INTERNATIONAL DARK-SKY ASSOCIATION

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Guidance for Electronic Message Centers (EMCs)

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Purpose

Electronic Message Centers (EMCs) are also known as “LED signs,” “LED displays,” “solid-state lighting signs,” “digital billboards,” “mobile digital billboards,” “changeable message signs,” “media facades,” “media towers,” “architectural lighting facades,” or “electronic signs.”[1] This guidance addresses outdoor installations as well as indoor installations that are intended to be viewed from outdoors, such as through store windows. This guidance addresses all EMC instal-lations no matter where situated, whether off or on a public right of way, and whether on- or off-premise.

EMCs have directly-viewed arrays of LED light sources (and potentially fiber optic or backlit dis-play light source) that are electronically controlled to display fixed or dynamic messages. Each LED in the array can be of a different color and brightness and is dynamically controlled. EMCs have been rapidly adopted for commercial sites and advertising. The nature of EMCs makes them a significant impact to the natural and built environment, often producing glare, light trespass, skyglow, and substantially changing the nightscape.

To address deficiencies in many sign codes that only address legacy sign installations, IDA has developed minimum requirements and a set of best practices for EMCs in order to minimize the environmental hazard that often results from carelessly installed and operated signs. These recommendations are intended to be integrated by planners into existing sign ordinances and zoning codes and adopted by lighting practitioners. While IDA does not endorse the use of EMCs at night, it recognizes that these installations will continue to be developed and installed widely. IDA therefore presents the following guidance from a technical and scientific stand-point.

IDA Guidance for Electronic Message Centers (EMCs)

Background

The light-emitting diode (LED) is transforming the way we light our cities and towns. LEDs have now come to dominate the outdoor advertising industry, replacing legacy signs such as conventional flood-lighted billboards, exposed lamp and internally-illuminated (i.e. backlit) translucent signs, as well as ushering in new communication media. EMCs, are appearing with increasing frequency along roadsides and on urban buildings worldwide.

EMCs consist of arrays of many thousands of programmable LED light sources which, when viewed from a distance, make up a composite picture. Multiple advertisements can be displayed in one space, and can also be altered remotely. EMCs can be adjusted by time of day to changing traffic and ambient light conditions, and may require less electricity than legacy installations given the high efficiency of LEDs. However, EMCs are often being applied in novel ways that expand their application and may not be replacing a traditional sign or façade light on a one for one basis; thus may not represent any energy use reduction over past practices.

EMCs can be harmful to the nighttime environment. Much of the implementation of this medium to date has been uncontrolled, has been especially harmful to the environment, and has garnered much public attention. Unlike luminaires (i.e. light fixtures), EMC light emissions cannot be shielded, and the horizontal arrangement of their LEDs – typically aimed outward toward traffic and viewers – means that some of their light is necessarily emitted laterally into adjacent environments and upward into the night sky. Light that is emitted laterally can be a substantial source of

Background, continued

glare, temporarily limiting visual function for passing observers. Animated and/or rapidly cycling messages can be distracting to drivers, cyclists, and pedestrians and are suspected as being a potential traffic safety risk.[2] The light emission of EMCs can generate more lateral and upward light emission than conventional billboard lighting and thus can be visible to wildlife over long distances,[3] affecting breeding, foraging and orientation behaviors in individuals, potentially leading to population level impacts. EMCs may contribute substantially to light trespass[4] into residences and may thus have an impact upon human health. The primary method of mitigation is through luminance control, limiting hours of operation, and avoiding locating signs adjacent to sensitive areas or residential areas.

Measurement of EMC is different than most other outdoor lighting. The important metric for EMCs is their luminance – the light intensity of the light leaving the sign surface in a given direction, as opposed to most other lighting, which is often quantified by its illuminance – the light falling upon a surface, such as the billboard face or the ground. Proper installation, regula-tion and monitoring of EMCs requires the proper use of a luminance meter, and may require new measurement tools and procedures. Measurement of EMCs is discussed later in this guidance.[5]

IDA has developed this document to provide planners, lighting designers, architects, biologists, government officials, and the general public with a basic understanding of the environmental hazards and potential solutions to making EMCs less obtrusive and more sustainable. This guidance is particularly

Background, continued

well suited for municipal planning, regional planning, transportation planning, law enforcement, code enforcement, and conservation efforts where a lighting specialist may not be available. For those lighting professionals seeking additional guidance, technical standards from organizations like the International Commission on Illumination (CIE) and Illuminating Engineering Society (IES) can be layered atop this guidance.

ABOUT IDA

The need to protect and restore the natural nighttime environment is more urgent than ever. Light pollution, defined as light where it is not wanted or needed, affects our health, the environment, wildlife, and our ability to find awe in the natural night. Research indicates that light pollution is increasing at a global rate of five percent per year.

The International Dark-Sky Association, a 501(c)(3) nonprofit organization based in Tucson, Arizona is dedicated to preserving and protecting the natural nighttime environment.

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The IDA Guide for Electronic Messaging Centers (EMCs) was prepared for the International Dark-Sky Association (IDA) by the IDA Technical Committee and approved by the IDA Board of Directors.

Guidance for Electronic Message Centers (EMCs)

Lighting Zones

The following overlay lighting zones (LZs) are referred to in this document:[6]

LZ0: No ambient lighting. Areas where the natural environment will be seriously and adversely affected by lighting, and in which human activity is subordinate in importance to nature. This is the recommended default zone for undeveloped rural areas, including wilderness areas, parks and preserves. (Equivalent to CIE Environmental Zone E1)

LZ1: Low ambient lighting. Areas where lighting might adversely affect flora and fauna or dis-turb the character of the area. This is the recommended default zone for rural and low-density residential areas. (Equivalent to CIE Environmental Zone E2)

LZ2: Moderate ambient lighting. Areas of human activity where the vision of human residents and users is adapted to moderate light levels. This is the recommended default zone for light-commercial business districts and high-density or mixed-use residential districts. (Equivalent to CIE Environmental Zone E3)

LZ3: Moderately high ambient lighting. Areas of human activity where the vision of human res-idents and users is adapted to moderately high light levels. This is the recommended default zones for business districts in large cities. (Equivalent to CIE Environmental Zone E4)

LZ4: High ambient lighting. Areas of human activity where the vision of human residents and users is adapted to high light levels. Most cities do not have areas that meet this criterion. This is not a default zone. (Equivalent to CIE Environmental Zone E4)

Minimum Requirements

It is impractical to shield light from EMCs due to its orientation, so many of the traditional approaches to reducing the impacts of artificial light at night do not translate to EMCs. As a result, the potential harm of EMCs cannot be completely mitigated by design alone. Rather, minimizing the harmful effects of EMCs is best accomplished through careful operation, programming, and location of this technology to the greatest extent practical. As of 2019, it is common for EMCs to operate in daytime at luminances in excess of 5000 candelas per square meter (cd/m2), also be known as "nits." Such high luminances are necessary for visibility due to the high ambient illumination during the day. Achieving proper lighting control at night requires dimming of the LEDs to match the lower ambient illumination and thus render more appropriate visibility. However, sufficient dimming at night is infrequently implemented, resulting in over-lighting, decreased sustainability, and attendant environmental impacts.

These Minimum Requirements for urban, suburban, rural, and natural environments have been developed by practicing scientists and lighting engineers to provide a minimum level of protec-tion to the nighttime environment, while meeting the needs of advertisers. However, IDA strongly recommends also applying the Best Management Practices described herein, in addition to these Minimum Requirements, to provide greater protection of the nighttime environment and to meet the currently accepted standards of sustainability.

1. Luminance level - During the night hours, which commence no later than one hour after sunset, luminance levels shall not exceed the maximum values provided in Table 1 as measured:[7]

Lighting Zone	Nighttime Maximum Luminance (cd/m2)
LZ0	0
LZ1	20
LZ2	40
LZ3	80
LZ4	160

2. Curfew - EMCs shall be switched off completely after 2300h/11pm (or 30 minutes after the close of business for on-premises signs, whichever is later), and remain off until one hour before sunrise. EMC applications for traffic and safety information shall be exempt from curfew.

Best Management Practices

A number of best management practices are recommended for EMCs which can further decrease the negative impacts to the environment, reduce visual clutter, and improve the safety of drivers and pedestrians. The combination of adoption of these Minimum Requirements and Best Management Practices has the potential to result in no net increase or even a net reduction in light pollution caused by signage while simultaneously meeting the needs for commerce. Thus, the IDA strongly supports the incorporation of the following Best Management Practices into the relevant codes and regulations covering signs and/or outdoor lighting.

BMP 1. Monitoring – EMC device owner or the permit holder should continuously monitor signs twenty-four (24) hours per day, including monitoring of the reliability of hardware, software, network and other support infrastructure. Should a problem occur, the EMC shall remain unlit.[8]

BMP 2. Sensitive Area Setback – EMCs should not be placed within or adjacent to sensitive areas. These may include, but are not limited to: natural areas, beaches, wetlands, state and national parks, wildlife refuges, residential areas, observatories, and military training grounds. Setbacks in excess of 1 mile (1600 meters) from sensitive areas may be warranted.[9] Distance setbacks should be assessed on a case-by-case basis, considering the cumulative effect of multiple EMCs, and set forth by the appropriate authority in each community. Mobile EMCs should be addressed as well.

BMP 3.Distraction Limitation – Messages appearing on EMCs should minimize distraction to vehicle operators and pedestrian by setting a minimum message duration, setting a maximum transition time between messages, and by maintaining adequate spacing between EMCs along thoroughfares.[10]

BMP 4. Gradual Brightness Reduction – It is recommended that EMC luminance levels gradually dim between day and night modes (from sunset to 1-hour after sunset) to provide the proper contrast ratio with the ambient illumination level, and similarly before sunrise.

BMP 5. Size Limits – Larger EMCs have a proportionally greater impact upon the nighttime envi-ronment. While IDA does not commend a maximum size due to the diversity of EMC uses, it may be appropriate for planners to carefully assess the maximum area of illuminated ar-ea in the relevant code or regulation.

BMP 6. Density Limits – Because of the rapid adoption of EMCs, the cumulative impact to the environment of multiple installations should be addressed. The total light emissions from EMCs can be controlled through limiting the number or combined size of signs that are permitted for a given length of roadway or a given area of land.

Measurement

The ideal opportunity to measure luminance from an EMC is at the point of installation. Verification from the

manufacturer of meeting Minimum Requirements is strongly encouraged, in combination with "as installed" measurements. Luminance measures should be of a white screen at the programmed nighttime intensity level. Once installed and operating normally, it is substantially more difficult to obtain accurate luminance measures.

Luminance measures require care in collecting accurate data, and are more exacting to obtain than the use of the more common illuminance meter or "light meter." Proper setting of luminance meter, a perpendicular viewing angle, and control of stray light from other sources are critical considerations. A good primer on this topic is Alex Ryer's "Light Measurement Handbook," which is widely available online.

Guidance on collecting luminance measurements:

- Measure between 1 hour after the sunset and 1 hour before sunrise (use the official daily sunset and sunrise time).
- Take measurements in dry, cloudless weather conditions. Rainy, foggy, snowy conditions will result in erroneous measures.
- The luminance meter should view the EMC perpendicular to the surface and should be aimed at the center of the EMC.
- The luminance meter should be carefully aimed or mounted on a tripod; at least five replicate measurements should be taken and the median (e.g. middle) value utilized.

Once installed and operating, the non-static images and different color composition on EMCs will dramatically complicate measurement. Therefore, every attempt should be made to verify compliance with IDA Minimum Requirements using the night-mode white screen setting, and to do so before normal EMC operations.

Should there be a need to evaluate existing installation or reevaluate an installation, there are some tools that can be used to provide an approximate measure of luminance. A standard luminance meter used on moving color images will likely produce a measurement that is lower than the actual luminance due to shifting images and non-white colors (even when the luminance meter set to peak luminance mode). Smartphone applications have the potential to aid in this regard, yet there are no ideal solutions as of 2018.[11] Illuminance meters, also known as foot-candle or lux meters, can also be used to derive an approximate measurement of luminance, yet are prone to bias from other sources of light and distance from the EMC must be precisely known.[12] Such alternative measures may indicate whether the EMC is grossly out of compliance or not, but will subsequently require that the EMC owner/vendor be contacted to set a pure white screen for proper measurement using a luminance meter and measurements coordinated with the appropriate code enforcement office.

Revisions

Due to the rapidly evolving technology and implementation of EMCs, these Minimum Requirements, Best Management Practices, and in particular measurement guidance in this document may be periodically updated and improved. For the latest information on EMCs, or to learn more about outdoor lighting and dark skies, see the IDA website at www.darksky.org.

Endnotes

1. IDA uses an expansive definition for EMCs, and does not differentiate between signs used for advertising vs. other uses, not does IDA differentiate between on-premise signs and off-premise signs.
2. Dukic, T; Ahlstrom C; Patten C; Kettwich C; Kircher K. Effects of Electronic Billboards on Driver Distraction. Traffic Inju-ry Prevention. 2003;14(5):469-476, doi:10.1080/15389588.2012.731546; Belyusar D; Reimer B. Mehler B; Coughlin J. A Field Study on the Effects of Digital Billboards on Glance Behavior during Highway Driving. Accident Analysis & Prevention. 2016 (March) Vol 88: 88-96, doi:10.1016/j.aap.2015.12.014.
3. Luginbuhl, C; Boley, P; Davis, D. The impact of light source spectral power distribution on sky glow. Journal of Quanti-tative Spectroscopy and Radiative Transfer. 2014;139:21-26. doi:10.1016/j.jqsrt.2013.12.004.
4. Ho, C; Lin, H; Huang, K. A Study on Energy Saving and Light Pollution of LED Advertising Signs. Applied Mechanics and Materials, 2011;121-126:2979–2984, doi:10.4028/www.scientific.net/AMM.121-126.2979
5. e.g., IES Recommended Practice for Off-Roadway Sign Luminance (RP-39-19).
6. IES/IDA Model Lighting Ordinance (2011); CIE 150:2017 Standard Guide on the limitation of the effects of obtrusive light from outdoor lighting installations, Second Edition.
7. As a point of comparison, conventionally lit signs are typically illuminated to surface brightnesses of between 60 and 100 cd/m2. See C.B. Luginbuhl, H. Israel, P. Scowen, J. Polakis, T. Polakis, “Digital LED Billboard Luminance Recom-mendations How Bright Is Bright Enough?” (white paper, 2010).
8. A typical Best Management Practice is for EMCs to default to an unlit black screen when more than 50% of the LED emitters have failed or are otherwise not displaying properly.
9. A full-size electronic billboard at 50 cd/m2 as seen from 1 mile (1600 meters) away illuminates the landscape nearly three times greater than the planet Venus (the “evening star”), and is capable of casting a visible shadow and causing glare for an otherwise dark-adapted human observer. Since EMCs generally produce a range of colors, a broad range of wildlife may be impacted, giving further credence to substantial setbacks from sensitive areas.
10. IES Recommended Practice for Off-Roadway Sign Luminance (RP-39) recommends a minimum duration of at least 20 seconds. Other best practices to reduce distraction include transitions from one message to another in less than 0.5 seconds, and to require a minimum of 1200 feet (366 meters) between installations on roadways.
11. For example, the Candela App is no longer available.
12. IDA disagrees with the 2016 recommendation by the International Sign Association that EMC compliance measure-ments should use illuminance (foot-candles or lux) instead of luminance (candela per square meter). With EMCs be-coming increasingly popular, enforcement efforts should use the proper tool, and the growing market for luminance meters is bringing down the cost of these more accurate tools.