

ElectroniCast Consultants



LEDs Used in Night Vision Imaging System Compatible Lighting Global Market Forecast (2010-2017)

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This is the ElectroniCast forecast of global market consumption of packaged light emitting diodes (LEDs), also known as *component-level bulbs*, used in Night Vision Imaging System (NVIS) compatible lighting for non-civilian use, such as military, law enforcement, emergency medical services (EMS) and related.

A night vision device (NVD) comprises of an Infrared (IR) image intensifier tube in a rigid casing, commonly used by military forces and other non-civilian sectors; however, night vision technology has become more widely available for civilian use, for example, EVS, or enhanced vision systems are finding their way into private aircraft and vehicles. Infrared light is electromagnetic radiation with a wavelength between 0.7 and 300 micrometers, which equates to a frequency range between approximately 1 and 430 terahertz (THz).

Night vision goggles (NVG) combined with magnification lenses constitutes night vision binoculars. Other types include monocular night vision devices with only one eyepiece, which may be mounted to firearms as night sights. NVG and EVS technologies are becoming standard operating products on helicopter operations to improve safety. Light emitting diodes used in Night Vision Imaging Systems must provide an environment that will not have near infrared (NIR) noise, which would interfere with the nighttime sensitivity of the NVGs. It is important to note that night vision compatibility (NVC) is only achieved when the design of the lighting equipment allows for proper use with and without the NVIS, at night or during the day.

In this study report, we provide a detailed 2010-2017 market forecast for LEDs that have night vision compatibility in relationship to night vision imaging systems (NVIS)

NVIS are passive systems, which have a very high sensitivity to radiation in the approximate region of 600nm to 930nm (orange to near infrared). The NVIS work by converting photons from the outside night scene onto a micro-displayed visible image. The NVIS will amplify the nighttime scene approximately 2000 times. To protect the image intensifier assembly, the systems are equipped with an automatic gain control (AGC), which will aperture down the NVIS when exposed to bright lights in the region of approximately 600nm to 930nm. If displays or light sources are not NVIS compatible, the automatic gain control will activate and the NVIS will become proportionally less sensitive to nighttime objects outside of the cockpit.

The Department of Defense (United States) published the MIL-STD-3009 Standard for lighting, aircraft, night vision imaging system compatibility, which specifies the interface and performance requirements for aircraft lighting and display equipment that is intended to be used along with NVIS. This specification defines aircraft interior lighting standards for sources such as cockpit displays and caution / warning lights, for both day and nighttime operating conditions. NVIS filters designed for avionic applications must incorporate NIR attenuation properties, chromaticity, contrast for daylight readability and often EMI/RFI shielding. The MIL-STD-3009 superseded MIL-L-85762A standard. This standard also includes provisions for white light sources and for “leaky green” requirements.

The light emitting diodes in a display heavily influence its color, contrast, and NVIS radiance (NR) properties. White, green, and red light emitting diodes with certain spectral emission can be adjusted with filters to produce displays that comply with various NVIS color coordinates and NVIS Radiance (NR) specifications described in MIL-STD-3009. Meeting both color and Night Vision Imaging System (NVIS) Radiance limits can be challenging. Each application is unique and always involves certain constraints, such as space limitations or production methods, that may require a specific approach in order meet compliance.

Filters are ideal for many commercial and military applications, including crew-station displays for aircraft and ground vehicles, as well as portable display systems in personal digital assistants (PDA), palmtops, laptops, etc. Plastic Night Vision Imaging System (NVIS) filters are the ideal method for making virtually any light source compatible with NVIS, NVG, NVD, or any other night-vision apparatus. Plastic filters are extremely durable. Where all-glass filters might fracture, lightweight plastic material survives the most demanding real-world environments.

Quantitative Analysis LEDs face the challenge of creating definitive positions in the NVIS illumination market, as competing lighting solutions (technologies) are readily available and accepted. While this does not limit the potential success of LEDs, it does create some challenges. This report provides an independent examination and analysis of the changing market dynamics for LEDs used in selected end-use applications. The LED market forecast data are segmented by the following functions:

- Consumption Value (US\$, million)
- Quantity (number/units)
- Average Selling Prices (ASP \$, each)

The consumption value is determined by multiplying the number of units by the average selling price. The average selling prices are based on the price of the component-level LED bulbs at the initial factory level. The consumption values are based on the end-user application and the end-user region.

Regional Segmentation The market data are segmented into the following geographic regions, plus a Global summary:

- America
 - United States of America
 - The Rest of the American Region (ROA)
- EMEA (Europe, Middle Eastern countries, plus Africa)
- APAC (Asia Pacific)

LED Level Quantified in the ElectroniCast Study A Light Emitting Diode (LED) is a solid-state semiconductor device that converts electrical energy directly into light. On its most basic level, the semiconductor is comprised of two regions. The p-region contains positive electrical charges while the n-region contains negative electrical charges. When voltage is applied and current begins to flow, the electrons move across the n region into the p region. The process of an electron moving through the p-n junction releases energy. The dispersion of this energy produces photons with visible wavelengths. Below, are four levels (or “food chain”) of LEDs. For the purposes of THIS ElectroniCast study, we quantify and provide a market forecast for “Level 2”

Level 1 - The chip or die

Level 2 - The LED component (component-level bulb)

Level 3 - LED array; may include optics, heat sink and/or power supply

Level 4 - LED luminaire

Market Forecast and Analysis by Application The Night Vision Imaging System LED market is segmented into the following application categories:

- **Military**
 - Aircraft
 - Cockpit / Display Panel / Instrument Lighting
 - Other Interior Night Vision Compatible (NVC) Lighting
 - Exterior Aircraft NVC Lighting
 - Ships/Watercraft
 - Bridge Display Panel / Instrument Lighting
 - Other Interior Night Vision Compatible (NVC) Lighting
 - Exterior NVC Lighting
 - Ground Vehicle
 - Display Panel / Instrument Lighting
 - Other Interior Night Vision Compatible (NVC) Lighting
 - Exterior NVC Lighting
 - Ground Field Command / Man-Portable Devices / Other
 - Display Panel / Instrument Lighting
 - Other Interior Night Vision Compatible (NVC) Lighting
 - Exterior NVC Lighting
- **Law Enforcement / EMS / Emergency Services / Other Non-Civilian**
 - Aircraft
 - Cockpit / Display Panel / Instrument Lighting
 - Other Interior Night Vision Compatible (NVC) Lighting
 - Exterior Aircraft NVC Lighting Aircraft
 - Ships/Watercraft
 - Bridge Display Panel / Instrument Lighting
 - Other Interior Night Vision Compatible (NVC) Lighting
 - Exterior NVC Lighting
 - Ground Vehicle
 - Display Panel / Instrument Lighting
 - Other Interior Night Vision Compatible (NVC) Lighting
 - Exterior NVC Lighting
 - Ground Field Command / Man-Portable Devices / Other
 - Display Panel / Instrument Lighting
 - Other Interior Night Vision Compatible (NVC) Lighting
 - Exterior NVC Lighting

Ship/Watercraft Leads in Consumption The use of LEDs in Night Vision Imaging System compatible lighting will continue to be dominated by the Military market sector. The market forecast, by ElectroniCast Consultants, provides second-level (or sub-level) applications under the Military and the Law Enforcement/EMS application sectors. The next-level of detailed is provided in the report text, as well as in the Microsoft Excel database worksheets found in the addendum of the study report. During the 2010-2017 forecast period, as the luminous efficacy techniques improve (Lumens per Watt: lm/W), the LED is being considered for more than (just) indicator lighting.

The conversion of interior lights in aircraft cockpits and cabins to meet MIL Specifications and civil CASA standards can involve the following conversion techniques, based on cost effectiveness and operational requirement:

- Replacement of instrument panel glass with filter material
- Installation of filter material to warning, caution and annunciator indicators
- Replacement of existing lamps with LED based modular lamps
- Installation of NVIS compatible bridge and bezel lighting
- NVG compatible floodlights

These same techniques are also used for the conversion of vehicle driving instruments, ships' bridge, navigational and control lighting and communication equipment.

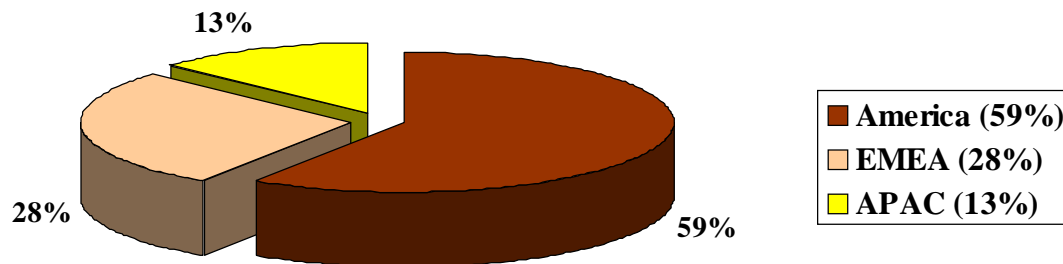
Exterior lighting for ships, aircraft and vehicles can be made Night Vision Goggles (NVG) friendly or dual mode Convert/NVG friendly through:

- Replacement of bulbs with form and fit compatible LEDs
- Installation of solid state LED based navigation and anti-collision lights
- Fitting filters to existing light fittings
- Addition of Infra Red LEDs for covert navigation and formation lights only visible through NVIS

The MIL-STD-3009 Interface Standard for Lighting, Aircraft, NVIS Compatibility: United States Department of Defense (DoD) document does not specify the type of lighting source; for example: incandescent, Electroluminescent (EL), or LED because, depending on the application, one technology may be better than another. For example, according to the DoD document, when an aircraft equipped with incandescent lighting is being retrofitted, it is usually easier to retrofit with incandescent lighting than to convert to EL or LED lighting. When designing an aircraft from the beginning, one type of technology may be preferred because it draws less power, is lighter, or has a longer life. When procuring lighting components or lighting systems under a "performance specification" philosophy the selection is left to the contractor.

America Leads in Market Share The American region held the market share lead in the consumption *value* of LEDs used in NVIS compatible lighting in 2010. The American region, led by the United States, is forecast to maintain the lead in relative market share throughout the 2010-2017 forecast period; however, the Asia Pacific region is forecast for the fastest growth according a study released by ElectroniCast on April 18, 2011.

**LEDs Used in NVIS Compatible Lighting
Global Consumption Market Share (%)
(2010)**



Source: ElectroniCast Consultants

LEDs Used in Night Vision Imaging System Compatible Lighting Global Market Forecast Table of Contents

1.	Executive Summary	1-1
1.1	LED Used in Night Vision Imaging Systems (NVIS)-Forecast Summary	1-1
1.2	Barriers to Growth	1-22
2.	LED Used in Night Vision Imaging Systems (NVIS)-Application Market Forecast	2-1
2.1	Overview	2-1
2.2	Market Forecast: Military Aircraft	2-19
2.3	Market Forecast: Military Ships/Watercraft	2-25
2.4	Market Forecast: Military Ground Vehicles (M-ATV and Others)	2-31
2.5	Market Forecast: Military Ground Field Command, Man-Portable	2-40
2.6	Market Forecast: Law Enforcement, Emergency Services Aircraft	2-44
2.7	Market Forecast: Law Enforcement, Emergency Services Ship/Watercraft	2-49
2.8	Market Forecast: Law Enforcement, Emergency Services Ground Vehicles	2-52
2.9	Market Forecast: Law Enforcement, Emergency Services Ground Field Command, Man-Portable	2-55
3.	Profile Briefs of LED and Related Companies -- Selected Competitors	3-1
4.	LEDs – Technology Overview	4-1
5.	Market Research Methodology	4-1
6.	Definitions - Acronyms, Abbreviations, and General Terms	5-1
7.	Market Forecast Data Base Explanation	6-1
7.1	Overview	6-1
7.2	Tutorial	6-3
ADD	Excel Data Base Spreadsheets (Global Market Forecast, 2009-2016)	
	o Detailed Data: ASP (\$, each); Quantity (Million); Value (\$, Million) for all Regions	

– List of Tables –

1.1.1	LEDs Used in NVIS Compatible Lighting Global Market Forecast, By Region (\$Million)	1-5
1.1.2	LEDs Used in NVIS Compatible Lighting Global Market Forecast, By Region (Quantity/Units)	1-6
1.1.3	LEDs Used in NVIS Compatible Lighting USA and Rest of America Market Forecast (\$Million)	1-7
1.1.4	LEDs Used in NVIS Compatible Lighting USA and Rest of America Forecast (Quantity/Units)	1-7
1.1.5	LEDs Used in NVIS Compatible Lighting Global Market Forecast, By Application (\$Million)	1-10
2.1.1	LEDs Used in NVIS Compatible Lighting Global Market Forecast, By Application (\$Million)	2-18
2.2.1	LEDs Used in NVIS Compatible Lighting Global Forecast, Military Aircraft (\$Million)	2-20
2.2.2	LEDs Used in NVIS Compatible Lighting USA and Rest of America, Military Aircraft (\$Million)	2-20
2.2.3	LEDs Used in NVIS Compatible Lighting EMEA Forecast, Military Aircraft (\$Million)	2-21
2.2.4	LEDs Used in NVIS Compatible Lighting APAC Forecast, Military Aircraft (\$Million)	2-21
2.3.1	LEDs Used in NVIS Compatible Lighting Global Forecast, Military Ship/Watercraft (\$Million)	2-25
2.3.2	LEDs Used in NVIS Compatible Lighting USA and Rest of America, Military Ship/Watercraft	2-26
2.3.3	LEDs Used in NVIS Compatible Lighting EMEA Forecast, Military Ship/Watercraft (\$Million)	2-26
2.3.4	LEDs Used in NVIS Compatible Lighting APAC Forecast, Military Ship/Watercraft (\$Million)	2-27
2.4.1	LEDs Used in NVIS Compatible Lighting Global Forecast, Military Ground Vehicle (\$Million)	2-35
2.4.2	LEDs Used in NVIS Compatible Lighting USA and Rest of America, Military Ground Vehicle	2-36
2.4.3	LEDs Used in NVIS Compatible Lighting EMEA Forecast, Military Ground Vehicle (\$Million)	2-36
2.4.4	LEDs Used in NVIS Compatible Lighting APAC Forecast, Military Ground Vehicle (\$Million)	2-37
2.5.1	LEDs Used in NVIS Compatible Global Forecast, Military Ground Command/Portable (\$Million)	2-40
2.5.2	LEDs Used in NVIS Compatible USA and ROA, Military Ground Command/Portable (\$Million)	2-41
2.5.3	LEDs Used in NVIS Compatible EMEA Forecast, Military Ground Command/Portable (\$Million)	2-41
2.5.4	LEDs Used in NVIS Compatible APAC Forecast, Military Ground Command/Portable (\$Million)	2-42
2.6.1	LEDs Used in NVIS Compatible Global Forecast, Law Enforcement/Emergency Aircraft (\$Million)	2-44
2.6.2	LEDs Used in NVIS Compatible USA and ROA, Law Enforcement/Emergency Aircraft (\$Million)	2-45

List of Tables (Continued)

2.6.3	LEDs Used in NVIS Compatible EMEA Forecast, Law Enforcement/Emergency Aircraft (\$Million)	2-45
2.6.4	LEDs Used in NVIS Compatible APAC Forecast, Law Enforcement/Emergency Aircraft (\$Million)	2-46
2.7.1	LEDs Used in NVIS Compatible Global Forecast, Law Enforcement/Emergency Ship/Watercraft	2-49
2.7.2	LEDs Used in NVIS Compatible USA and ROA, Law Enforcement/Emergency Ship/Watercraft	2-50
2.7.3	LEDs Used in NVIS Compatible EMEA Forecast, Law Enforcement/Emergency Ship/Watercraft	2-50
2.7.4	LEDs Used in NVIS Compatible APAC Forecast, Law Enforcement/Emergency Ship/Watercraft	2-51
2.8.1	LEDs Used in NVIS Compatible Global Forecast, Law Enforcement/Emergency Ground Vehicle	2-52
2.8.2	LEDs Used in NVIS Compatible USA and ROA, Law Enforcement/Emergency Ground Vehicle	2-53
2.8.3	LEDs Used in NVIS Compatible EMEA Forecast, Law Enforcement/Emergency Ground Vehicle	2-53
2.8.4	LEDs Used in NVIS Compatible APAC Forecast, Law Enforcement/Emergency Ground Vehicle	2-54
2.9.1	LEDs Used in NVIS Compatible Global, Law Enforcement/Emergency Ground Command/Portable	2-55
2.9.2	LEDs Used in NVIS Compatible USA and ROA, Law Enforcement/Emergency Ground/Portable	2-56
2.9.3	LEDs Used in NVIS Compatible EMEA, Law Enforcement/Emergency Ground Command/Portable	2-56
2.9.4	LEDs Used in NVIS Compatible APAC, Law Enforcement/Emergency Ground Command/Portable	2-57
4.1	LED Color Variety – Selected Examples	4-9
4.1	LED Color Chart	4-11
7.1.1	ElectroniCast Market Forecast Database Application Category Hierarchy List	7-2

– List of Figures –

1.1.1	LEDs Used in NVIS Compatible Lighting Global Forecast, By Top-Level Application (\$Million)	1-8
1.1.2	Chromaticity Limits for NVIS Colors, NVIS White and NVIS Blue	1-11
1.1.3	NVIS Response Curves	1-12
1.1.4	NVIS Colors Allowed in a “Class A” Cockpit	1-13
1.1.5	NVIS Colors: Type I Class B	1-14
1.1.6	Example of LED Packaged Chip (Component-Level) Bulb	1-15
1.1.7	Example of LED Packaged Chip (Component-Level) Bulb	1-15
1.1.8	Example of LED Packaged Chip (Component-Level Bulb) Surface Mount Variations	1-16
1.1.9	Example of LED Packaged Chip: Flux (Component-Level Bulb)	1-16
1.1.10	Example of High Brightness LED Packaged Chip (Component-Bulb)	1-17
1.1.11	Diagram of a Typical LED Chip	1-18
1.1.12	Diagram of a Typical LED Chip	1-19
1.1.13	LED Chip Cross-Sectional Structure	1-20
1.1.14	ESD Protection Diodes	1-21
2.1.1	Force XXI Battle Command Brigade and Below (FBCB2) Computer and Display	2-7
2.1.2	TADS and PNVIS Mounted on an Apache Helicopter	2-10
2.1.3	Rotary Wing Aircraft Cockpit Display	2-11
2.1.4	Long Range Tactical Unmanned Air Vehicle (UAV)	2-12
2.1.5	HMS Queen Elizabeth and HMS Prince of Wales (United Kingdom Aircraft Carriers)	2-14
2.1.6	Exterior Night Vision Compatible LED Military Solution (Example)	2-15
2.1.7	NVIS-Friendly Exterior Aircraft Lighting	2-16
2.3.1	LED-Base Wave-Off Light System for Aircraft Carriers	2-27
2.3.2	Helicopter Visual Approach System	2-28
2.4.1	Mine Resistant Ambush Protected (MRAP) All Terrain Vehicle (M-ATV)	2-33
2.4.2	LEDs in the M-ATV Ground Vehicle for NVIS Compatible Lighting USA Market Forecast (\$, Million)	2-34
2.4.3	Military All Terrain Vehicle	2-38
2.4.4	Military Mine Protected Vehicle	2-39
3.1	PCB Assembly	3-24
3.2	LED Backlit Display	3-26
3.3	Rugged Touch Screen with NVIS Capability	3-41
3.4	LED Down light with 102 Lumens per Watt Fixture	3-55
3.5	LED Lighting Military Solutions	3-58
3.6	LED Lighting in Railway Station	3-60

– List of Figures – Continued

3.7	LED Technology Safelight Design	3-71
3.8	LED Lighting (water flow stream)	3-75
3.9	NVIS/LED Control Panel	3-79
3.10	Integrated Weapons Delivery System	3-80
3.11	Cockpit Modular Display/Panel	3-89
3.12	Cockpit Large Area Display	3-90
3.13	Traffic Lamp LED	3-97
3.14	High Power LED Lamp	3-97
3.15	Surface Mount Type LED	3-98
3.16	Surface Mount Type LED	3-101
3.17	Exterior Aircraft LED Lighting	3-105
3.18	High-brightness LED Module	3-117
3.19	Surface-Mount Multi-layer Ceramic Packages	3-122
3.20	LED Linear Optical Array	3-129
3.21	Solid-State NVIS Lamps	3-141
3.22	LED Escalator Light	3-145
3.23	Nanostructures Designed for Different Color Emission	3-149
3.24	LED Array Lighting – Lamp	3-155
3.25	Light-Measurement Device	3-164
3.26	SSL LED: Replacement for Halogen Lamp in Spotlights	3-170
3.27	LED-Based Digital Billboard (Signage/Display)	3-185
3.28	Diagram of Backlight LED Drivers	3-188
3.29	Diagram of Multifunction Backlight LED Drivers	3-189
3.30	Diagram of White Backlight LED Drivers	3-190
3.31	Diagram White Backlight LED Drivers	3-191
3.32	Rotary Wing Aircraft Cockpit Display	3-193
3.33	Ultra-Thin LED	3-205
3.34	Quality Management System in LED Manufacturing	3-209
3.35	Military and Harsh-Environment LEDs	3-229
3.36	LED-Based Marine Biology Lighting Device	3-233
4.1	LED Chromatic Chart	4-10
4.2	Evolution of Research Emphasis During Technology Life Cycle	4-12
4.3	LED Chip: Metal Layer (Thin Film Technology)	4-13
4.4	Vertical LED Chip	4-14
4.5	AC LED Technology on a Wafer	4-20
4.6	Ultra High Bright LED Chip	4-21
4.7	Ultra-Thin LED	4-24
4.8	Solid-State Lighting LED	4-25
4.9	LED Module with High Light Quality	4-26
4.10	Transparent and flexible inorganic, organic hybrid n-type: Thin Film Transistors (TFTs)	4-30
4.11	Lumiramic Phosphor Technology: Thin Film Flip Chip (TFFC) technology	4-31
4.12	Wire-to-Board LED Connector	4-34
4.13	Next-Generation Light Emitting Diode Module	4-38
4.14	4-Leaded RGB LED	4-40
4.15	Vertically Conducting Advanced LED Structure	4-44
4.16	AlGaInP LED Efficacy	4-46
5.1	Market Research & Forecasting Methodology	5-3