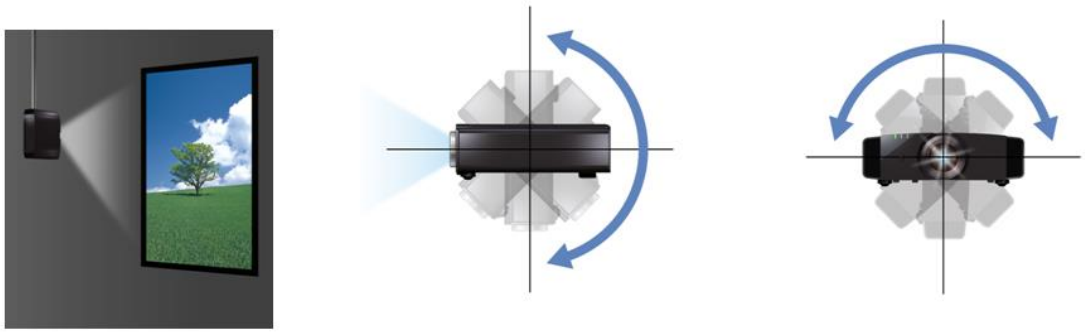

Figure 9: BLU-Escent Projectors can be mounted in Any Orientation

Supporting this universal flexibility in mounting is the rugged construction and attention to the needs of the simulator community. They are ideally suited for installs on the motion base in a flight simulator, for instance.

Safety and Environmental Impact

Moving from a lamp-based projector to a solid state light source means that there is no longer the mercury in the lamp to worry about, eliminating any disposal concerns.

Since the projector contains a laser source, JVC has taken special care to be sure no laser light can escape the projector housing. This is facilitated by the strong die-cast block that holds the blues lasers. This is good for thermal management and allows the projector to have a Class II laser classification. This means you follow the same safety considerations as you would with a lamp based projector.

Low Cost of Operation

There are a number of costs associated with a projector used in a simulation environment. In addition to the purchase price, there are recurring costs. Since the days of CRTs, lamps have been the most common, and costly, consumable projector part. This is cost is now greatly reduced in the

BLU-Escent models with illumination lifetimes up to 40,000 hours or more, depending on your optics and their efficiency. In addition, you save on the maintenance cost to replace a lamp and recalibrate the projector, and maintain calibration throughout the life of the lamp – which can be significant.

Secondly, projectors require electricity to run them and have an impact on the heating and air conditioning costs and capacity. The BLU-Escent projectors require less power than lamp-based projectors, but they now incorporate an eco-mode that can save even more electricity. Using the Hide function allows end users to run the projector in Normal or Eco mode, with the latter saving about 300 hours of operation time if used just one hour per day. Even though the light that emanates from the projector is reduced during Eco Mode, this has no effect on other projectors during adjustment or recalibration. This is especially important in an environment where multiple projectors are installed.

Great Performance-Value Offering

In conclusion, we believe that the JVC BLU-Escent projectors offer some of the best performance for simulator applications at a price point that few can match. That's a great performance-value proposition.

Specifications

		DLA-VS2300G	DLA-VS2300ZG	DLA-VS2500G	DLA-VS2500ZG
Image Device		0.7-inch D-ILA (1920X1080) x 3; >90% Aperture Ratio			
Brightness		1200 ANSI Lumens (typical) / 1000 ANSI Lumens (minimum)			
Resolution		1920x1080		3840 x 2160 e-shift 4K Resolution	
Contrast Ratio		30000:1 (typical) / 20000:1 (minimum)			
Uniformity		Greater than 80%			
Aperture		-	16 Steps (Lens Aperture)	-	16 Steps (Lens Aperture)
Gamma Control		Std 2.2 Gamma and 3 User adjustable Gamma presets			
Color Management		7-Axis adjustable CMS			
HDMI Input-Supported Formats		1920x1080 60p/50p		1920x1080 60p/50p (Dual Input Capability)	
Low Latency Mode		1080p60/50			
Latency		25ms w/1080p60 Input			
Color Bit Depth		10-bit Input via HDMI 1.4b, 10-bit display			
I/O Terminals		2 x HDMI v1.4b (locking HDMI connectors); LAN: RJ45 x 1; RS-232C: D-Sub 9 pin (male) x 1; Wired Remote (Mini) x 1			
Remote Control		RS-232C/LAN Fully featured control protocol Wired/IR Remote Control			
Lens		Option: 1.0:1 or 1.2:1 Fixed Lens, ± 50% Vertical Offset, ± 10% Horizontal Offset Capability	1.4-2.8:1 Zoom Lens (Remote Zoom and Focus), ± 80% Vertical Offset, ± 34% Horizontal Offset	Option: 1.0:1 or 1.2:1 Fixed Lens, ± 50% Vertical Offset, ± 10% Horizontal Offset Capability	1.4-2.8:1 Zoom Lens (Remote Zoom and Focus), ± 80% Vertical Offset, ± 34% Horizontal Offset
Light Source		Laser/Phosphor: 125 Steps Power Setting (25%-100%) Class II laser			
Light source Life		20,000h (typical @Max Power) / 40,000h (typical @Low Power with Auto Intensity)			
Power Requirement		AC 100V-240V, 50/60Hz			
Power Consumption		290 Watts Maximum, 5W Standby			
Noise Level (0-26°C, 32-79°F)		<48dB (A) at 39.4"/1m (3.3ft)			
Operating Environment		Temperature range: 5°C-35°C			
		Humidity: 20%-80% (non-condensing)			
Operating Altitude		<2000 meters for safe operation			
Installation Orientation		Angle free			
Dimensions (W x H x D)		18" x 7.25" x 18.6" (455 x 179 x 472mm)			
Weight		36.4lbs, (16.5kg)	38.1lbs, 17.3kg)	36.4lbs, (16.5kg)	38.1lbs, 17.3kg)
Supplied Accessories		Power Cord x2 (US, EU)			
Approvals	Safety	North America CSA C22.2 No.60950-1-07（Amd1：2011）, UL60950-1-2011 2nd edition Europe IEC60950-1:2005(2nd)+Amd1:2009+Amd2:2013 EN60950-1:2006+A11:2009+A1:2010+A12:2011+A2:2013			
	EMI	North America FCC part 15 Class A(US), ICES-003 Issue 5 Class A(CAN), Europe EN61000-3-2:2006+A1:2009+A2:2009, EN61000-3-3:2013, EN55022:2010(Class A), EN55024:2010 Australia EN55022:2010/AC2011 Class A			
	Environmental	Common RoHS North America Proposition 65 (US) Europe WEEE New Battery directive			
Optional Product		Calibration Software (PK-CS1301G) Remote RM-MH13G / Wired Remote RM-MH14G-A			

Design and specifications are subject to change without notice.

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