PENN STATE ARCHITECTURAL ENGINEERING SENIOR THESIS

CRYSTAL LAKE ELEMENTARY SCHOOL

LAKE MARY, FLORIDA

LEAH MATERN
LIGHTING/ELECTRICAL OPTION
FACULTY ADVISORS: DR. RICHARD MISTRICK AND TED DANNERTH
APRIL 7, 2011

Crystal Lake Elementary School

Project Team

Owner	Seminole County Public School
Architect	Shenkel Shultz
MEP	Matern Engineering
Structural	Burton, Braswell, Middlebrook
Contractor	R.E. Harris Construction

Architecture

- 11 acres of land in the residential area of Lake Mary, FL
- Exterior Walls: Red Brick Veneer, with one row of yellow soldier brick located above all rectangular walls
- Roofing Material:
  - Main and Exterior Covered Play Area: Prefinished 24 gauge standing seam metal deck with a 1/6 slope
  - Covered Entry: Metal deck on pre-engineered metal trusses
  - Exterior Covered Walkways: Flat roof of pre-engineered aluminum canopy system

Structural

- Reinforced concrete slab with vapor barrier
- Foundation supported by reinforced concrete footings
- Composite steel floor system
- Pre-fabricated cold formed steel truss system

Building Statistics

Location	Lake Mary, FL
Size	113,927 S.F.
	2 Stories
Cost	$11,765,100

Mechanical

- Four air handling units located in three different mechanical rooms on the first floor
- Two air handling units located in two different rooms on the second floor
- Two air cooled rotary screw compressor chillers located outside the building to provide cool air to the building
- Centrifugal Kitchen Exhaust Fan

Lighting

- Variety of Luminaires
- Variety of light sources including fluorescent, incandescent, HID, and LED lamps
- Battery powered emergency light sources include incandescent and fluorescent lamps

Electrical

- Pad Mounted Transformer provided by Utility: 277/480V, 3 Phase, 4 Wire
- 125 KW Emergency Diesel Generator: 480/277V, 3 phase, 4 Wire

Executive Summary

Crystal Lake Elementary School is a public educational facility that is financed by taxes from the surrounding community. Therefore, cost and energy efficiency is an important factor in designing this building. This report will focus on the lighting and electrical redesign of four different spaces within this elementary school. In addition, the emergency system was redesigned to include the chillers, a photovoltaic array was implemented on the roof, a roof structural analysis was performed, and the acoustics in the multipurpose room were evaluated.

The lighting design and electrical circuiting for these changes was redesigned for the covered entrance and covered walkways on the exterior entrance to the building, the lobby, the multipurpose room, and a primary classroom. The lighting is designed based on guidelines from the IESNA handbook, as well as the emphasis on energy efficiency throughout the building. To determine if the illuminance recommendations are met, computer calculations from AGI32 are performed.

Due to the excessive heat of the summers in Florida and the use of this space as a hurricane shelter in the summers, the emergency system is redesigned to include the two chillers located on the exterior of the building.

With the main design goal as energy efficiency, a photovoltaic array is implemented on the roof of this building to decrease the buildings reliability on the utility company. A study is performed to determine if this system is cost effective and worth the initial upfront cost of materials and labor. Since this system is being places on the roof of the building, a structural analysis of the existing roof structure is performed to determine if there are any additional construction costs to implement the photovoltaic system.

The multipurpose room is typically used as an auditorium space, making the acoustical performance of the space is important. Therefore, an acoustical analysis of the existing space is performed to determine if the reverberation time is desirable for this space type.

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Building Information and Statistics

Due to the increase in population in Lake Mary, Florida, there became the need for a new school. Seminole County decided to build a public elementary school that contains 780 student stations in the heart of Lake Mary, Florida on an 11 acre plot of land. This school is located in between two large residential neighborhoods. It will host students in this area from Kindergarten through the 5th grade.

The exterior of this building fits in well with the surrounding area. There is a covered entry in the center of this symmetric building supported by six 20'-6" structural columns. The exterior façade is brick veneer with many aluminum windows with tinted glazing to keep out the heat from the sun. On the side of the building, in a fenced in area, there is an exterior covered play area for the students.

Upon entrance to this building there is a two-story lobby space with an elevator in the center surrounded by the main staircase. From the main entrance there is access to the various corridors that provide circulation throughout the building. The first floor of this building contains a 5,250 SF multipurpose room with a 997 SF wooden stage where large assembly meetings are held and this is also used as the students dining area and auditorium. In addition, the first floor contains a 1,231 SF music room, many classrooms, and administrative offices. The second floor is mainly dedicated to classroom spaces.

Building Name: Crystal Lake Elementary School

Location: Lake Mary, FL

Building Occupant: students grades K-5, teachers, and administrators of the school.

Occupancy Type: The primary occupancy is Educational and the Secondary occupancy is assembly.

Size: 113,927 SF

Number of Stories: 2 stories

Project Team:

Owner: Seminole County Public Schools
Architect: Shenkel Shultz
Civil Engineer: Kilma Weeks
Construction Manager/ General Contractor: R.E. Harris Construction
Structural Engineer: Burton, Braswell, Middlebrooks
MEP Engineer: Matern Professional Engineering, Inc.

Dates of Construction: June 29, 2006-July 29, 2006

Cost: $11,765,100

Project Delivery Method: The overall project delivery method was Design-Bid-Build.

Covered Entrance and Covered Walkways

Spatial Description

The covered entrance and covered walkways are located on the west façade of the building. It is an architectural focal point that can be seen by any person approaching the building. This is a good transition space that connects the interior and exterior spaces. There are six columns that are both functional and aesthetically pleasing that support the structure.

The entrance to the building consists of three sets of double doors with large windows above each set of doors, which are visually pleasing. There is also one door on the north side of this space that gives direct access into the administrative offices. All visitors must enter the bulding through this space, since the covered entrance is the only public entrance to the school.

Space Category:

Exterior Space/Building Façade

Materials:

Location	Material	Reflectance
Ceiling	Exterior Drywall	0.89
Column	White Latex Paint	0.93
	Brick Veneer	0.1
Floor	Reinforced Concrete Slab	0.25
Building Façade Wall	Windows	
	Doors	0.8
	Brick Veneer	0.1

Figure 1: Building Façade Surface Materials

Dimensions: 37’6” x 31’6” with 23’ high ceilings

Area: 1,397 ft^2

Tasks/Activities:

The Covered Entrance and Walkways are primarily circulation spaces. There are no gathering areas within this space and the purpose is to successfully move people from the exterior to the interior.

Covered Entrance and Walkway Plans and Elevations:

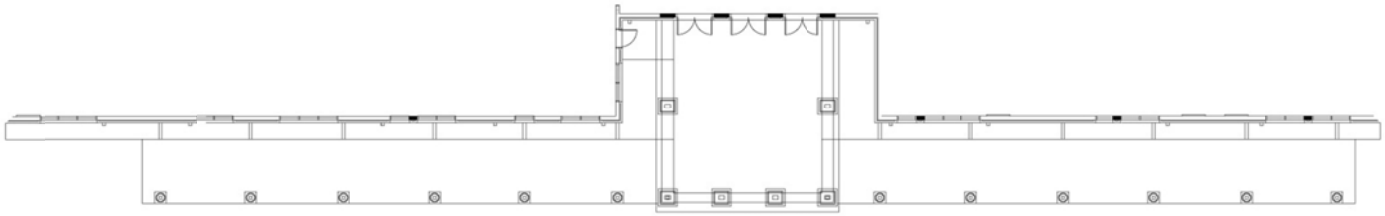

Figure 2: Covered Entrance and Walkway Floor Plan

Figure 3: Covered Entrance and Walkway Elevation

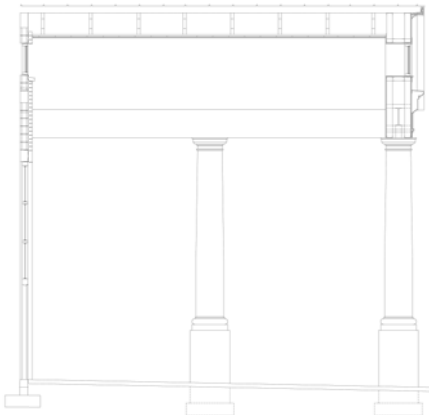

Figure 4: Covered Entrance Section

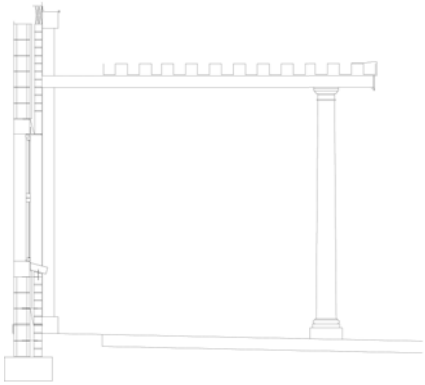

Figure 5: Covered Walkway Section

Lighting Design Criteria and Considerations

Outdoor, Educational Facilities, Building Exteriors, Entrances, Active (pedestrian/conveyance)-(IESNA Lighting Handbook, 9th Ed.)

- **Appearance of Space and Luminaires**
  - The entrance is the first space visitors, faculty, and students see as they approach the school. Therefore, the entrance must enhance the design and architecture of the space to create a welcoming environment. The lighting should direct the circulation of people into the building entrance and not create "visual clutter" that might distract the visitors. The lighting layout should be uniform and create a pattern that helps direct the flow of pedestrian traffic into the building.

- **Color Appearance (and Color Contrast)**
  - When this building is being used for events at night the only exterior lighting on the building is in the covered entrance. It is important that the color rendering enhance the visibility of visitors. The space should have a CCT of around 3000K and a CRI of around 80 to create a welcoming atmosphere within the space.

- **Direct Glare**
  - Direct glare should be avoided at any spot within the space. Therefore, luminaires should be chosen so that there is not a direct line of sight to the bare lamp. Lenses on all luminaires should be used to help prevent this.

- **Light Distribution on Surfaces**
  - Excessive brightness and noticeable shadows should be avoided. The layout of luminaires should follow a pattern throughout the space. Uniform brightness should be avoided. The lighting design should help draw people in. Since this space is open to the exterior on three sides the use of reflected light is limited. There needs to be both direct and indirect lighting within this space to limit shadowing.

- **Light Pollution/Trespass**
  - The light from this exterior space must not trespass into the surrounding properties or interfere with the natural dark sky.

- **Modeling of Faces or Objects**
  - It is important to model faces so that facial expressions can be seen. Multidirectional lighting should be used to help model faces by creating depth, shape, and texture. It is important to have both horizontal and vertical illuminance in this space.

- **Peripheral Detection**
  - Anyone within these spaces needs to have to ability to see an oncoming threat in the dark. The lighting design should illuminate the perimeter of the covered entrance so that anyone within this space can see an oncoming threat in their peripheral vision.

- **Point(s) of Interest**
  - The points of interest are the Crystal Lake Elementary School Sign on the exterior of this space as well as the entrance to the building. Both of these should be clearly visible to attract attention

- **Reflected Glare**
  - Reflected glare from surrounding polished or glossy surfaces should be avoided so that circulation is not inhibited. The large amount of glass on the façade of the building has the potential to produce reflected glare. Luminaires should not be aimed toward the glass.

- **Shadows**
  - Harsh shadows should be avoided so that they do not interfere with the circulation through the space. The use of linear or area light sources should be used to minimize sharp shadows.

- **Source/Task/Eye Geometry**
  - The source should not obstruct the person's ability to walk clearly though the space. It is important to use lenses on the luminaires so that the source does not have an effect on pedestrians.

- **Sparkle/Desirable Reflected Highlights**
  - To make the space visually pleasing, there should be small points of visual interest. The use of decorative luminaires, such as wall sconces, to highlight the texture of the building façade is desirable.

- **Surface Characteristics**
  - This space is used as both a school and a hurricane shelter. Therefore, at times of emergency this entrance will be the main circulation space to move people in and out of the building. It is important that the lighting be designed so that the quick movement of large numbers of people is smooth and easy.

- **Illuminance (Horizontal)**
  - Category B: Performance Simple orientation for short visits, 5 fc.
- **Illuminance (Vertical)**
  - Category A: Public Spaces, 3 fc

- **Power Allowance** (ASHRAE/IESNA Std. 90.1)
  - Space-by-Space Method: Main Entries=30 W/linear ft. of door width
    : Canopies and Overhangs=1.2

- **Controls**
  - Lighting is only necessary in this space from dusk to dawn. For safety, minimal lighting will be required during all nighttime hours, which will be controlled by a photocell. When the building is in use for nighttime activities, all lighting will be on and be controlled by a time clock.

- **Luminance Ratios**
  - Ceilings and walls should have a luminance ratio of 3:1

- **Psychological Aspect**
  - The space should feel open, welcoming, and public. It should be a good transition from the wide open outdoors into the building. The lighting design should give visitors a sense of excitement as they enter the space. Visual Clarity is very important to this space. It is necessary that the lighting design create uniformity on the floor for circulation and provide good perimeter lighting for safety.

Luminaire Information

Luminaire Schedule										
Type	**Image**	**Manufacturer**	**Catalog Number**	**Description**	**Mounting**	**Mounting Height**	**Ballast/Power Supply**	**Voltage**	**Lamp**	**Wattage**
A1		Ligman	91123-SFMB-70	Surface Mounted Luminaire for canopy mounting. Aluminum housing with high corrosion resistance. High quality reflector for broad spread light distribution.	Ceiling Surface	10’-6”	Magnetic	277	GE CMH70/C/U/830MED	90 W
B1		Lumux	UD410/PL42/277/BLACK	Wall Mounted luminaire for outfoor application. Fully shielded light source for up and down lighting . Low copper aluminum die cast housing with tempered clear glass.	Wall Surface	8’-0”	Electronic	277	GE F42TBX/830/A/ECO	90 W
C1		Ligman	80036-M-35	Recessed luminaire designed for exterior lighting. Aluminum powder painted front frame with a die-cast aluminum housing with corrosion resistance.	Ceiling Recessed	24’-6”	Electronic	277	GE CMH39TUVCU830G12	45 W
*Luminaire, Lamp, Ballast Specification Sheets are located in Appendix A										

Light Loss Factors					
Type	**LLD**	**LDD**	**RSDD**	**BF**	**LLF Total**
A1	0.667	0.77	N/A	1.00	0.513
B1	0.841	0.77	N/A	1.00	0.648
C1	0.677	0.77	N/A	1.00	0.521

Controls

The exterior lighting within the covered entrance and walkways that is not required for emergency and safety lighting will be controlled by a LP8 Peanut Lighting Control Panel. The lighting necessary from dusk to dawn for security and emergency lighting purposes will be controlled by a EM exterior photocell located on the north side of the building. Specification sheets for these controls are located in Appendix A.

Type	Manufacturer	Product Name	Catalog Number	Description	Location
TC-1	Watt Stopper	LP8 Peanut Lighting Control Panel	LP8F-4-115	Effective zone-based control of exterior lighting. This panel controls up to 4 zones of lighting. Zones respond to control signals from the system clock to turn the lighting on or off.	Covered Walkways and Covered Entrance
EM-1	Wattstopper	EM Exterior Photocell	EM-24D2	Photocell will work with a power pack to signal a change in light level to the panel to determine when the exterior lighting needs to be on.	Covered Walkways and Covered Entrance

Table 1: Control Schedule

Lighting Design

Design Concept

The architecture of the main entrace façade consists of brick with painted concrete columns with a symmetric layout. Therefore, the lighting design will provide the recommended amount of light while drawing the attention of oncoming visitors to the entrance of the building. The lighting design should be energy efficient and cost effective.

The primary elements of this space are the architectural columns, the brick veneer façade, and the tall covered entrance. The lighting design should highlight these features, while remaining and energy efficient design. It is necessary to provide perimeter lighting on the building for security purpose; therefore, direct/indirect luminaires will be used that will graze the brick veneer to highlight this building element. The covered entrance should create a glow will create a glow and immediate draw attention to oncoming guests to this space by creating a welcoming atmosphere where recessed luminaires will be used so that the light source cannot be scene until people are in this space. The columns will be highlighted by not applying light directly to them. The glow from the space behind the columns will cause them to pop out and create a pleasant dark/bright contrast. The covered walkways will be lit from canopy mounted luminaires to create a well-lit circulation space.

Performance Data

The following contains renderings and calculation data that was calculated using AGI32 for the proposed lighting design.

Figure 6: Covered Entrance and Covered Walkways with Type A1 ,B1, C1 Luminaires on

Figure 7: Covered Entrance with Type A1, B1, C1 Luminaire on

Figure 8: Covered Walkways with Type A1, B1, and C1 Luminaire on

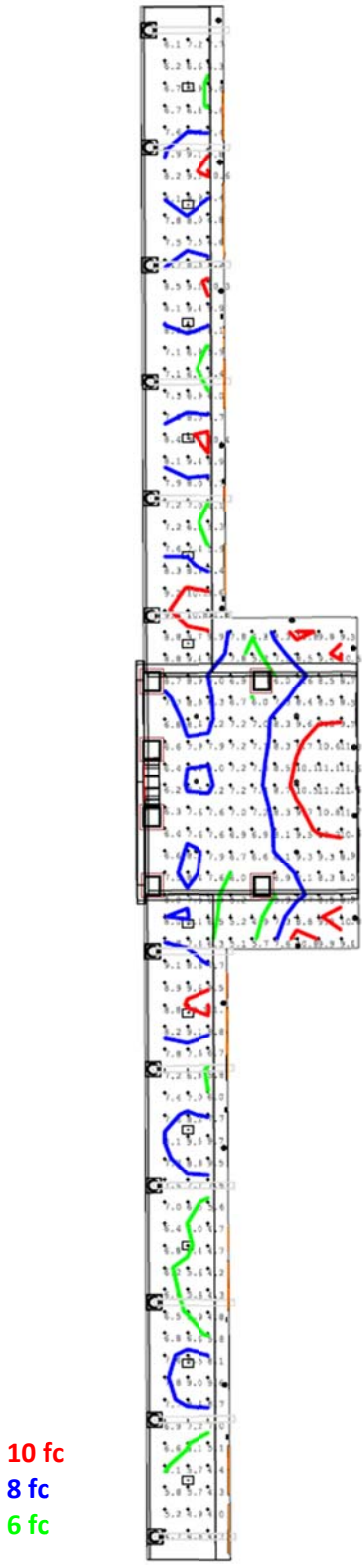

Figure 9: Covered Entrance and Covered Walkways for illuminance levels with Type A1 ,B1, and C1 luminaires on

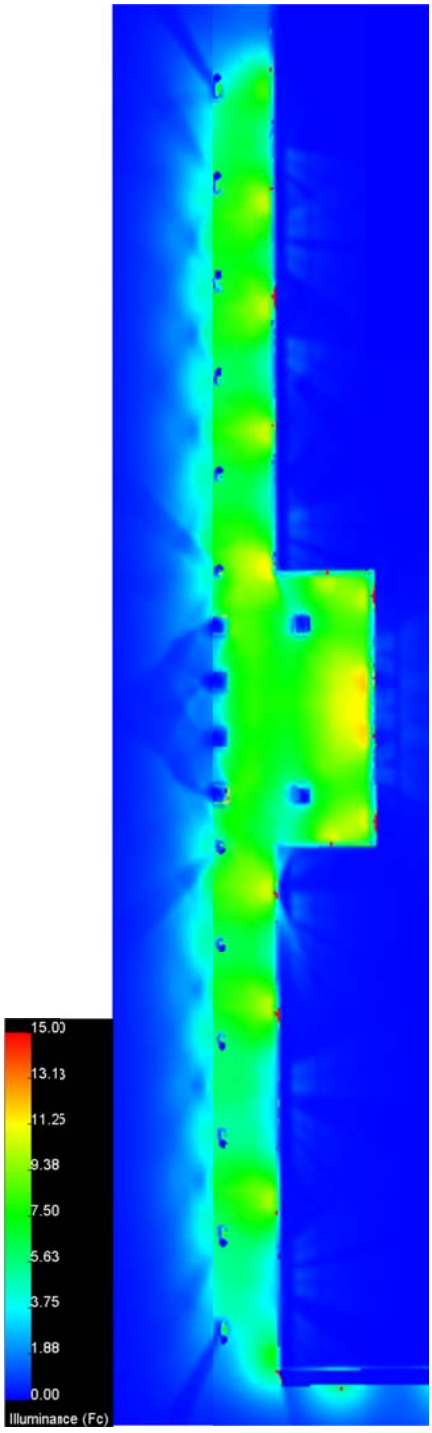

Figure 10: Covered Entrance and Covered Walkways Psuedo Diagram for illuminance levels with Type A1 ,B1, and C1 luminaires on

Illuminance Levels						
Location	**Average (fc)**	**Max (fc)**	**Min (fc)**	**Max/Min**	**Coeff. Variation**	**Meets Recommendations**
Walkways	7.78	11.8	4.0	2.95	0.2	Yes

Table 2: Illuminance levels throughout space

Power Allowance			
Total Size	**Power Allowance**	**Total Power Allowed (Watts)**	**Total Power Used (Watts)**
3205 ft^2	1.2 W/ft^2	3846	2700
18 ft	30W/linear ft	540	360

Table 3: Power Allowance

This lighting design meets ASHRAE 90.1/IESNA Standandes for power allowances.

Performance Summary

The redesign of this space meets the recommended lighting levels set forth by IESNA. The lighting design in this space is designed to create an inviting space that directs circulation to the entrance of the building. To achieve this, all of the ambient lighting in the space is achieved from a surface mounted canopy luminaire for the covered walkway and recessed downlights for the covered entrance. Also, it was necessary to provide security lighting to the perimeter of the space, which is achieved from direct/indirect luminaires on the façade of the building.

The luminaires selected work with both the canopy roof above the covered walkways and the exterior drywall ceiling of the covered entrance. The intent was to use luminaires that can be placed in an exterior environment, and that will provide an energy efficient lighting design, while maintaining a welcoming entrance to this school. All the luminaires used are lensed, so that there is no direct line of sight to any lamp and therefore will not cause any discomfort to its occupants. All the luminaires selected are either fluorescent of metal halide light sources and have a CCT of 3000K and a high CRI.

The symmetric lighting layout provides the recommended amount of light on the circulation plane by achieving the IESNA recommendation of 5 fc.

The covered entrance and covered walkways meets the requirements set by IESNA, and achieves the welcoming aspect desired. The lighting Plan for this space is located in Apendix B. The controls in this space meet the shutoff requirements set by ASHRAE 90.1/IESNA.

Lobby

Spatial Description

Upon entrance into the school, the lobby is the first space that people encounter. It is the central cirulation space that connects all the corridors in the building and also host the main staircase and elevator. It has direct access into the administrative offices on the north side.

The main purpose of this space is to welcome students and visitors to the school, as well as guide them to their desired destination. The rectangular layout of this space combined with the high ceilings is welcoming and inviting. The high ceiling creates a spacious feeling as students and visitors enter and helps accent the main architectural feature of this space: the central staircase. On a display wall in the center of this space, students works are displayed and meant to attract the attention of passing people.

Space Category:

Interior Space/ Circulation Space

Materials:

	Material	Reflectance
Ceiling	Acoustical Ceiling Tile	0.75
	White Painted Gypsum Wall Board	0.89
Walls	White Epoxy Paint	0.93
	Vinyl Cove Base	0.83
Doors	Gray Painted Doors	0.80
Floor	Vinyl Composition Tile	0.81

Table 4: Lobby Surface Materials

Dimensions:

45’4” x 52’8” with 28’ high ceilings
Area: 2342 ft^2
Perimeter: 196 ft

Tasks/Activities:

The Lobby is designed for circulation purposes; it is not meant to be a gathering space.

Lobby Plans and Elevations

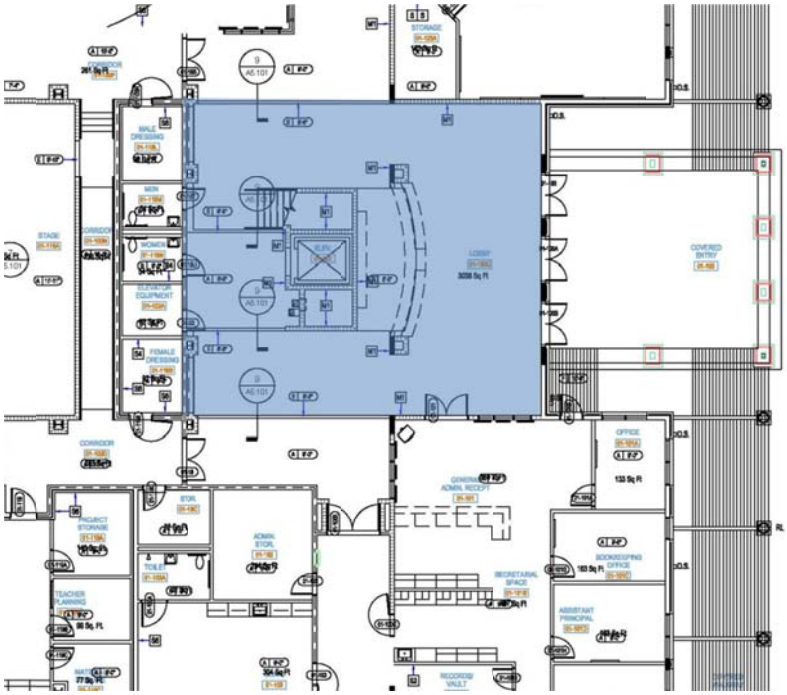

Figure 11: Lobby Floor Plan

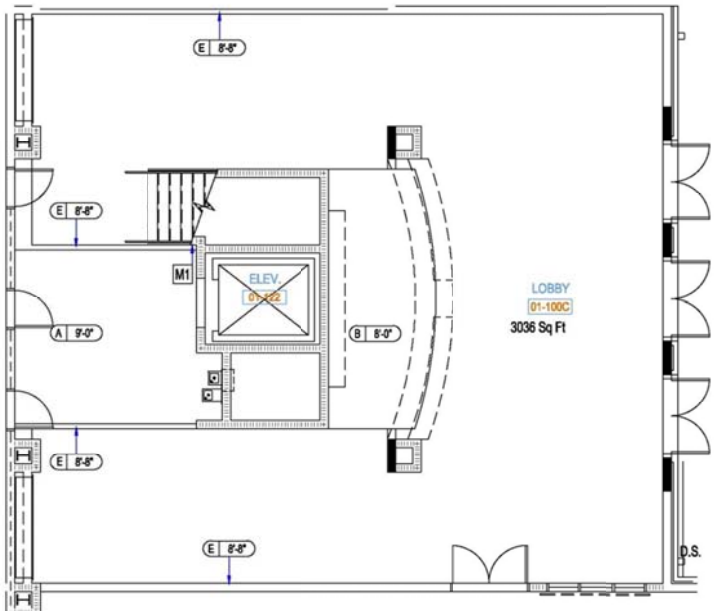

Figure 12: Detailed Lobby Floor Plan

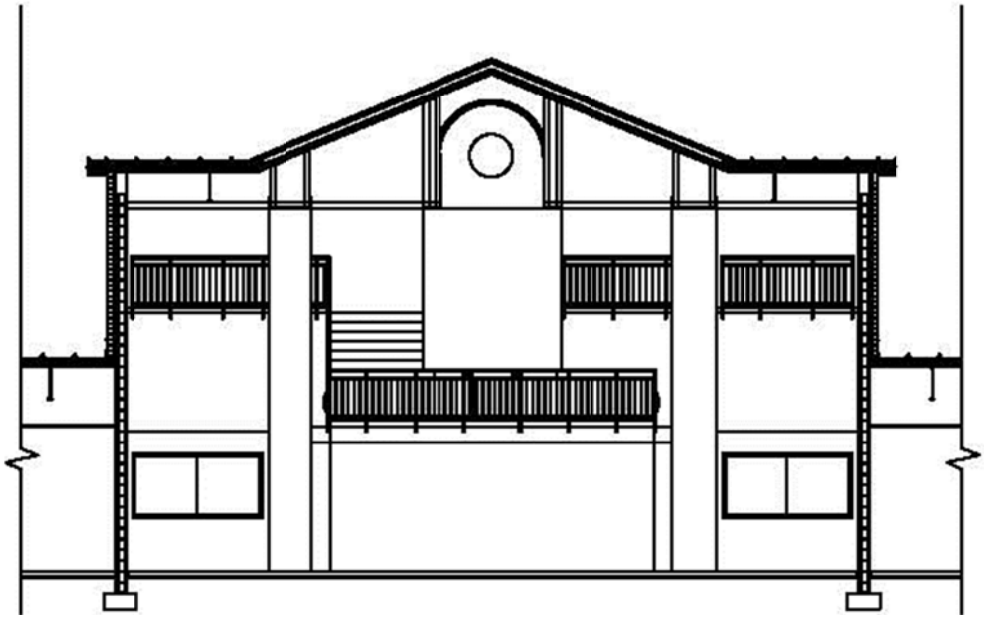

Figure 13: East Section

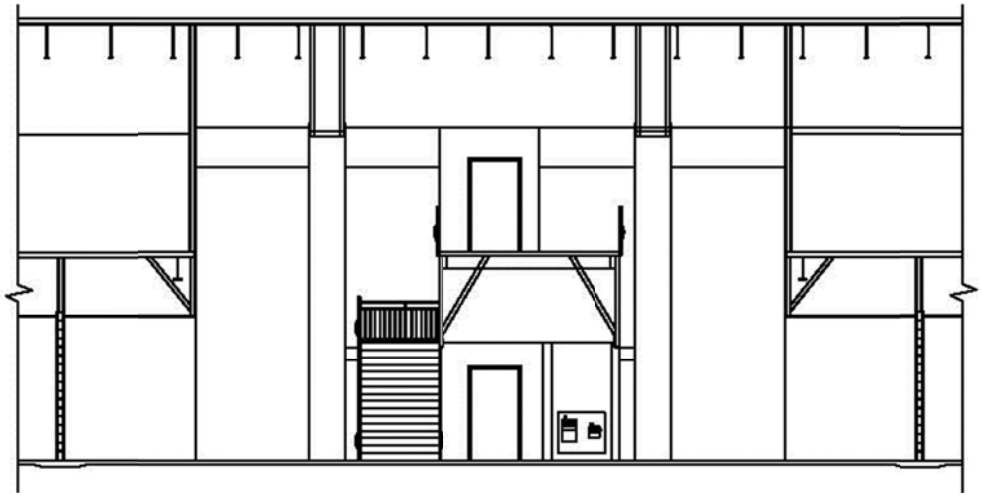

Figure 14: West Section

Lighting Design Criteria and Considerations

Interior, Educational Facilities, Corridors
Interior, Service Spaces, Stairways and corridors (IESNA Lighting Handbook, 9th Ed.)

- **Color Appearance (and Color Contrast)**
  - The lobby should welcome visitors in and give them direction to where they are headed in the building. Therefore, the color appearance is important to ensure the visibility and aesthetics of the space, while assuring that circulation is smooth. A CRI of 80 or more should be used to accentuate the appearance of skin tones, and surrounding displays.

- **Direct Glare**
  - Direct glare can cause visitors to feel uncomfortable in the space and can affect their visibility within the space. Therefore, people should not be able to have a direct line of sight to the lamp.

- **Light Distribution on Surfaces**
  - Circulation throughout the space needs to be smooth and uninhibited. The luminaires should be placed to avoid shadows on the floor so that visibility is not affected. The different surfaces should not have significant variations in brightness, but pure uniformity should be avoided so that there is some visual interest. Wall washers should be used on the wall where student work and create a variation in surface illuminance.

- **Modeling of Faces or Objects**
  - Objects and faces need to be modeled in order to see depth and texture. Nonverbal communication is very important for faculty and administrators to successfully help students. To achieve this, both vertical and horizontal illumination is needed. Along with downlight and angled lighting to fully model the objects and faces, reflected light of the surfaces can be utilized.

- **Points on Interest**
  - The main point of interest in this room is the student work display on central wall. Therefore, wall washing luminaire should be used so walls have a higher illuminance level to draw the attention of passing people.

- **Shadows**
  - Shadows can affect a person's ability to move though the space uninhibited. To avoid this linear luminaires or area sources should be used to create diffuse shadows. Fluorescent lamps with white reflectors are recommended as the area source.

- **Illuminance (Horizontal)**
  - Category C: Working spaces where simple visual tasks are performed, 10 fc

- **Illuminance (Vertical)**
  - Category C: Working spaces where simple visual tasks are performed, 10 fc

- **Power Allowance** (ASHRAE/IESNA Std. 90.1)
  - Space-by-Space Method: Lobby=1.3 W/ft^2

- **Luminance Ratios**
  - Luminance ratio between the ceiling and walls should be 3:1

- **Psychological Aspects**
  - Students first time in school is in Elementary school, so it is expected that student will be scared and uneasy to be away from the parents for the first time. The first interior space the students see is the lobby. Therefore, the psychological impression should be spacious and public. Students and visitors should feel welcome and comfortable upon entrance inside the school. The lighting design should assist in making them feel at ease and create an environment where they feel safe.

Luminaire Information

Luminaire Schedule										
Type	**Image**	**Manufacturer**	**Catalog Number**	**Description**	**Mounting**	**Mounting Height**	**Ballast/Power Supply**	**Voltage**	**Lamp**	**Wattage**
D1		Lightolier	8011 CL	Recessed Luminaire with an aluminum reflecter and medium distribution. Clear white flange.	Ceiling Recessed	9'-0" unless otherwise noted	Electronic	277	GE F32TBX/841/ A/ECO	36 W
E1		ELP	Duplux 226/8	Recessed Luminaire with a clear finish reflector. 8" aperture.	Ceiling Recessed	24'-6"	Electronic	277	GE F26DBX/841/ ECO4P	54 W
B1		Lumex	UD410/PL42/2 77/Black	Wall Mounted luminaire for outfoor application. Fully shielded light source for up and down lighting . Low copper aluminum die cast housing with tempered clear glass.	Wall Surface	8'-0"	Electronic	277	GE F42TBX/830/ A/ECO	90 W
F1		ELP	114 T-5WW-MPTB	Small, recessed linear wall washing luminaire. The reflector is high-purity aluminum with 95% reflectance.	Ceiling Recessed	8'-0"	Electronic	277	F14W/T5/841 /ECO	23 W
*Luminaire, Lamp, Ballast Specification Sheets are located in Appendix A										

Light Loss Factors					
Type	**LLD**	**LDD**	**RSDD**	**BF**	**LLF Total**
D1	0.85	0.75	0.964	0.98	0.602
E1	0.85	0.75	0.964	0.9	0.553
B1	0.841	0.79	0.915	0.98	0.596
G1	0.919	0.75	0.964	1.2	0.797

Controls

The lobby lighting will be controlled by a LP8 Peanut Lighting Control Panel. This system will provide multiple zones so that all required lighting will be on during the hours of operation. This will also control the emergency lighting for this space. Specification sheets for these controls are located in Appendix A.

Type	Manufacturer	Product Name	Catalog Number	Description	Location
TC-1	Watt Stopper	LP8 Peanut Lighting Control Panel	LP8F-4-115	Effective zone-based control of exterior lighting. This panel controls up to 4 zones of lighting. Zones respond to control signals from the system clock to turn the lighting on or off.	Lobby

Table 5: Control Schedule

Lighting Design

Design Concept

Since this is the first spacethe visitors encouter in Crystal Lake Elementary School, the lighting design needs to welcome visitors to the building and facilitate their circulation throughout the space.

In order to bring people into the building smoothly, the lighting design "brings the outside in." To achieve this, the same direct/indirect luminaire that is on the exterior façade of the building as people enter is on the two large columns. This direct/indirect luminaire accentuates the height of the space by highlighting its vertical features of the columns and makes this space feel spacious and welcoming.

Circulation is the main purpose of this space and therefore uniformity is necessary on the horizontal surfaces in the space. To make this space function, recessed downlights were used to create uniformity throughout the space.

Visual interest is an important category within this space. Also, this space typically displays current student works and important details of the school. Therefore, there is a wall of visual interest located under the main staircase. To draw attention to this wall, the wall is washed with a surface mounted luminaire to increase the illuminance on this wall and draw the immediate attention of visitors as they enter this space.

The walls and ceilings are highly reflective materials and help distribute reflected light to the workplane.

Performance Data

The following cantains renderings and calculation data that was calculated using AGI32 for the proposed lighting design.

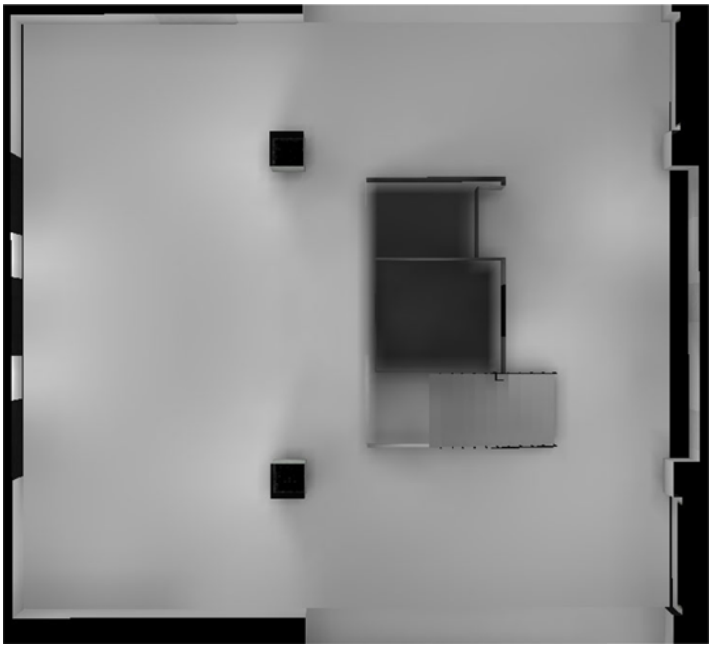

Figure 15: Lobby with Type B1, E1, D1, F1 luminaires on

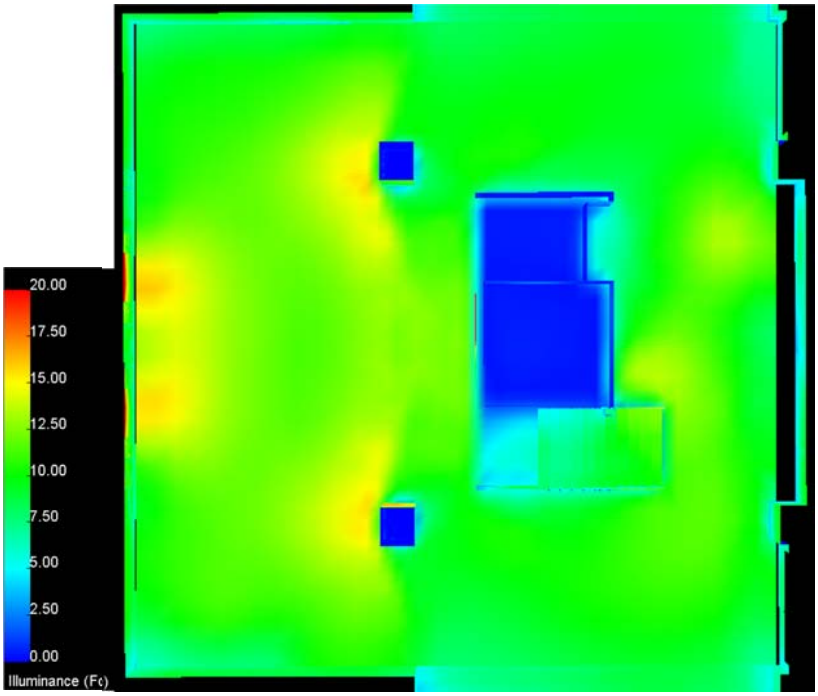

Figure 16: Lobby Psudo Rendering with Type B1, D1, E1, F1 luminaires on

Figure 17: Lobby with Type B1, D1, E1, F1 luminaires on

Figure 18: East Elevation

Figure 19: Lobby North-East Isometric view

Illuminance Levels						
Location	**Average (fc)**	**Max (fc)**	**Min (fc)**	**Max/Min**	**Coeff. Variation**	**Meets Recommendations**
Circulation Space	11.07	15.9	7.6	2.09	0.15	Yes

Table 6: Illuminance levels throughout space

Power Allowance			
Total Size	**Power Allowance**	**Total Power Allowed (Watts)**	**Total Power Used (Watts)**
2281 ft^2	1.3 W/ft^2	2965	1141

Table 7: Power Allowance

This lighting design meets ASHRAE 90.1/IESNA Standandes for power allowances.

Performance Summary

The redesign of this space meets the recommended lighting levels set forth by IESNA. The lighting design in this space is designed to create a spacious feel. To achieve this, the vertical elements are highlighted. Also, it was necessary to achieve uiniformity throughout the space that can be achieved by using a uniform lighting layout to assure that circulation through the space is smooth.

The luminaires selected easily fit into the existing gypsum wall board ceiling. The intent was to use luminaires that work well with the transition from exterior to interior. All the luminaires selected are fluorescent light sources and have a CCT of 4100 and a high CRI.

The uniform lighting layout of recessed downlight succeeds in providing uniformity throughout this circulation space, while achieving the IESNA recommendation of 5 fc on the floor. In addition, this added light will direct visitors attention to the informational wall in the center of this space, due to the higher levels of luminance.

The lobby meets the requirements set forth by IESNA, while creating a welcoming environment. The lighting Plan for this space is located in Apendix B. The controls in this space meet the shutoff requirements set by ASHRAE 90.1/IESNA.

Multipurpose Room

Spatial Description

The Multipurpose Room two main uses: assemblies and cafeteria area. Additionally, when necessary, this room is used as a hurricane shelter for the surrounding community. There are multiple entrances from the north, south and west. This room is located near the center of the building directly east of the main lobby, with direct access on the east side to the kitchen space. There is a large stage located on the west side. If necessary, there is a partition wall that can separate the space so that both dining and a presentation can occur concurrently.

The Multipurpose Room is designed to be a suitable presentation space and lunch space on a regular basis. Typically, only students, faculty, and administrators have access to this room; however, in the chance of an emergency this space is open to the public.

Space Category:

Interior Space/ Special Purpose Space

Materials:

Location	Material	Reflectance
Ceiling	Acoustical Ceiling Tile	0.75
	White Painted GWB	0.89
Walls	White Epoxy Paint	0.93
	Vinyl Cove Base	0.83
	Partition Wall	0.93
	Gray Painted Doors	0.80
Cafeteria Furniture	Table and Chairs	0.22
Auditorium Furniture	Chairs	0.22
Floor	Vinyl Composition Tile	0.81

Table 8: Multipurpose Room Surface Materials

Dimensions:

Aproximately 64'-4" x 85'-1" with 11'-1" ceilings where acoustical ceiling tile is used and 10'-5" ceiling where gypsum wall board is used.

Area: 5250 ft^2

Stage Area: 997 ft^2

Perimeter: 244 ft

Tasks/Activities:

The Multipurpose Room is designed to be a suitable presentation space and cafeteria space on a regular basis. Movable furniture is available in this space to provide an easy change from one use to another. There is also a partition wall that can separate the space so that both dining and a presentation can occur concurrently.

Multipurpose Room Plans and Elevations

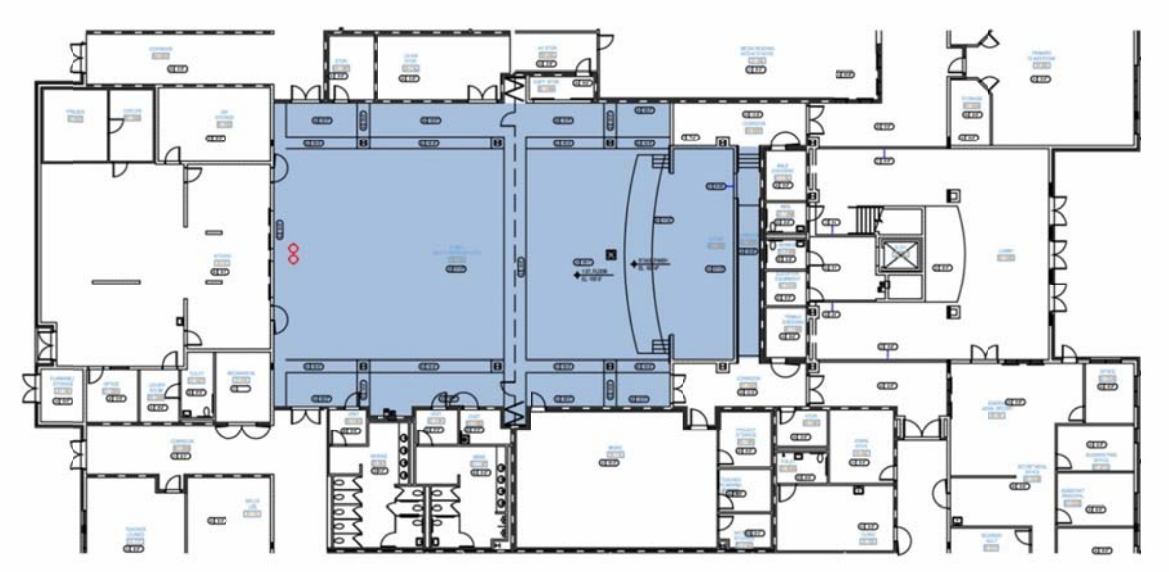

Figure 20: Multipurpose Room Floor Plan

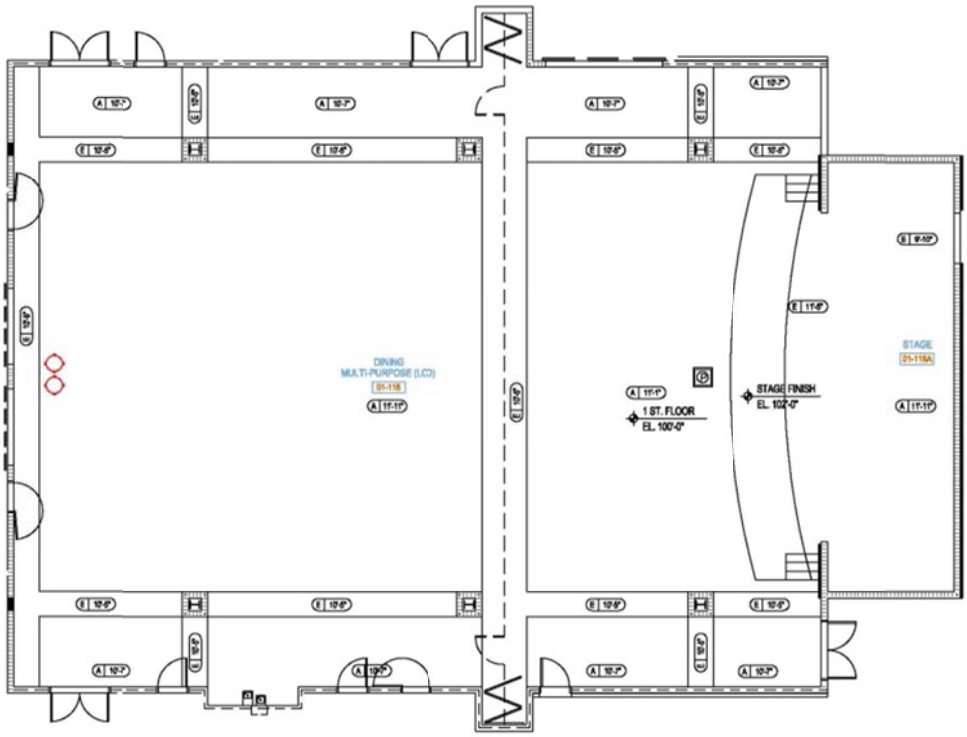

Figure 21: Detailed Multipurpose Room Floor Plan

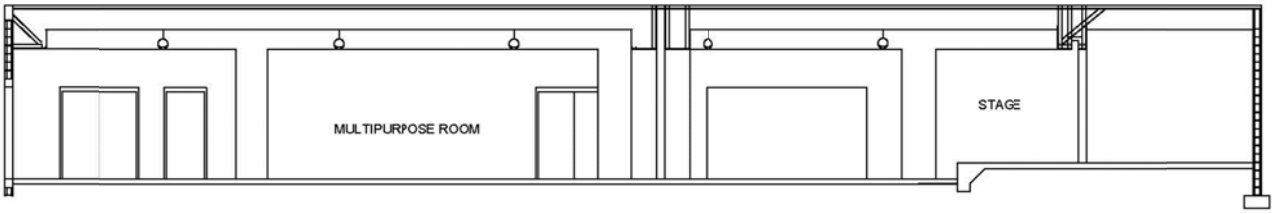

Figure 22: South Section

Lighting Design Criteria and Considerations

Interior, Auditoriums, Assembly
Interior, Reading, Printed Tasks, 8-and10-point type
Interior, Food Services Facilities, Dining (IESNA Handbook)

- **Appearance of Space and Luminaires**
  - Since this is a multipurpose space and the furniture layout has the ability to change, the use of a uniform lighting layout is desired to avoid "visual clutter" as the space changes. When this space is being used as an assembly area, the lighting on the stage should be brighter than the surrounding area to draw the attention of the audience. To achieve this, track lighting luminaires should be used to direct light to the stage and the lighting throughout the multipurpose room should have various scenes to change the light levels within the room.

- **Color Appearance (and Color Contrast)**
  - The appearance of skin tones and food is critical in this space for both the stage and the general area; therefore, a CRI of greater than 80 should be used.

- **Direct Glare**
  - Direct glare should be avoided for all possible room uses. Luminaires should be chosen so that there is no direct line of sight to the lamps. When available, lenses and shielding devices can be used to block the direct line of sight.

- **Light Distribution on Surfaces**
  - Shadows should be avoided as to not interfere with the visibility within the space and create a comfortable environment for all. The design will be in a regular pattern so that it is neither confusing nor distracting.

- **Modeling of Faces or Objects**
  - Face modeling is important for the nonverbal communication within the space and on the stage. Both vertical and horizontal illumination should be used to create depth in faces and objects. Some of this multidirectional Illumination can come from the

reflected light off the different surfaces within the space. To achieve this on the stage track lighting is used.

- **System Control and Flexibility**
  - This space has many functions; therefore, the system control needs to be able to create many different light levels for the various tasks. The lighting control should have different lighting settings for eating, presentations, and presentations utilizing the projection screen.

- **Illuminance (Horizontal)**- Important
  - Multipurpose Space
    Category C: Working Spaces where simple visual tasks are performed, 10fc
  - Stage
    Category C: Working Spaces where simple visual tasks are performed, 10fc

- **Illuminance (Vertical)** – Important
  - Category A: Public Spaces, 3 fc

- **Power Allowance** (ASHRAE/IESNA Std. 90.1)
  - Space-by-Space Method: Multipurpose=1.3 W/ft^2

Luminaire Information

Luminaire Schedule										
Type	**Image**	**Manufacturer**	**Catalog Number**	**Description**	**Mounting**	**Mounting Height**	**Ballast/Power Supply**	**Voltage**	**Lamp**	**Wattage**
D1		Lightolier	8011 CL	Recessed Luminaire with an aluminum reflecter and medium distribution. Clear white flange.	Ceiling Recessed	10'-7"	Electronic	277	GE F32TBX/841/A/ECO	36 W
G1		Ledalite	7306-F01-I-N-4-1-2-E-W	Suspended luminaire with optical acrylic lens to provide high-angle glare control. High efficiency.	Ceiling Suspended	10'-8"	Electronic	277	GE F28W/T5/835/ECO	37 W
H1		Intense Lighting	ITH637-W-PS	Surface mounted theatrical luminaire track head. It is adjustable for precision aiming.	Ceiling Surface	11'-5"	Electronic	120	GE CMH70PAR30L830SP	90 W
*Luminaire, Lamp, Ballast Specification Sheets are located in Appendix A										

Light Loss Factors					
Type	**LLD**	**LDD**	**RSDD**	**BF**	**LLF Total**
D1	0.85	0.88	0.975	0.98	0.715
G1	0.92	0.86	0.926	1.09	0.799
H1	0.77	0.88	0.975	1.00	0.661

Controls

The redesign of the lighting in this space, also requires a redesign of the current control system to operate the new lighting design. Both Luminaire Type D1 and E1 will be wired through six duel-technology occupancy sensors within the room. Since this is a rectangular space, wall mounted sensors will be used. The duel-technology occupancy sensor is located at the four corners of the room and will work well for all three uses of the room. The occupancy sensor will be a WattStopper DT-200 series duel technology ceiling/wall mounted sensor, and the equipment schedule and cut sheets are located at the end of this report. In addtion there will be a five preset scene controller that will control the luminaire settings within the room

The stage lighting will be on a separate control system that has five preset scenes for the stage. This gives flexibility within the space to allow for a variety of lighting possiblities depending on the use of the stage. The control system is a Watt Stopper LMSW-105 digital 5-button scene switch. Specification sheets for these controls are located in Appendix A and a wiring diagram for this system is located in Appendix B.

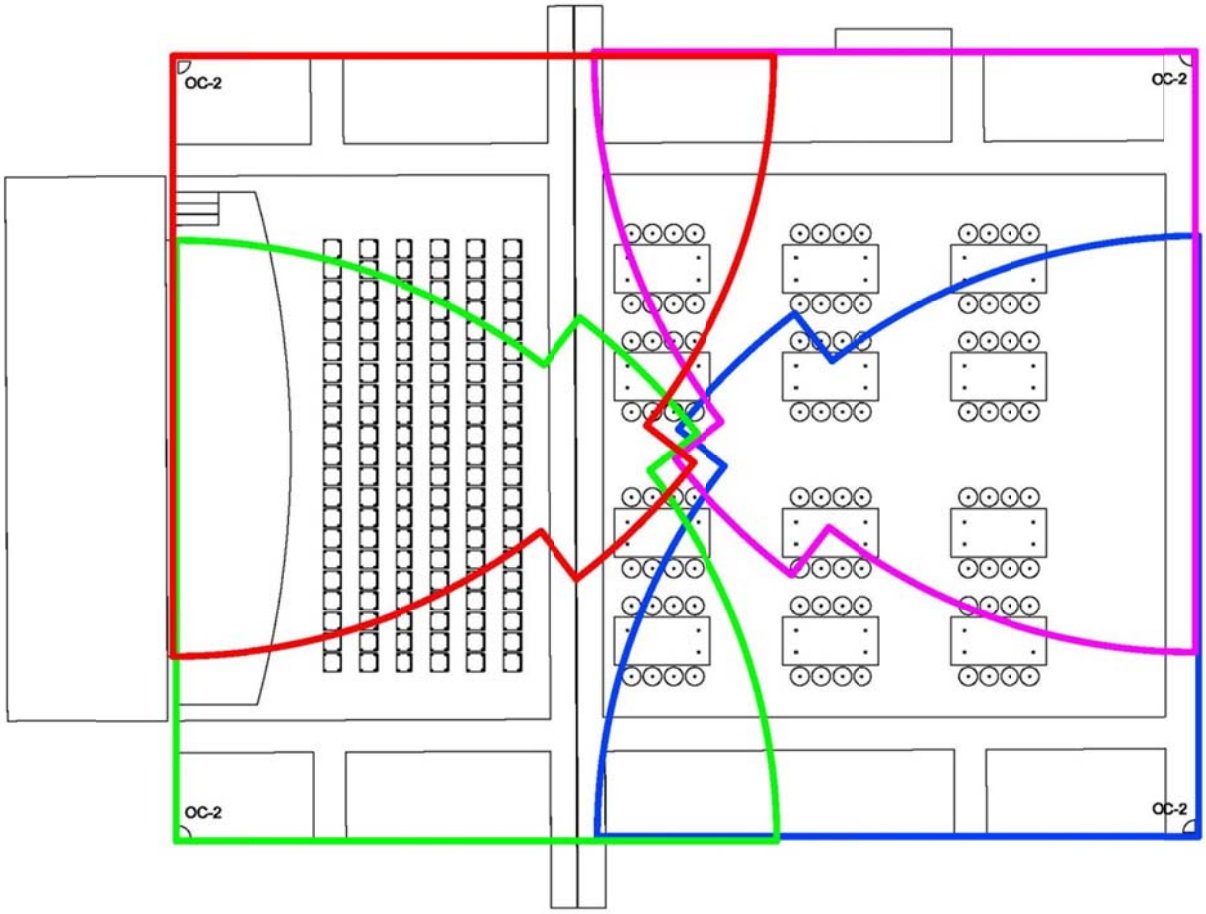

Figure 23: Schematic for Ocuupancy Sensor Coverage Area

Type	Manufacturer	Product Name	Catalog Number	Description	Location
OC-2	Watt Stopper	DT-200 Series Dual Technology Ceiling/Wall Sensor	DT-200	Passive infrared (PIR) and ultrasonic technologies utilized.	Multipurpose Room
DS-1	Watt Stopper	LMSW-105 Digital 5-Button Scene Switch	LMSW-105-W	Low Voltage device that recalls preset lighting scenes to change the level of lighting.	Multipurpose Room

Table 9: Multipurpose Room Equipment Schedule

Lighting Design

Design Concept

Due to the multiple uses of the multipurpose room, the lighting design should be designed to fit the needs of the three space types: auditorium space, cafeteria space, and when the partition is separating the space into both a cafeteria space and an auditorium space. When students are in this space using it as a cafeteria, they should feel the openness and become comfortable within the space. When it is used as an auditorium, observers should feel relaxed and the attention should be drawn to the stage. As an emergency shelter, the lighting design will create a uniformly lit space with no furniture present. To achieve all of these things a lighting design was created that uses track lighting to put emphasis on the stage with an increase in illuminance on the stage as well as recessed downlights that can be used to achieve uniformity on the stage when needed. Semi-Indirect pendant luminaires were used to emphasize the height of the ceiling by placing light uniformly on the ceiling as well as applying uniformity throughout the space for all three settings. Downlights were used to emphasise the walkways within the space and create uniformity around the edge of the room.

The walls and ceilings are highly reflective materials and help distribute reflected light to the workplane.

Performance Data

The three different uses of this space utilize different combinations of the luminaires available. The following performance data will show illuminance data and renderings for the different lighting scenes.

The following cantains renderings and calculation data that was calculated using AGI32 for the proposed lighting design.

Lighting design for multipurpose room as cafeteria

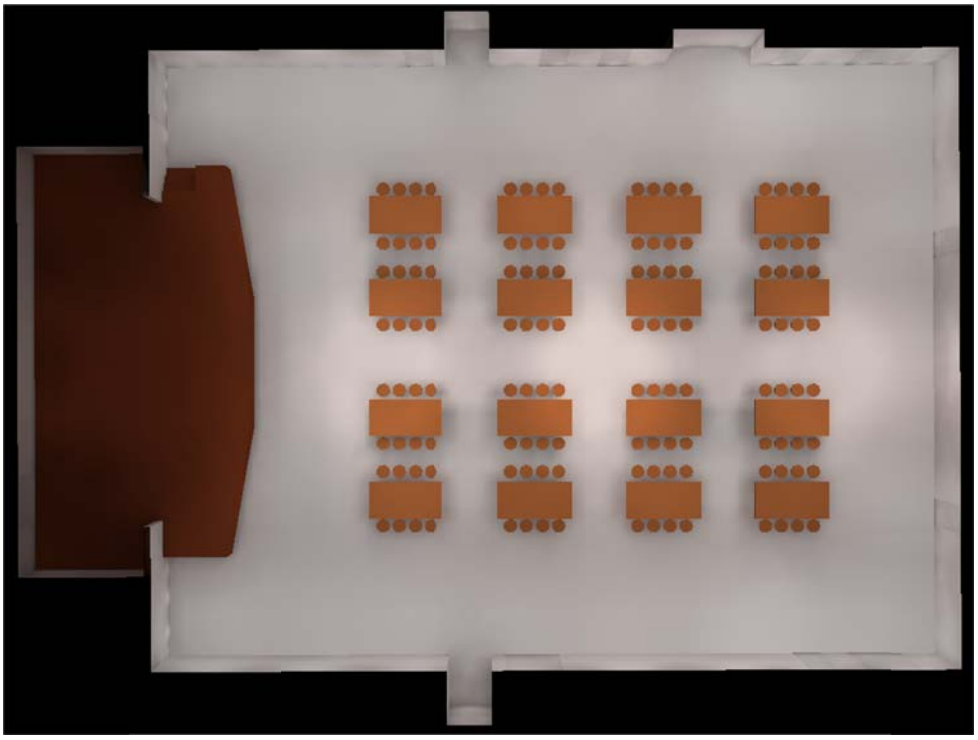

Figure 24: Multipurpose Room as Cafeteria with Type D1 and G1 lights on

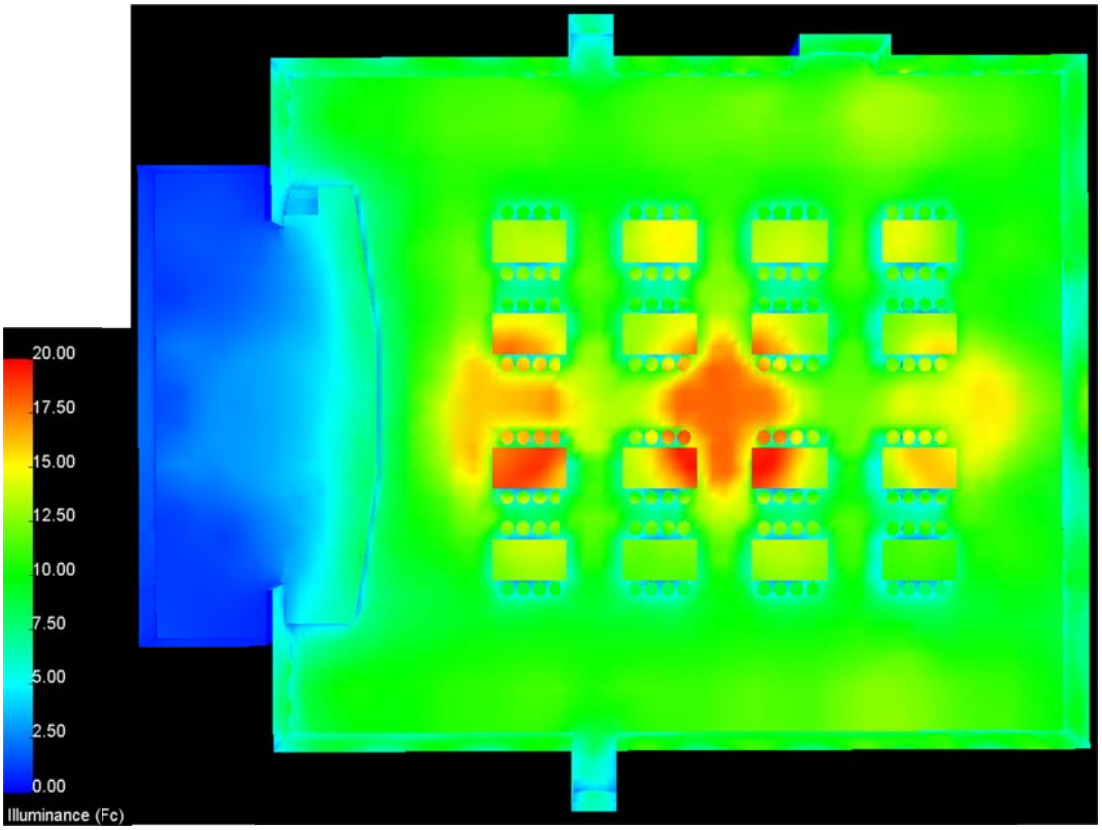

Figure 25: Multipurpose Room as Cafeteria with Type D1 and G1 lights on

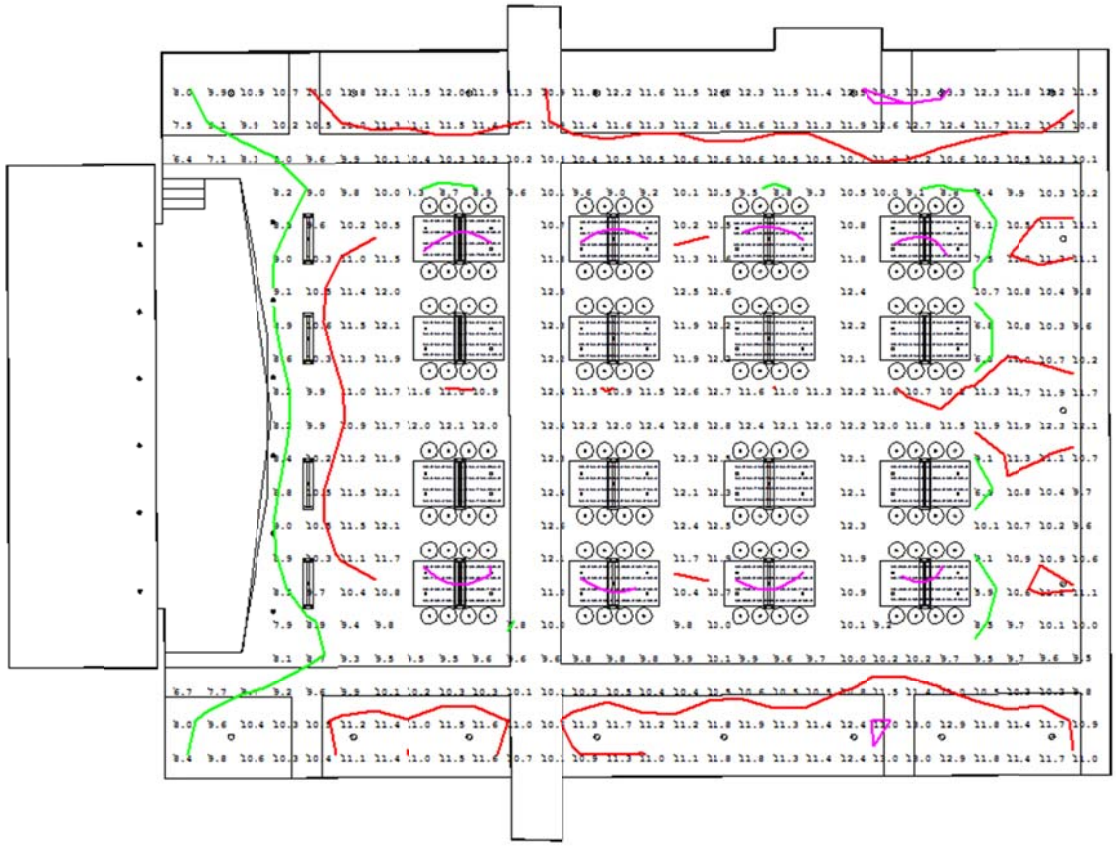

Figure 26: Multipurpose Room as Cafeteria with Type D1 and G1 lights on

Figure 27: Multipurpose Room North Elevation

Figure 28: Multipurpose Room North-East Isometric view

Illuminance Levels						
Location	**Average (fc)**	**Max (fc)**	**Min (fc)**	**Max/Min**	**Coeff. Variation**	**Meets Recommendations**
Cafeteria Table	13.60	14.19	12.78	1.11	0.03	Yes
Circulation Space	10.72	13.3	5.9	2.25	0.12	Yes

Table 10: Illuminance levels throughout space

Lighting Design for Cafeteria as Auditorium

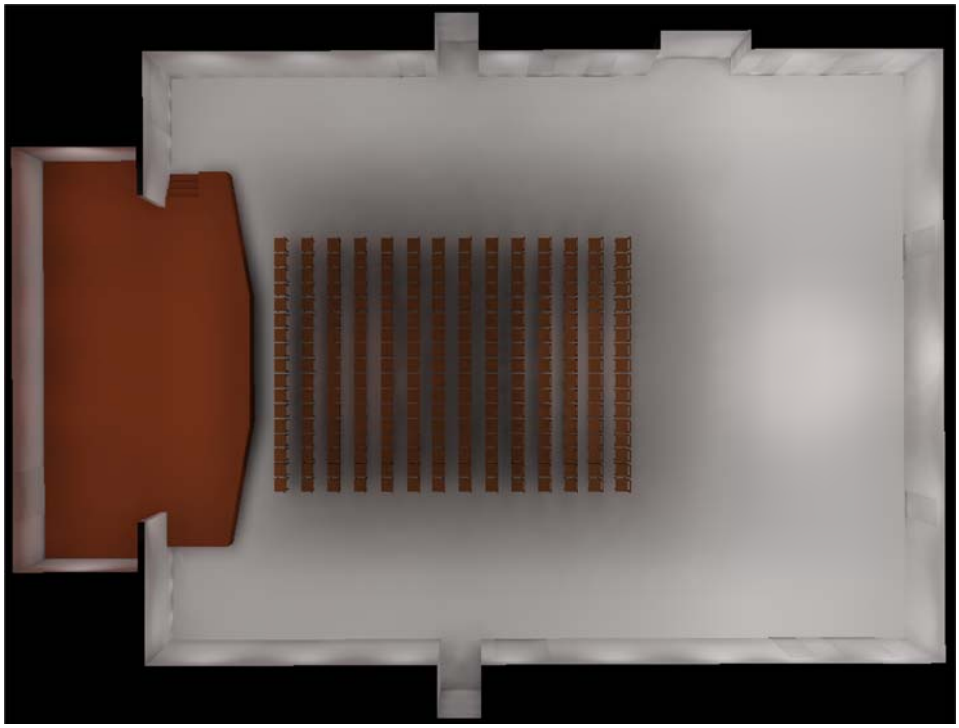

Figure 29: Multipurpose Room as Auditorium with Type D1, and G1 lights on

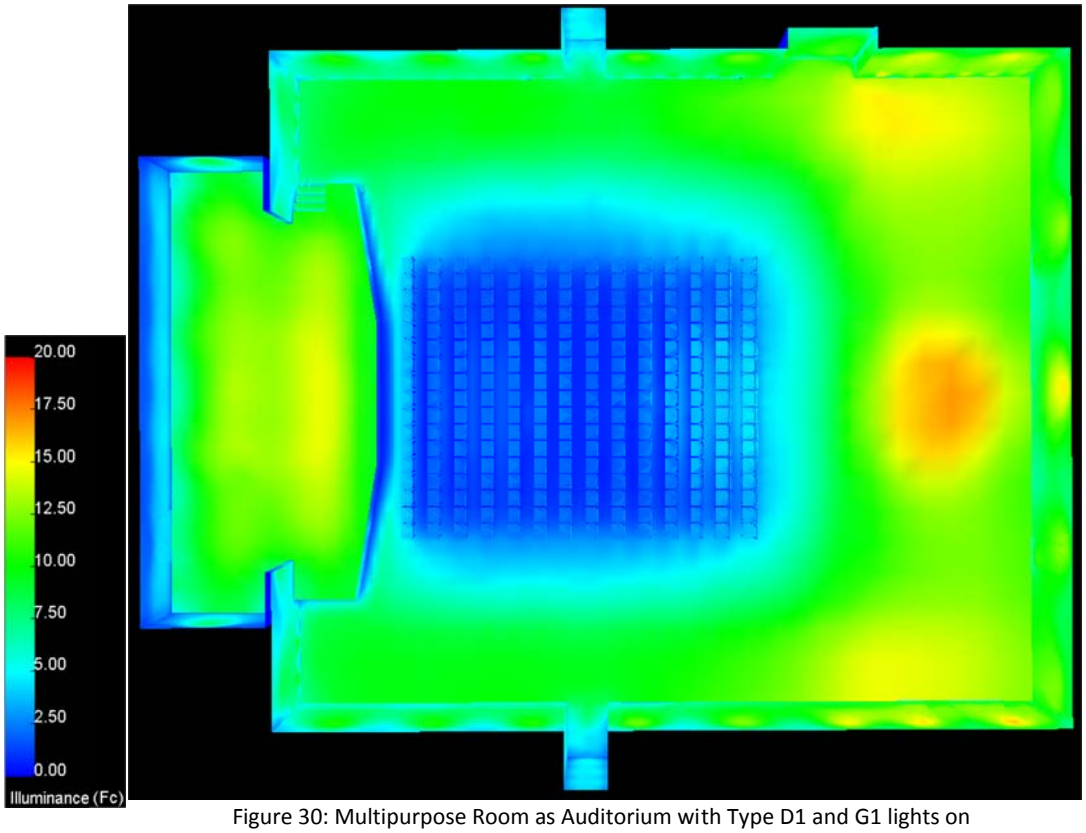

Figure 30: Multipurpose Room as Auditorium with Type D1 and G1 lights on

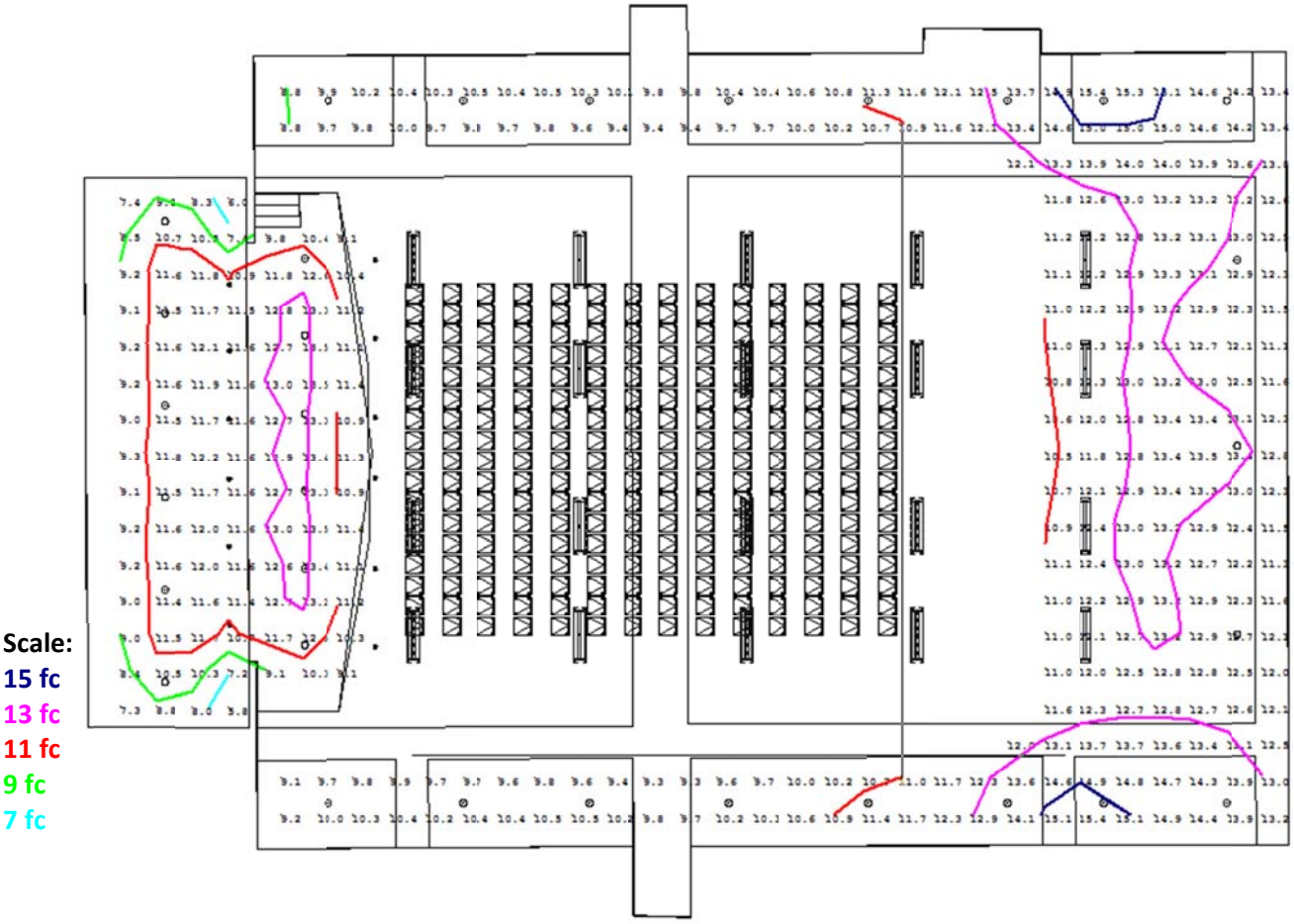

Figure 31: Multipurpose Room as Auditorium with Type D1 and G1 lights on

Figure 32: Multipurpose Room North Elevation

Figure 33: Multipurpose Room North-East Isometric view

Illuminance Levels						
Location	**Average (fc)**	**Max (fc)**	**Min (fc)**	**Max/Min**	**Coeff. Variation**	**Meets Recommendations**
Circulation Space	12.02	15.4	8.8	1.75	0.13	Yes
Stage	10.92	13.5	5.8	2.33	0.16	Yes

Table 11: Illuminance levels throughout space

Lighting Design for Multipurpose Room with partition wall separating the room into both an auditorium space and a cafeteria

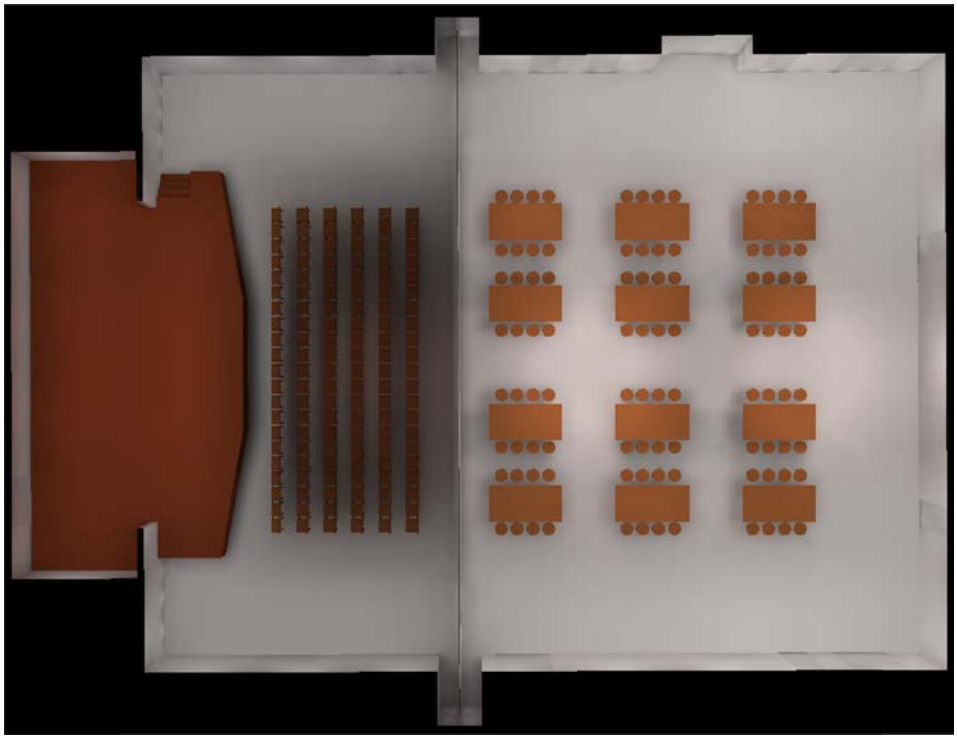

Figure 34: Multipurpose Room as Cafeteria and Auditorium with Type D1 and G1 lights on

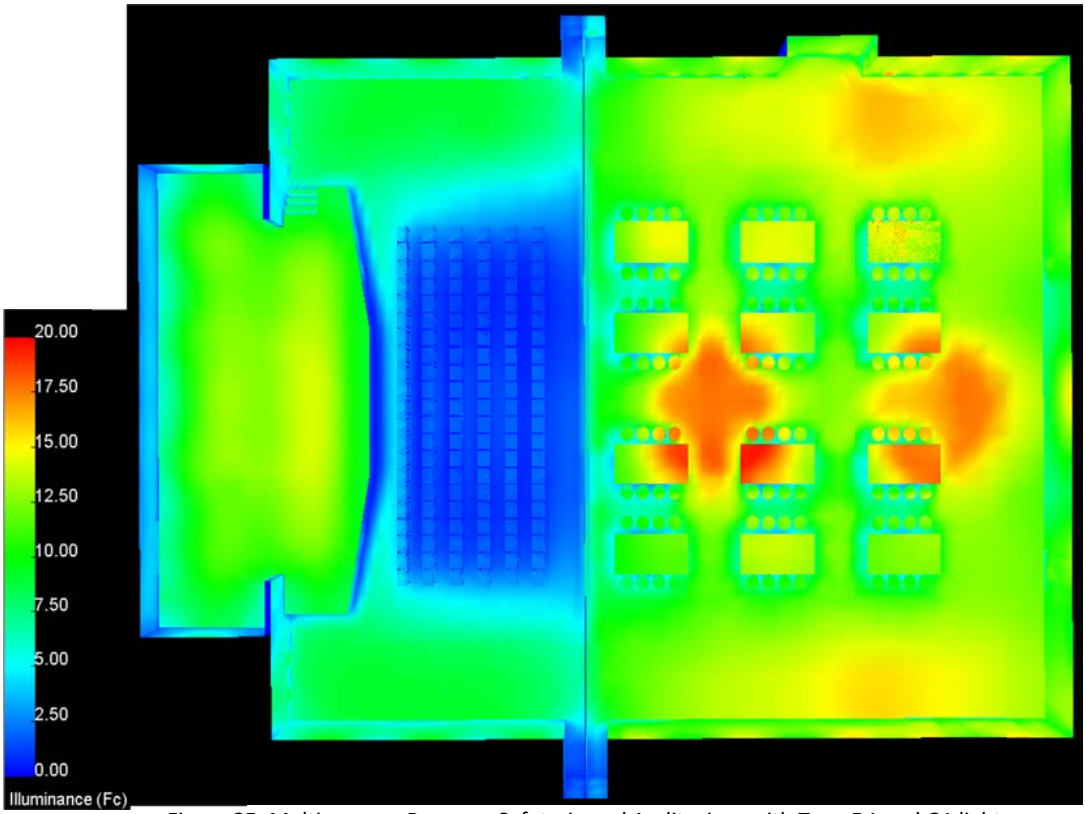

Figure 35: Multipurpose Room as Cafeteria and Auditorium with Type D1 and G1 lights on

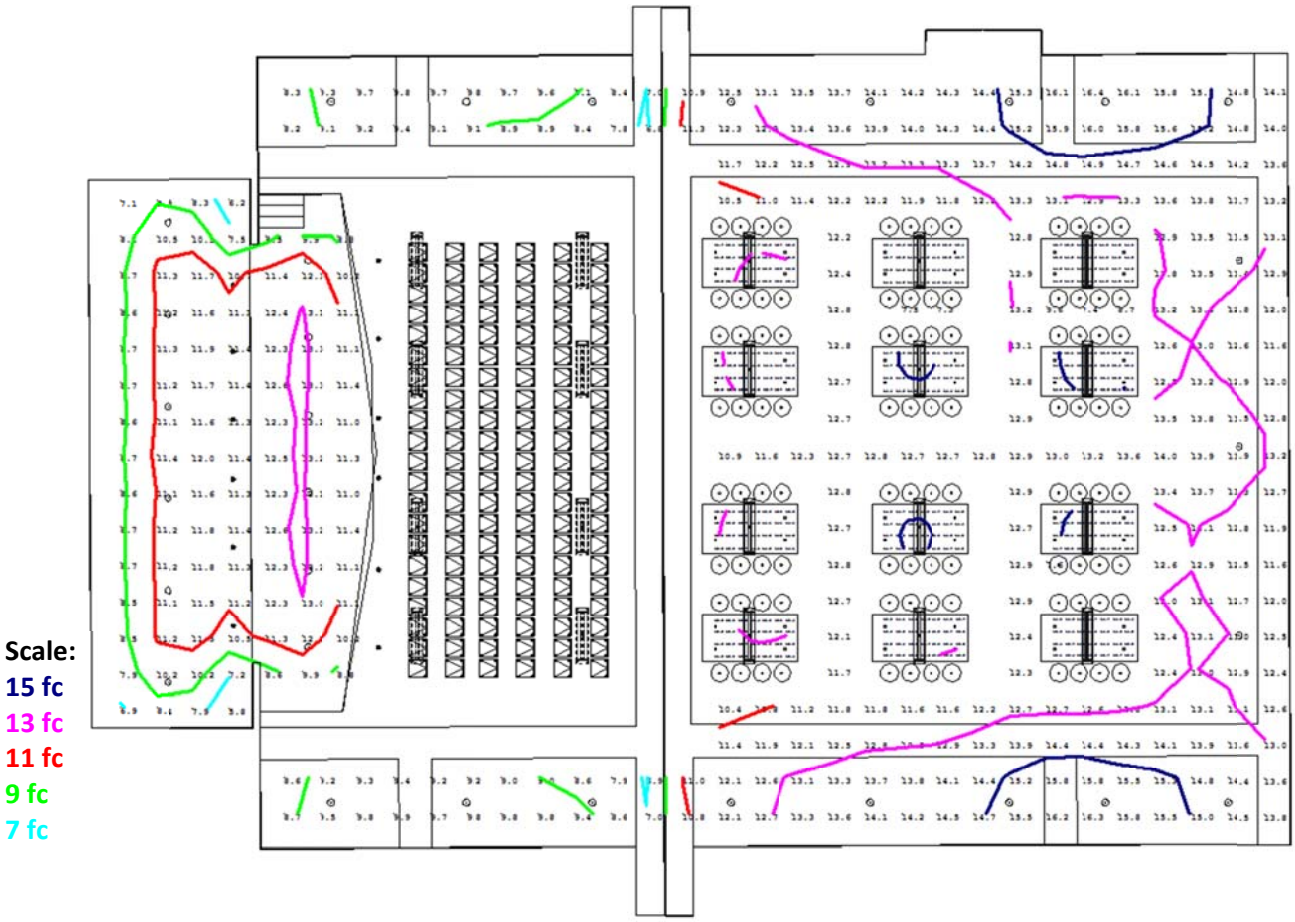

Figure 36: Multipurpose Room as Cafeteria and Auditorium with Type D1 and G1 lights on

Figure 37: Multipurpose Room North Elevation

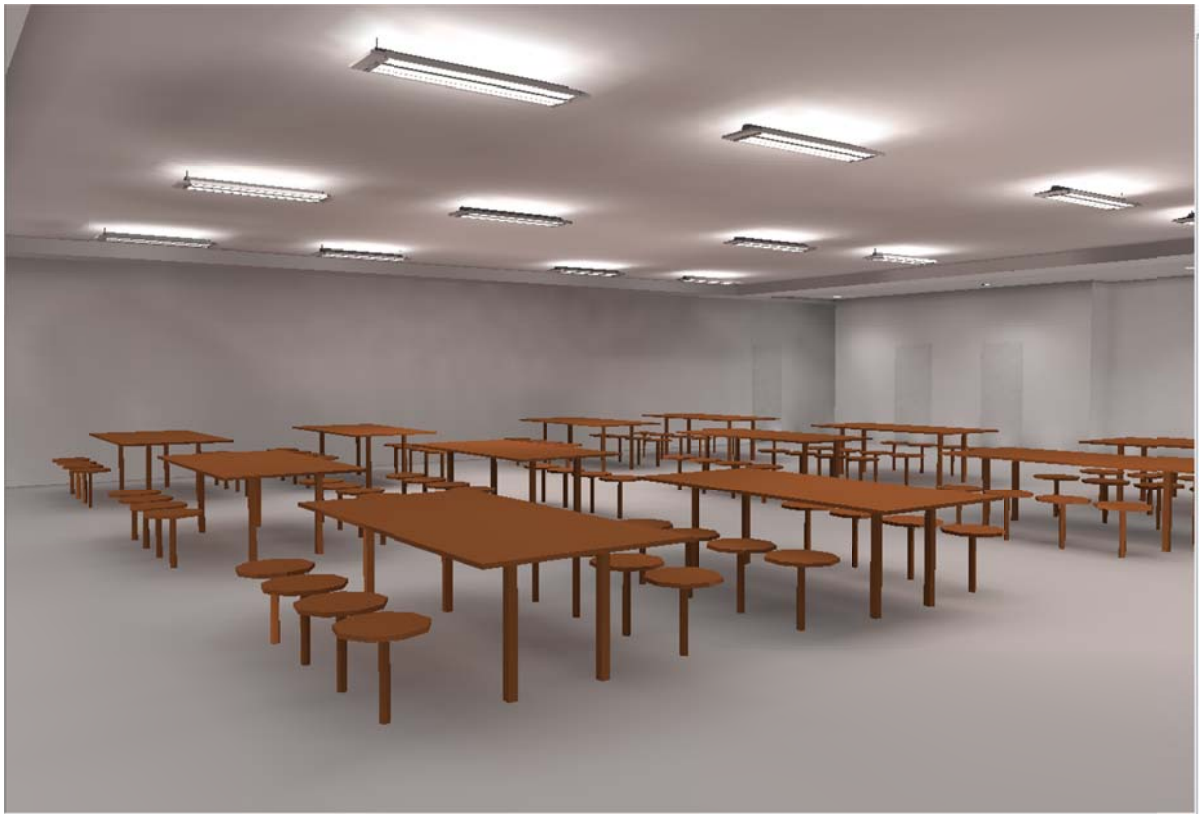

Figure 38: Multipurpose Room South-East Isometric view

Figure 39: Multipurpose Room South-East Isometric view

Illuminance Levels						
Location	**Average (fc)**	**Max (fc)**	**Min (fc)**	**Max/Min**	**Coeff. Variation**	**Meets Recommendations**
Cafeteria Table	14.04	14.58	13.2	1.11	0.03	Yes
Circulation Space	12.45	16.4	6.8	2.41	0.17	Yes
Stage	10.65	13.3	5.8	2.29	0.16	Yes

Table 12: Illuminance levels throughout space

Power Allowance			
Total Size	**Power Allowance**	**Total Power Allowed (Watts)**	**Total Power Used (Watts)**
6252 ft^2	1.3 W/ft^2	8127.6	2936

Table 13: Power Allowance

This lighting design meets ASHRAE 90.1/IESNA Standandes for power allowances.

Performance Summary

The redesign of this space meets the recommended lighting levels set forth by IESNA. The lighting design in this space is designed to compliment all of the different uses of this space: auditorium, cafeteria, auditorium and cafeteria, and emergency shelter.

The luminaires selected fit a specific purpose . Recessed downlights are used to highlight the cirulation spaces in the room. The luminaires also provide scalloping on the walls for visial interest on the perimeter. The intend was to maximize the ceiling height where people will be standing and use pendant fixtures where people will be seated. Therefore, semi-indirect luminaires are used in the center of the space where the cafeteria tables and auditorium seating is located. Alos, adjustable track lighting is used to light the stage. The luminaires selected in the spae are fluorescent light with the stage lighting being metal halide. The fluorescent light sources have a CCT of 3500K, while the metal halide light sources are 3000K; both have a high CRI.

The lighting layout provides uniformity along the cirulation spaces, as well as, the cafeteria tables, while achieving the IESNA recommendation of 10 fc throughout the space. The lighting Plan for this space is located in Apendix B. The controls in this space meet the shutoff requirements set by ASHRAE 90.1/IESNA.

Primary Classroom

Spatial Description:

Students and faculty can find themselves wondering through the various corridors on the first and second floor that direct them to many different classroom spaces. This primary classroom is a typical classroom space in Crystal Lake Elementary School that can accommodate 25 students. This particular classroom is located on the north side of the building on the first floor.

Space Category:

Interior Space/ Workspace

Materials:

Location	Material	Reflectance
Ceiling	2x2 Acoustical Ceiling Tile	0.75
Walls	White Latex Paint	0.93
	Whiteboard	0.8
	Tack Board	0.17
	Vinyl Cove Base	0.83
	Combination of Windows (made with laminated, tinted glass that is solar gray with a U value of 1.10 in the winter 1.13 in the summer and has a shading coefficient of 0.64)	
Doors	Light Gray Painted Door	0.8
Floor	Carpet	0.43
	Vinyl Composition Tile	0.83

Table 14: Primary Classroom Surface Materials

Dimensions:

Aproximately 27'-7" x 40'-0" with 9' ceilings, exterior wall south facing

Area: 969 ft^2

Perimeter: 135'-2"

Tasks/Activities:

This classroom is designed to provide a suitable learning environment for its students. Since this is a learning area, the primary tasks include reading and writing. With student desks, teaching equipment, and the propsed lighting design, this space creates a good educational environment. Only students, faculty members, and admistrators are permitted in this space during school hours.

Furniture:

(Manufacturer information was not provided. Reflectance levels are estimated based on equipment schedule)

Equipment	Reflectance
1 Marker board	0.8
2 Tack boards	0.17
4' x 4' Tack Board	0.17
8' x 4' Tack Board	0.17
Custom Cubby and Coat Hooks (Wood-Oak)	0.22
TMI Base Unit- B2052 30" X 36" X 24" (Wood-Oak)	0.22
TMI - B2542 30" X 36" X 24" (Wood-Oak)	0.22
TMI WALL UNIT – W2052 32" x 36" x 14" (Wood-Oak)	0.22
Student Chair/Desk (Wood-Oak)	0.22
Desk and Chair (Wood top with metal base desk with plastic chairs)	Desk=0.5, Chair=0.62
Table and Chair (Wood-Oak)	0.22

Table 15: Primary Classroom Furniture Material and Reflectance

Classroom Plans and Elevations:

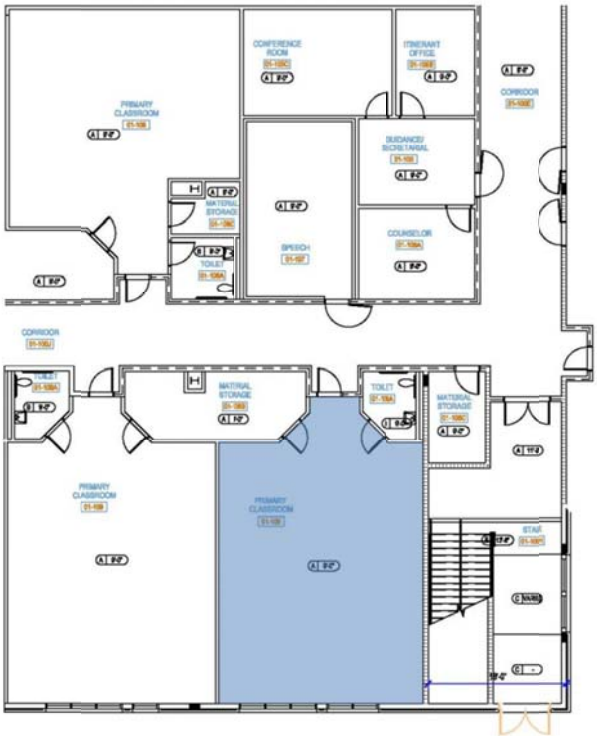

Figure 40: Primary Classroom Floor Plan

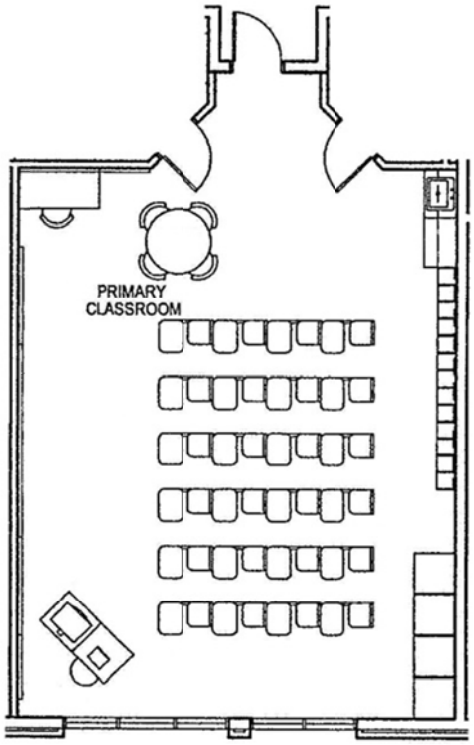

Figure 41: Detailed Primary Classroom Floor Plan

Note: Sections and Elevations of this space are unavailable

Lighting Design Criteria and Considerations

Interior, Educational Facilities, Classrooms, General
Interior, Reading, Printed Tasks, 8-and10-point type
Interior, Handwritten Task, White boards (IESNA Lighting Handbook)

- **Appearance of Space and Luminaires**
  - The luminaires and furnishings within this space will provide a visual cue as to the function of the space. Since eyes are drawn to the brightness, the luminaires will create bright areas where students should direct their attention to learn, mainly the front room where the teacher will be teaching. The luminaires will provide suitable light, while not creating a distraction for the students.

- **Color Appearance (and Color Contrast)**
  - For students to successfully complete their work environment needs to be visually pleasing. A CRI of 70 or above is desired to create an acceptable work environment with good color rendering, but a CRI of 80 or above will be used within this space.

- **Daylighting Integration and Control**
  - Having natural daylight present in the classroom will be good for the student's psychology. For this particular room we have north facing windows, but typically shading devices will be used all year round. Since this building is located in a warm climate, the sun will add a large amount of extra heat to the room, which will create an uncomfortable environment for its occupants. Although, the use of sunlight would be desirable to decrease the reliance on electric light, it will increase the energy usage in the form of air condition and therefore will not be implemented in this design.

- **Direct Glare**
  - Direct glare will create an uncomfortable environment for students and affect their ability to complete tasks. Since direct light is needed to provide enough illuminance on the work plane a lens will be used to reduce this glare.

- **Flicker (and Strobe)**
  - Flicker can be a distraction to the eye and affect students' ability to focus on their teacher and/or work. To reduce the flicker of the light source, high frequency electronic ballast can be used.

- **Light Distribution on Surfaces**
  - Shadows from objects will be avoided, so not to affect visibility, comfort, or perception. Both the horizontal plane and instructional wall need to be uniformly lit to provide a good work environment. However, total uniformity within the space will be avoided so that there is visual interest.

- **Light Distribution on Task Plane (Uniformly)**
  - The task plane is the student desks. Shadows will be avoided on the desks, so that it does not affect visibility, comfort, or perception. A lighting layout that provides uniformity across the task plane will be utilized.

- **Luminances of Room Surfaces**
  - Since this room is painted with white latex paint, the luminance of the room surface will be affected by the reflectance of this material. It is important that the whiteboard have uniform luminance to enhance the students' ability to clearly view the whiteboard. The lighting design will assist in directing focus to the instructional wall by directing light to this wall by using wall washers. To reduce the shadows on the work plane created by hands, both direct and diffuse light will be incorporated.

- **Modeling of Faces or Objects**
  - The ability of the teacher to be able to effectively read the facial expressions of students is important to his/her effectiveness as a teacher. Therefore, it is important that the lighting enhance the areas around the mouth and eyes of the students. Concentrated downlighting will be avoided and multidirectional lighting will be implemented, while incorporating the reflected illuminance from the walls and ceilings to help model students' faces.

- **Points on Interests**
  - The point of interest is the front center of the room, on the east wall, where teaching will occur and the whiteboard is present. The lighting design will create uniform illumination across the whiteboard. In relationship to the surrounding surfaces, the instructional wall will draw the focus by having higher brightness.

- **Reflected Glare**
  - Glare from the glossy surfaces and veiling reflections will be avoided through the use of lensed luminaires over the workplane.

- **Shadows (Somewhat Important)**
  - Shadows on the work plane can cause issues in the ability for students to learn due to the distraction of the lighting design. Linear or area light sources will be used to create diffuse shadows.

- **Source/Task/Eye Geometry**
  - Occupants will not be able to have a clear view on the light source to prevent discomfort. The lighting design will make use of reflected light, and avoid having luminaires directly above the task plane.

- **Surface Characteristics**
  - Many of the surface materials in this task space have a high reflectance. This is desirable so that interreflection can occur to reduce the contrast of between the luminaires and the background, as well as, allow for the use of fewer luminaires at fewer watts. The lighting design will make use of the reflected light to create and the necessary wall light to enhance the environment.

- **System Control and Flexibility**
  - The tasks in this space vary and each task requires different light levels. Therefore, having multiple switches is desired to allow for various lighting levels. Occupancy sensors will be used ensure that energy for the electric lighting is not being wasted when people are not present in this room.

- **Illuminance (Horizontal)**
  - Category D: Performance of visual tasks of high contrast and large size, 30 fc.

- **Illuminance (Vertical)**
  - Category D: Simple orientation for short visits, 30 fc

- **Power Allowance** (ASHRAE/IESNA Std. 90.1)
  - Space-by-Space Method: Classroom=1.4 W/ft^2

- **Psychological Aspects**
  The primary classroom will be further investigated throughout the design to determine a suitable design to create the psychological impression of a public space.

  Elementary school students are typically struggling to get used to the feeling of being at school and being away from their parents. Therefore, a public feeling should be achieved when they are in one of their classrooms. They should feel that the space is open and inviting, so that they feel comfortable learning within this space.

  The lighting design should work with the current furniture layout to enhance the learning environment and ultimately promote productivity. The design should complement the function of the space.

Luminaire Information

Luminaire Schedule										
Type	**Image**	**Manufacturer**	**Catalog Number**	**Description**	**Mounting**	**Mounting Height**	**Ballast/Power Supply**	**Voltage**	**Lamp**	**Wattage**
I1		Litecontrol	LG-WWD-4414T5-SGL-CWM-EOR/LH-LP/ELB-277	Recessed luminaire with an optical system to provide uniform wall wash lighting. A extruded frosted acrylic soft glow lens diffuser. Semi-specular high reflectance aluminum primary optic reflector	Ceiling Recessed	9'-0"	Electronic	277	GE F28W/T5/841 /ECO	37 W
I2		Litecontrol	LG-WWD-4414T5-SGL-CWM-IND-LP/ELB-277	Recessed luminaire with an optical system to provide uniform wall wash lighting. A extruded frosted acrylic soft glow lens diffuser. Semi-specular high reflectance aluminum primary optic reflector	Ceiling Recessed	9'-0"	Electronic	277	GE F28W/T5/841 /ECO	37 W
I3		Litecontrol	LG-WWD-4414T5-SGL-CWM-INT-LP/ELB-277	Recessed luminaire with an optical system to provide uniform wall wash lighting. A extruded frosted acrylic soft glow lens diffuser. Semi-specular high reflectance aluminum primary optic reflector	Ceiling Recessed	9'-0"	Electronic	277	GE F28W/T5/841 /ECO	37 W
I4		Litecontrol	LG-WWD-4414T5-SGL-CWM-EOR/RH-LP/ELB-277	Recessed luminaire with an optical system to provide uniform wall wash lighting. A extruded frosted acrylic soft glow lens diffuser. Semi-specular high reflectance aluminum primary optic reflector	Ceiling Recessed	9'-0"	Electronic	277	GE F28W/T5/841 /ECO	37 W

Luminaire Schedule										
J1		Lightolier	2001CL	Open aperture compact fluorescent recessed downlight. Aluminum reflector with a matte white flange. Specular clear finish.	Ceiling Recessed	9'-0"	Electronic	277	GE F13TBX/841/ A/ECO	16 W
K1		Ledalite	3324-D1-ST-T232-S-1-2-E	Recessed Luminaire with an optical system with highly reflective painted interiors.	Ceiling Recessed	9'-0"	Electronic	277	GE F32T8/SP41/E CO/C	62 W
*Luminaire, Lamp, Ballast Specification Sheets are located in Appendix A										

Light Loss Factors					
Type	**LLD**	**LDD**	**RSDD**	**BF**	**LLF Total**
I1	0.92	0.88	0.974	0.96	0.757
I2	0.92	0.88	0.974	0.96	0.757
I3	0.92	0.88	0.974	0.96	0.757
I4	0.92	0.88	0.974	0.96	0.757
J1	0.94	0.89	0.974	1.00	0.815
K1	0.95	0.88	0.974	0.88	0.717

Controls

The redesign of the lighting in this space, also requires a redesign of the current control system to operate the new lighting design. The task lighting (Luminaire Type C) and the lighting at the entrance to the room (Luminaire Type B) and the wall washing luminairies (Luminaire Type A) will be located on a duel-technology occupancy sensor. Since this room is not a rectangular space, a ceiling mounted occupancy sensor will be used and preferred over a wall mounted occupancy sensor by the door. The duel-technology occupancy sensor is located so that the entrance to the room is visible as well as located above the students desk where the majority of activity within the space will occur. The occupancy sensor will be a WattStopper DT-300 series dual technology ceiling sensor, and the equipment schedule and cut sheets are located in Appendix B

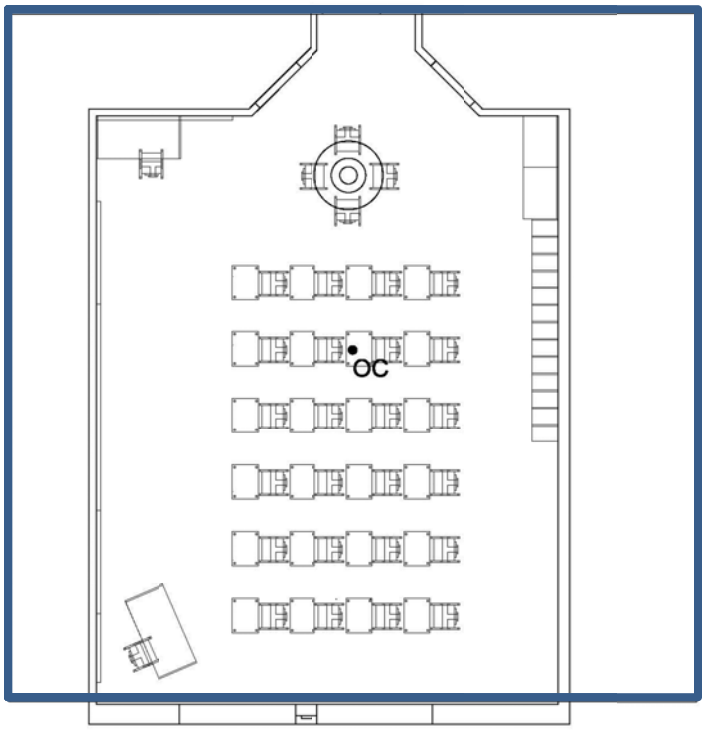

Figure 42: Schematic for Ocuupancy Sensor Coverage Area

Type	Manufacturer	Product Name	Catalog Number	Description	Location
OC-1	Watt Stopper	DT-300 Series Dual Technology Ceiling Sensor	DT-300-U	Passive infrared (PIR) and ultrasonic technologies utilized. Flat appearance of sensor with a 360 degrees of coverage	Primary Classroom

Table 16: Primary Classroom Equipment Schedule

Lighting Design

Design Concept

The primary classroom should promote learning within the space. Students should feel comfortable and attentive while in this space. The lighting design should provide uniform lighting on the workplane of the students desks, while avoiding glare. To achieve this, lensed luminaires will be used directly above the workplane. Energy efficient lamps and ballasts are used. The uniform, high levels of light will provide a public feeling within the space to enhance the students ability to learn.

The walls and ceilings are highly reflective materials and help distribute reflected light to the workplane.

Performance Data

The following cantains renderings and calculation data that was calculated using AGI32 for the proposed lighting design.

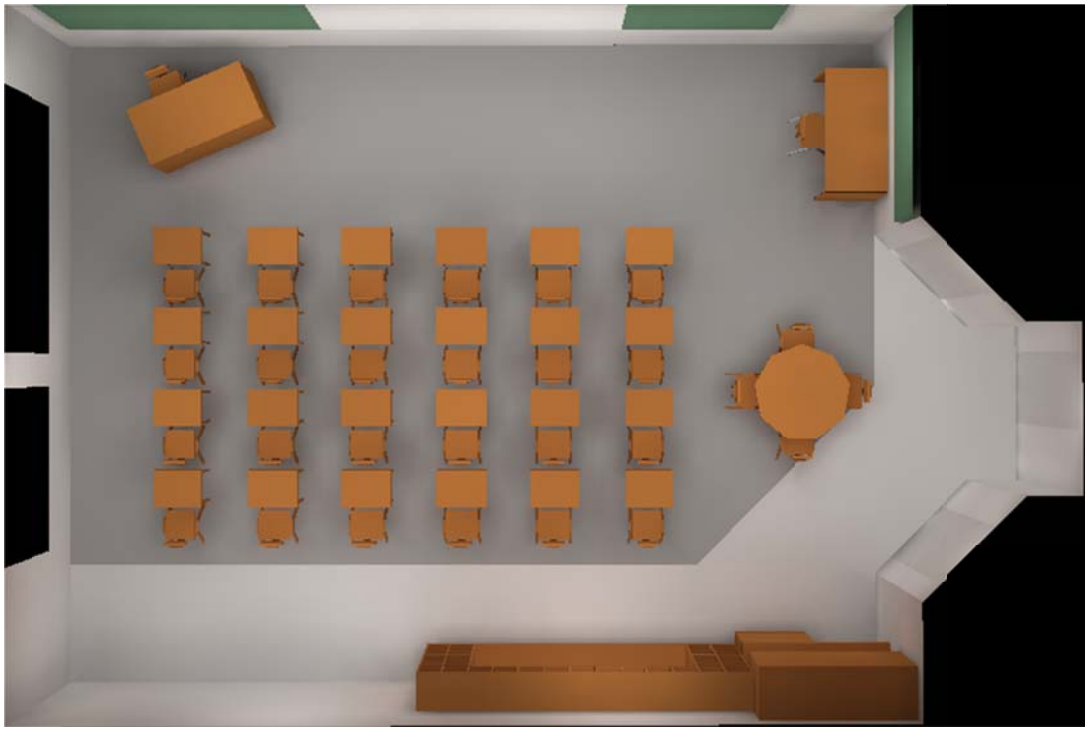

Figure 43: Primary Classroom with Type I1 ,I2, I3, I4, J1 And K1 lights on

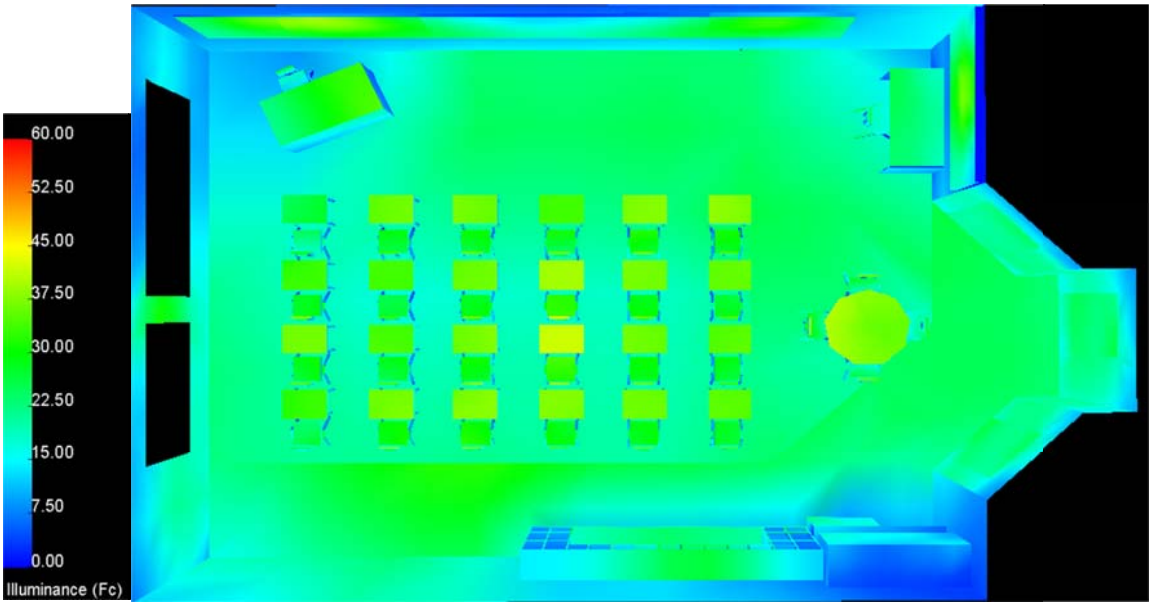

Figure 44: Primary Classroom Illumininance Pseudo Color Rendering with Type I1 ,I2, I3, I4, J1, And K1 lights on

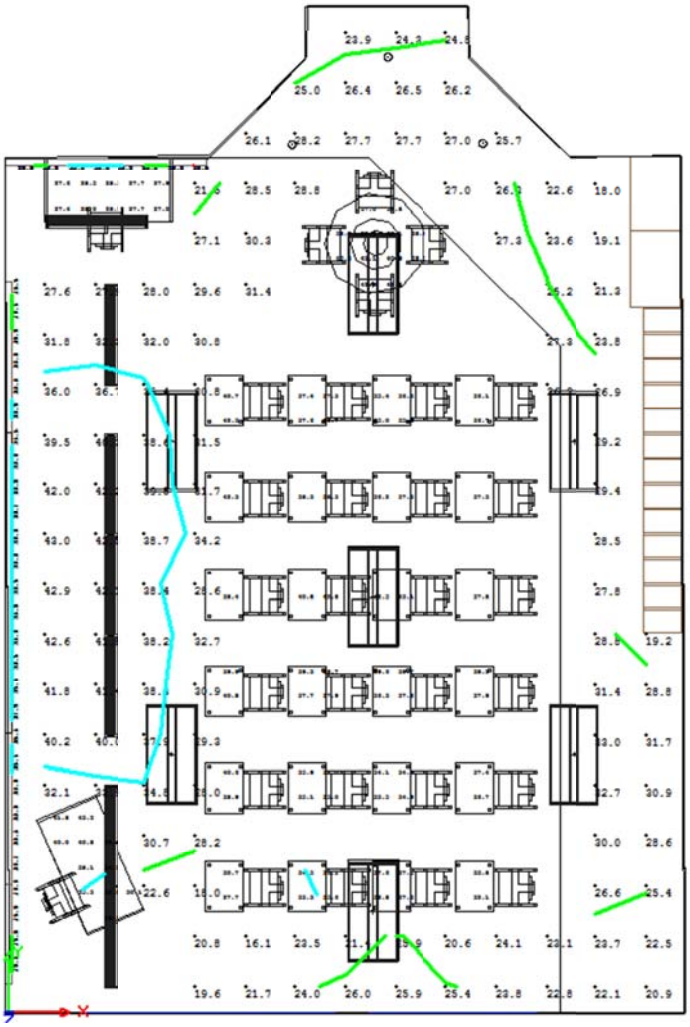

Figure 45: Primary Classroom Isolines for illuminance levels with Type A1 ,A2, A3, B, And C lights on

Figure 46: Primary Classroom East Elevation

Figure 47: Primary Classroom South-West Isometric view

Illuminance Levels						
Location	**Average (fc)**	**Max (fc)**	**Min (fc)**	**Max/Min**	**Coeff. Variation**	**Meets Recommendations**
Students Desk	37.16	43.1	27.7	1.56	0.08	Yes
Teacher's Desk	32.46	39.7	26.0	1.54	0.12	Yes
Table	39.55	42.0	36.8	1.14	0.04	Yes
Circulation Path	29.44	43	16.1	2.67	.22	Yes
White Board	36.51	40.3	28.9	1.39	0.07	Yes
Tack Baords	28.63	34.83	21.8	1.70	0.13	N/A

Table 17: Illuminance levels throughout space

Power Allowance			
Total Size	**Power Allowance**	**Total Power Allowed (Watts)**	**Total Power Used (Watts)**
975 ft^2	1.4 W/ft^2	1365	741

Table 18: Power Allowance

This lighting design meets ASHRAE 90.1/IESNA Standandes for power allowances.

Performance Summary

The redesign of this space meets the recommended lighting levels set forth by IESNA. The lighting design in this space is designed to create the Flynn Impession of a Public space. To achieve this, all of the luminaires used are recessed so that the space feels as open a possible. Also, it was necessary to achieve uniformity throughout the space, uniformity on the workplane, or students desks, as well as create a uniform lighting design.

The luminaires selected easily fit into the current grid ceiling layout with 2x2 ceiling tile. The intent was to use luminaires that work well with this learning environment. To acheive this, luminaires above the work plane have a lense so that there is no direct line of sight to the lamp. Also, the luminaires that are lighting the taskboards in the front of the room are also lensed so that the teacher does not have a direct line of sight to the lamp, as well as a spline to avoid any discomforter from the onlooking students. All the luminaires selected are fluorescent light sources and have a CCT of 4100 and a high CRI.

The uniform lighting layout above the students desks provides an even distribution of light, while achieving the IESNA recommendation of 30 fc on the students desks. The recessed wall washing luminaires at the front of the classroom have many purposes. Although not required by IESNA, I wanted to reach an average illuminance level of 30 fc on the task boards at the front of the room that will display class information, to assure there is enough illuminance that students can read these boards with ease. In addition, this added light will direct the students attention to the front of the classroom, due to the higher levels of illuminance on the east wall. The whiteboard in the front of the classroom needs 30 fc per IESNA recommendations, which was meet. Uniformity on the whiteboard was achieved and there should be no issue with glare.

The primary classroom meets the requirements set forth by IESNA, and achieves the public psychological impress desired, while creating a comfortable learning environment. The controls in this space meet the shutoff requirements set by ASHRAE 90.1/IESNA.

Electrical Redesign for Lighting Spaces

The redesigning of the lighting spaces requires a redesign of the branch circuit distribution within these four spaces. The fours spaces that the branch circuiting is redesigned for are the covered walkways and entrance, the lobby, the multipurpose room, and a primary classroom. The overall purpose of the lighting redesign of these spaces is to lower the energy consumption within these spaces to save this school money on electrical costs.

For the covered entrance and covered walkways, the lighting redesign uses a symmetric design with canopy mounted luminaires under the covered walkways that lead a visitor to the covered entrance that welcomes them into the building. The covered entrance has recessed downlights to light this space. In addition to the necessary lighting to reach the IESNA recommended illuminance values, direct/indirect luminaires are places on the façade of the building that will remain on throughout the night to provide security for the school.

For the lobby, the lighting design is meant to create a smooth transition from the exterior of the building to the first interior space that occupants see. Therefore, the direct/indirect luminaire on the exterior façade is located on the columns of this space. Also, to meet IESNA recommended illuminance values recessed downlights are places on the ceiling. There is a wall located under the main staircase in the center of this building, where the school displays current works from the students and important school information. To draw attention to this wall, higher illuminance levels are produced by using linear wall washing luminaires.

For the multipurpose room, the lighting design must work for both the cafeteria space, the auditorium space, when the partition wall is in use, and when this space is used as an emergency shelter. Therefore the center of the space where auditorium and cafeteria seating is located is lit by semi-indirect pendant luminaires. The circulation space throughout the room is illuminated by recessed downlights in a linear pattern. In addition, the stage is illuminated by two rows of adjustable track luminaires that are controlled by a scene controller for the different needs of the stage.

For the primary classroom, the lighting design uses recessed linear luminaires to provide adequate lighting on the work plane. In addition, wall washing luminaires are used to light both the whiteboard and the tackboards. Recessed downlights are used to light the exits from the room.

The redesigning of lighting in four spaces has changed both the circuiting and controls in these spaces. All of the lighting that has been changed is 277 V. The lighting affected is located on both normal and emergency/normal panels. The panels affected by the lighting redesign are highlighted in the table below.

Panelboards						
Panel Tag	Voltage	System	Entrance	Lobby	Multipurpose Room	Classroom
1EH1	480Y/120V, 3P, 4W	N/E	X	X		
1H1	480Y/120V, 3P, 4W	N	X	X	X	X
1L1	208Y/120V, 3P, 4W	N			X	

Table 19: Panels affected by lighting design

Controls

Controls for all of the redesigned lighting spaces can be found under the controls section of the space desired.

Lighting Layouts

Lighting layouts for the four spaces that have been redesigned are located in Appendix B.

Exising Panelboard Schedules

The following are the existing panel schedules for Panel 1H1, Panel 1HE1, and Panel 1L1, which note the circuits that will be affected by the four spaces redesigned.

Panel 1H1

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VOLTS L/N	277		PANEL	1H1	DEPTH(IN.) 5.75
VOLTS PH.	480	<------AIC RATING------>	MLO(***)	225	SECTIONS 1
PHASE	3	SERIES RATED 65 KA(*)	MCB	_____	SECTION WIDTH(IN.) 20
MOUNTING	SURF	FULLY RATED _____KA	SH. TRIP	_____	PLUG-IN N/A
TYPE	NF	(*)NOTE: MAY REQUIRE FULL	BUS	COPPER	BOLT-ON YES
MFR	SQ D	RATING TO ACHIEVE.			NEMA 3R _____

GENERAL NOTES:
(1) ALL C.B.'S FEEDING HVAC EQUIPMENT TO BE HACR TYPE.
(2) ALL C.B.'S FEEDING ELEV. EQUIP. TO BE SHUNT-TRIP TYPE.
(3) ALL C.B.'S FEEDING ELEV. EQUIP. TO BE SIZED AS REQUIRED BY MFR.
(4) ALL C.B.'S FEEDING HID LTG TO BE HID RATED.

_____ NOTE: NON-LINEAR PNL, 200% NEUTRAL
_____ NOTE: ISOLATED GROUND BUS
_____ NOTE: SHUNT TRIP C.B.
_____ NOTE: GFI C.B.
_____ NOTE: SIZE CB PER MFR. RECOMMENDATIONS.

163	TOTAL AMPS A PHASE	(***) NOTE: SIZE SHOWN IS MINIMUM	MAIN SERVICE	NO	
163	TOTAL AMPS B PHASE	ACCEPTABLE MLO AMPERAGE. INCREASE	ACTUAL CONN. LOAD	136	163 AMPS
163	TOTAL AMPS C PHASE	SIZE IF REQUIRED FOR QUANTITY OF	NEC LOAD/DEMAND	136	163 AMPS
NONE	ERROR CODE	POLES.	NEC DIVERSITY	136	163 AMPS
			XFMR KVA 0		

DESCRIPTION	LOAD CONN	TYPE	AMPS	AMPS	AMPS	C.B. AMPS	C.B. POLE	CKT. NO.	CKT. NO.	C.B. POLE	C.B. AMPS	AMPS	AMPS	AMPS	DESCRIPTION	LOAD CONN	TYPE
GEN. LTG.	3660	1	13	\\\\\\\	\\\\\\	20	1	1	2	1	20	13	\\\\\\	\\\\\\	GEN. LTG.	3660	1
GEN. LTG.	3200	1	\\\\\\\	12	\\\\\\	20	1	3	4	1	20	\\\\\\	12	\\\\\\	GEN. LTG.	3290	1
GEN. LTG.	3555	1	\\\\\\\	\\\\\\\	13	20	1	5	6	1	20	\\\\\\	\\\\\\	9	GEN. LTG.	2530	1
GEN. LTG.	2440	1	9	\\\\\\\	\\\\\\	20	1	7	8	1	20	14	\\\\\\	\\\\\\	GEN. LTG.	3740	1
GEN. LTG.	2048	1	\\\\\\\	7	\\\\\\	20	1	9	10	1	20	\\\\\\	11	\\\\\\	GEN. LTG.	2935	1
GEN. LTG.	2900	1	\\\\\\\	\\\\\\\	10	20	1	11	12	1	20	\\\\\\	\\\\\\	10	HALL LTG	2785	1
GEN. LTG.	315	1	1	\\\\\\\	\\\\\\	20	1	13	14	1	20	11	\\\\\\	\\\\\\	HALL LTG	3085	1
EXTR LTG	2840	2	\\\\\\\	10	\\\\\\	20	1	15	16	1	20	\\\\\\	15	\\\\\\	EXTR LTG	4030	2
SPARE	0		\\\\\\\	\\\\\\\	0	20	1	17	18	1	20	\\\\\\	\\\\\\	16	EXTR LTG	4340	2
SPARE	0		0	\\\\\\\	\\\\\\	20	1	19	20	1	20	7	\\\\\\	\\\\\\	EXTR LTG	1860	2
SPARE	0		\\\\\\\	0	\\\\\\	20	1	21	22	1	20	\\\\\\	9	\\\\\\	EXTR LTG	2480	2
SPARE	0		\\\\\\\	\\\\\\\	0	20	1	23	24	1	20	\\\\\\	\\\\\\	2	SCHOOL SIGN	500	2
SPARE	0		0	\\\\\\\	\\\\\\	20	1	25	26	1	20	0	\\\\\\	\\\\\\	SPARE	0	
SPARE	0		\\\\\\\	0	\\\\\\	20	1	27	28	1	20	\\\\\\	0	\\\\\\	SPARE	0	
SPARE	0		\\\\\\\	\\\\\\\	0	20	1	29	30	1	20	\\\\\\	\\\\\\	0	SPARE	0	
SPACE			0	\\\\\\\	\\\\\\		1	31	32	1	20	0	\\\\\\	\\\\\\	SPARE	0	
SPACE			\\\\\\\	0	\\\\\\		1	33	34	1	20	\\\\\\	0	\\\\\\	SPARE	0	
SPACE			\\\\\\\	\\\\\\\	0		1	35	36	1	20	\\\\\\	\\\\\\	0	SPARE	0	
SPACE			0	\\\\\\\	\\\\\\		1	37	38	1		0	\\\\\\	\\\\\\	SPACE		
SPACE			\\\\\\\	0	\\\\\\		1	39	40	1		\\\\\\	0	\\\\\\	SPACE		
SPACE			\\\\\\\	\\\\\\\	0		1	41	42	1		\\\\\\	\\\\\\	0	SPACE		
	0	14	0	\\\\\\\	\\\\\\			S.F.	S.F.			0	\\\\\\	\\\\\\		0	14
----------	0	14	\\\\\\\	0	\\\\\\	-----	-----	S.F.	S.F.	-----	-----	\\\\\\	0	\\\\\\	----------	0	14
----------	0	14	\\\\\\\	\\\\\\\	0	-----	-----	S.F.	S.F.	-----	-----	\\\\\\	\\\\\\	0	----------	0	14

Panel 1HE1

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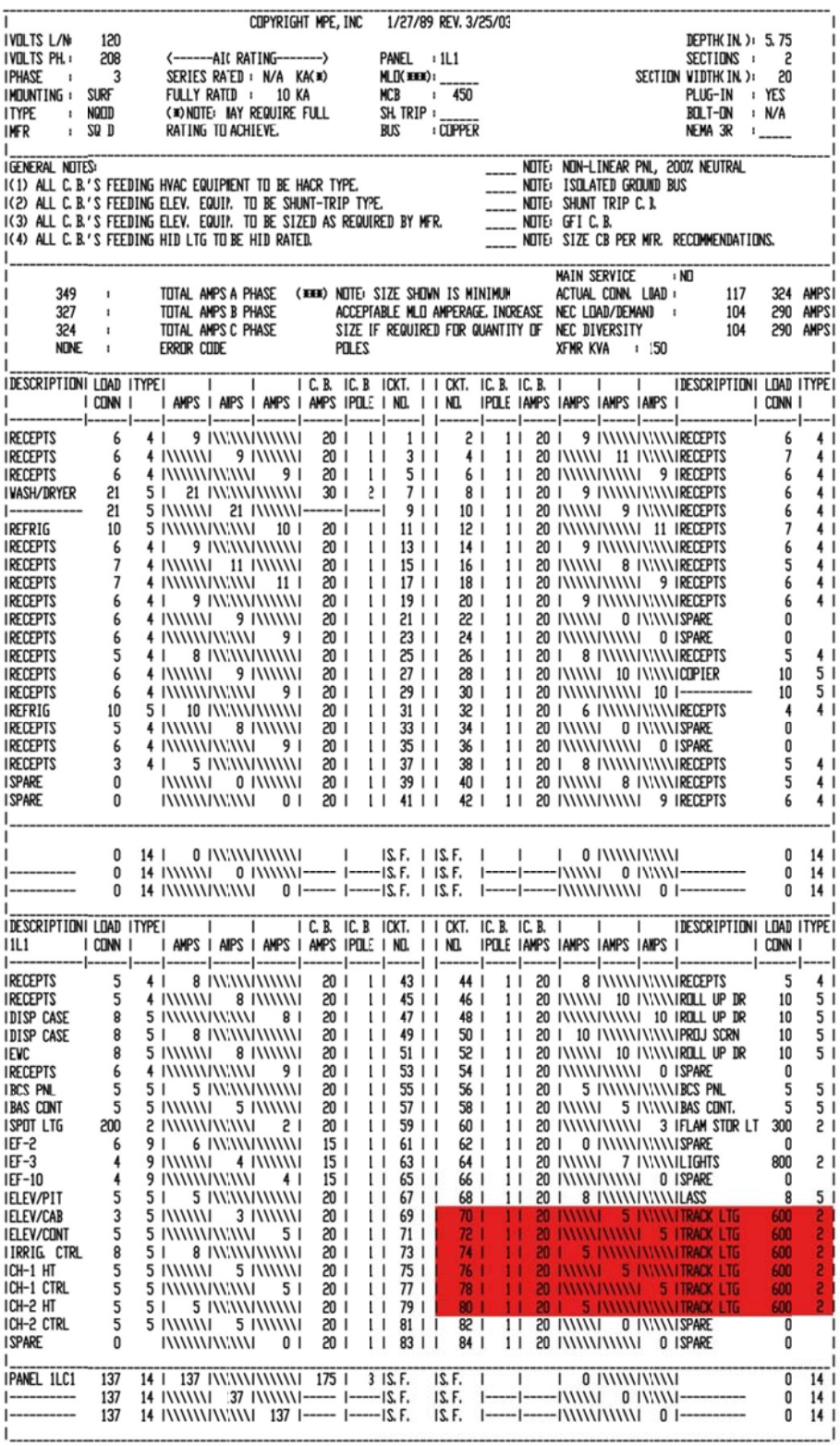
-------------------------------------------------------------------------------------------------------------------
|                                    COPYRIGHT MPE, INC    1/27/89 REV. 3/25/03                                    |
|VOLTS L/N:     277                                                                     DEPTH(IN.): 5.75           |
|VOLTS PH.:     480      <------AIC RATING------->      PANEL   : 1EH1                   SECTIONS  :    1           |
|PHASE    :       3      SERIES RATED :   65 KA(*)      MLO(***):  100            SECTION WIDTH(IN.):   20           |
|MOUNTING :   SURF       FULLY RATED  :______KA         MCB     :______                 PLUG-IN   : N/A            |
|TYPE     :   NF         (*)NOTE:  MAY REQUIRE FULL     SH.TRIP :______                 BOLT-ON   : YES            |
|MFR      :   SQ D       RATING TO ACHIEVE.             BUS     : COPPER                NEMA 3R   :_____           |
|__________________________________________________________________________________________________________________|
|GENERAL NOTES:                                                         _____ NOTE:  NON-LINEAR PNL, 200% NEUTRAL  |
|(1) ALL C.B.'S FEEDING HVAC EQUIPMENT TO BE HACR TYPE.                 _____ NOTE:  ISOLATED GROUND BUS           |
|(2) ALL C.B.'S FEEDING ELEV.  EQUIP.  TO BE SHUNT-TRIP TYPE.           _____ NOTE:  SHUNT TRIP C.B.               |
|(3) ALL C.B.'S FEEDING ELEV.  EQUIP.  TO BE SIZED AS REQUIRED BY MFR.  _____ NOTE:  GFI C.B.                      |
|(4) ALL C.B.'S FEEDING HID LTG TO BE HID RATED.                        _____ NOTE:  SIZE CB PER MFR. RECOMMENDATIONS.|
|__________________________________________________________________________________________________________________|
|                                                                        MAIN SERVICE      : NO                    |
|      45    :        TOTAL AMPS A PHASE   (***) NOTE: SIZE SHOWN IS MINIMUM     ACTUAL CONN. LOAD :    34    41  AMPS|
|      41    :        TOTAL AMPS B PHASE         ACCEPTABLE MLO AMPERAGE. INCREASE NEC LOAD/DEMAND   :    34    41  AMPS|
|      41    :        TOTAL AMPS C PHASE         SIZE IF REQUIRED FOR QUANTITY OF  NEC DIVERSITY          34    41  AMPS|
|     NONE   :        ERROR CODE                 POLES.                            XFMR KVA     :   0                 |
|__________________________________________________________________________________________________________________|
|DESCRIPTION| LOAD |TYPE|      |      |      | C.B. |C.B |CKT. | | CKT. |C.B. |C.B. |     |     |     |DESCRIPTION| LOAD |TYPE|
|           | CONN |    | AMPS | AMPS | AMPS | AMPS |POLE| NO. | | NO.  |POLE |AMPS |AMPS |AMPS |AMPS |           | CONN |    |
|-----------|------|----|------|------|------|------|-----|-----| |------|-----|-----|-----|-----|-----|-----------|------|----|
|HALL/RR LTG  1535    2 |    6 |\\\\\\|\\\\\\|   20 |   1 |   1 | |    2 |   1 |  20 |  11 |\\\\\|\\\\\|KITCH/OFFI   2985    2 |
|HALL/RR LTG  2895    2 |\\\\\\|   10 |\\\\\\|   20 |   1 |   3 | |    4 |   1 |  20 |\\\\\|  12 |\\\\\|MULTI-PURP   3325    2 |
|OFFICE/STOR  2705    2 |\\\\\\|\\\\\\|   10 |   20 |   1 |   5 | |    6 |   1 |  20 |\\\\\|\\\\\|  10 |LTG          2828    2 |
|EXTR LTG     3210    2 |   12 |\\\\\\|\\\\\\|   20 |   1 |   7 | |    8 |   1 |  20 |   0 |\\\\\|\\\\\|SPARE           0      |
|SPARE           0      |\\\\\\|    0 |\\\\\\|   20 |   1 |   9 | |   10 |   1 |  20 |\\\\\|   0 |\\\\\|SPARE           0      |
|SPARE           0      |\\\\\\|\\\\\\|    0 |   20 |   1 |  11 | |   12 |   1 |  20 |\\\\\|\\\\\|   0 |SPARE           0      |
|SPARE           0      |    0 |\\\\\\|\\\\\\|   20 |   1 |  13 | |   14 |   3 |  40 |  17 |\\\\\|\\\\\|PANEL 1LE1     17   14 |
|SPARE           0      |\\\\\\|    0 |\\\\\\|   20 |   1 |  15 | |   16 |-----|-----|\\\\\|  17 |\\\\\|-----------    17   14 |
|SPARE           0      |\\\\\\|\\\\\\|    0 |   20 |   1 |  17 | |   18 |-----|-----|\\\\\|\\\\\|  17 |-----------    17   14 |
|                       |    0 |\\\\\\|\\\\\\|                                      |   0 |\\\\\|\\\\\|                       |
|                       |\\\\\\|    0 |\\\\\\|                                      |\\\\\|   0 |\\\\\|                       |
|                       |\\\\\\|\\\\\\|    0 |                                      |\\\\\|\\\\\|   0 |                       |
|                       |    0 |\\\\\\|\\\\\\|                                      |   0 |\\\\\|\\\\\|                       |
|                       |\\\\\\|    0 |\\\\\\|                                      |\\\\\|   0 |\\\\\|                       |
|                       |\\\\\\|\\\\\\|    0 |                                      |\\\\\|\\\\\|   0 |                       |
|                       |    0 |\\\\\\|\\\\\\|                                      |   0 |\\\\\|\\\\\|                       |
|                       |\\\\\\|    0 |\\\\\\|                                      |\\\\\|   0 |\\\\\|                       |
|                       |\\\\\\|\\\\\\|    0 |                                      |\\\\\|\\\\\|   0 |                       |
|                       |    0 |\\\\\\|\\\\\\|                                      |   0 |\\\\\|\\\\\|                       |
|                       |\\\\\\|    0 |\\\\\\|                                      |\\\\\|   0 |\\\\\|                       |
|                       |\\\\\\|\\\\\\|    0 |                                      |\\\\\|\\\\\|   0 |                       |
|__________________________________________________________________________________________________________________|
|                                                                                                                  |
|                0   14 |    0 |\\\\\\|\\\\\\|      |     |S.F. | |S.F.  |     |     |   0 |\\\\\|\\\\\|                0   14 |
|----------     0   14 |\\\\\\|    0 |\\\\\\|----- |-----|S.F. | |S.F.  |-----|-----|\\\\\|   0 |\\\\\|----------     0   14 |
|----------     0   14 |\\\\\\|\\\\\\|    0 |----- |-----|S.F. | |S.F.  |-----|-----|\\\\\|\\\\\|   0 |----------     0   14 |
|__________________________________________________________________________________________________________________|
```

Panel 1L1



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VOLTS L/N	120			DEPTH(IN.)	5.75
VOLTS PH.	208	<------AIC RATING------>	PANEL : 1L1	SECTIONS	2
PHASE	3	SERIES RATED : N/A KA(*)	MLO(***): _____	SECTION WIDTH(IN.)	20
MOUNTING	SURF	FULLY RATED : 10 KA	MCB : 450	PLUG-IN	YES
TYPE	NQOD	(*)NOTE: MAY REQUIRE FULL	SH. TRIP : _____	BOLT-ON	N/A
MFR	SQ D	RATING TO ACHIEVE.	BUS : COPPER	NEMA 3R	_____

GENERAL NOTES:
(1) ALL C.B.'S FEEDING HVAC EQUIPMENT TO BE HACR TYPE.
(2) ALL C.B.'S FEEDING ELEV. EQUIP. TO BE SHUNT-TRIP TYPE.
(3) ALL C.B.'S FEEDING ELEV. EQUIP. TO BE SIZED AS REQUIRED BY MFR.
(4) ALL C.B.'S FEEDING HID LTG TO BE HID RATED.

_____ NOTE: NON-LINEAR PNL, 200% NEUTRAL
_____ NOTE: ISOLATED GROUND BUS
_____ NOTE: SHUNT TRIP C.B.
_____ NOTE: GFI C.B.
_____ NOTE: SIZE CB PER MFR. RECOMMENDATIONS.

349	:	TOTAL AMPS A PHASE	(***) NOTE: SIZE SHOWN IS MINIMUM	MAIN SERVICE : NO		
327	:	TOTAL AMPS B PHASE	ACCEPTABLE MLO AMPERAGE, INCREASE	ACTUAL CONN. LOAD	117	324 AMPS
324	:	TOTAL AMPS C PHASE	SIZE IF REQUIRED FOR QUANTITY OF	NEC LOAD/DEMAND	104	290 AMPS
NONE	:	ERROR CODE	POLES.	NEC DIVERSITY	104	290 AMPS
				XFMR KVA : 150		

DESCRIPTION	LOAD CONN	TYPE	AMPS	C.B. AMPS	IC.B POLE	CKT. NO.	CKT. NO.	IC.B. POLE	C.B. AMPS	AMPS	AMPS	AMPS	DESCRIPTION	LOAD CONN	TYPE
RECEPTS	6	4	9	20	1	1	2	1	20	9			RECEPTS	6	4
RECEPTS	6	4	9	20	1	3	4	1	20		11		RECEPTS	7	4
RECEPTS	6	4	9	20	1	5	6	1	20			9	RECEPTS	6	4
WASH/DRYER	21	5	21	30	2	7	8	1	20	9			RECEPTS	6	4
	21	5	21			9	10	1	20		9		RECEPTS	6	4
REFRIG	10	5	10	20	1	11	12	1	20			11	RECEPTS	7	4
RECEPTS	6	4	9	20	1	13	14	1	20	9			RECEPTS	6	4
RECEPTS	7	4	11	20	1	15	16	1	20		8		RECEPTS	5	4
RECEPTS	7	4	11	20	1	17	18	1	20			9	RECEPTS	6	4
RECEPTS	6	4	9	20	1	19	20	1	20	9			RECEPTS	6	4
RECEPTS	6	4	9	20	1	21	22	1	20		0		SPARE	0	
RECEPTS	6	4	9	20	1	23	24	1	20			0	SPARE	0	
RECEPTS	5	4	8	20	1	25	26	1	20	8			RECEPTS	5	4
RECEPTS	6	4	9	20	1	27	28	1	20		10		COPIER	10	5
RECEPTS	6	4	9	20	1	29	30	1	20			10		10	5
REFRIG	10	5	10	20	1	31	32	1	20	6			RECEPTS	4	4
RECEPTS	5	4	8	20	1	33	34	1	20		0		SPARE	0	
RECEPTS	6	4	9	20	1	35	36	1	20			0	SPARE	0	
RECEPTS	3	4	5	20	1	37	38	1	20	8			RECEPTS	5	4
SPARE	0		0	20	1	39	40	1	20		8		RECEPTS	5	4
SPARE	0		0	20	1	41	42	1	20			9	RECEPTS	6	4
	0	14	0			S.F.	S.F.			0				0	14
	0	14	0			S.F.	S.F.				0			0	14
	0	14	0			S.F.	S.F.					0		0	14

DESCRIPTION 1L1	LOAD CONN	TYPE	AMPS	C.B. AMPS	IC.B POLE	CKT. NO.	CKT. NO.	IC.B. POLE	C.B. AMPS	AMPS	AMPS	AMPS	DESCRIPTION	LOAD CONN	TYPE
RECEPTS	5	4	8	20	1	43	44	1	20	8			RECEPTS	5	4
RECEPTS	5	4	8	20	1	45	46	1	20		10		ROLL UP DR	10	5
DISP CASE	8	5	8	20	1	47	48	1	20			10	ROLL UP DR	10	5
DISP CASE	8	5	8	20	1	49	50	1	20	10			PROJ SCRN	10	5
EWC	8	5	8	20	1	51	52	1	20		10		ROLL UP DR	10	5
RECEPTS	6	4	9	20	1	53	54	1	20			0	SPARE	0	
BCS PNL	5	5	5	20	1	55	56	1	20	5			BCS PNL	5	5
BAS CONT	5	5	5	20	1	57	58	1	20		5		BAS CONT.	5	5
SPOT LTG	200	2	2	20	1	59	60	1	20			3	FLAM STOR LT	300	2
EF-2	6	9	6	15	1	61	62	1	20	0			SPARE	0	
EF-3	4	9	4	15	1	63	64	1	20		7		LIGHTS	800	2
EF-10	4	9	4	15	1	65	66	1	20			0	SPARE	0	
ELEV/PIT	5	5	5	20	1	67	68	1	20	8			CLASS	8	5
ELEV/CAB	3	5	3	20	1	69	70	1	20		5		TRACK LTG	600	2
ELEV/CONT	5	5	5	20	1	71	72	1	20			5	TRACK LTG	600	2
IRRIG. CTRL	8	5	8	20	1	73	74	1	20	5			TRACK LTG	600	2
CH-1 HT	5	5	5	20	1	75	76	1	20		5		TRACK LTG	600	2
CH-1 CTRL	5	5	5	20	1	77	78	1	20			5	TRACK LTG	600	2
CH-2 HT	5	5	5	20	1	79	80	1	20	5			TRACK LTG	600	2
CH-2 CTRL	5	5	5	20	1	81	82	1	20		0		SPARE	0	
SPARE	0		0	20	1	83	84	1	20			0	SPARE	0	
PANEL 1LC1	137	14	137	175	3	S.F.	S.F.			0				0	14
	137	14	37			S.F.	S.F.				0			0	14
	137	14	137			S.F.	S.F.					0		0	14

Feeder Sizing Worksheet

Panel Worksheet for Panel 1H1

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	1H1	Panel Location:	RM 01-141		
Nominal Phase to Neutral Voltage------->	277	Phase:	3		
Nominal Phase to Phase Voltage-------->	480	Wires:	4		

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	GEN. LTG.	3	CLASS	3660	w	1.00	3660	3660	
2	A	GEN. LTG.	3	CLASS	3125	w	1.00	3125	3125	
3	B	GEN. LTG.	3	ART	3200	w	1.00	3200	3200	
4	B	GEN. LTG.	3	CLASS	3290	w	1.00	3290	3290	
5	C	GEN. LTG.	3	CLASS	3555	w	1.00	3555	3555	
6	C	GEN. LTG.	3	MEDIA	2530	w	1.00	2530	2530	
7	A	GEN. LTG.	3	MEDIA	2440	w	1.00	2440	2440	
8	A	GEN. LTG.	3	MEDIA	3740	w	1.00	3740	3740	
9	B	GEN. LTG.	3	LOBBY	2870	w	1.00	2870	2870	
10	B	GEN. LTG.	3	CLASS	2935	w	1.00	2935	2935	
11	C	GEN. LTG.	4	LOBBY	475	w	1.00	475	475	
12	C	HALL LTG.	3	CORR.	2785	w	1.00	2785	2785	
13	A	GEN. LTG.	3	LOBBY	324	w	1.00	324	324	
14	A	HALL LTG.	3	CORR.	3085	w	1.00	3085	3085	
15	B	EXTR. LTG	3	EXTERIOR	1980	w	1.00	1980	1980	
16	B	EXTR. LTG	4	EXTERIOR	4030	w	1.00	4030	4030	
17	C	GEN. LTG.	3	MULTI	438	w	1.00	438	438	
18	C	EXTR. LTG	4	EXTERIOR	4340	w	1.00	4340	4340	
19	A	GEN. LTG.	3	MULTI.	740	w	1.00	740	740	
20	A	EXTR. LTG	4	EXTERIOR	3472	w	1.00	3472	3472	
21	B	SPARE			3601	w	1.00	3601	3601	
22	B	EXTR. LTG	4	EXTERIOR	3580	w	1.00	3580	3580	
23	C	SPARE			3601	w	1.00	3601	3601	
24	C	SCHOOL SIGN	9	EXTERIOR	500	w	1.00	500	500	
25	A	SPARE			3601	w	1.00	3601	3601	
26	A	SPARE			3601	w	1.00	3601	3601	
27	B	SPARE			3601	w	1.00	3601	3601	
28	B	SPARE			3601	w	1.00	3601	3601	
29	C	SPARE			3601	w	1.00	3601	3601	
30	C	SPARE			3601	w	1.00	3601	3601	
31	A	SPACE			2770	w	1.00	2770	2770	
32	A	SPARE			3601	w	1.00	3601	3601	
33	B	SPACE			2770	w	1.00	2770	2770	

34	B	SPARE			3601	w	1.00	3601	3601	
35	C	SPACE			2770	w	1.00	2770	2770	
36	C	SPARE			3604	w	1.00	3604	3604	
37	A	SPACE			2770	w	1.00	2770	2770	
38	A	SPACE			2770	w	1.00	2770	2770	
39	B	SPACE			2770	w	1.00	2770	2770	
40	B	SPACE			2770	w	1.00	2770	2770	
41	C	SPACE			2770	w	1.00	2770	2770	
42	C	SPACE			2770	w	1.00	2770	2770	
PANEL TOTAL								121.6	121.6	Amps= 146.4

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					39.7	39.7	33%	143.3
PHASE TOTAL	B					44.6	44.6	37%	161.0
PHASE TOTAL	C					37.3	37.3	31%	134.8

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		40.7	40.7	1.25	50.9	50.9	1.00		
4	HID lighting		15.9	15.9	1.25	19.9	19.9	1.00		
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		65.0	65.0	1.00	65.0	65.0	1.00		
Total Demand Loads						135.8	135.8			
Spare Capacity			0%			0.0	0.0			
Total Design Loads						135.8	135.8	1.00	Amps=	163.4

Default Power Factor =	1.00	
Default Demand Factor =	100	%

Revised Panelboard 1H1

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	1H1	MIN. C/B AIC:	65K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	RM 01-141	OPTIONS:	
SIZE/TYPE MAIN:	225A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
GEN. LTG.	CLASS	3660	20A/1P	1	*			2	20A/1P	3125	CLASS	GEN. LTG.
GEN. LTG.	ART	3200	20A/1P	3		*		4	20A/1P	3290	CLASS	GEN. LTG.
GEN. LTG.	CLASS	3555	20A/1P	5			*	6	20A/1P	2530	MEDIA	GEN. LTG.
GEN. LTG.	MEDIA	2440	20A/1P	7	*			8	20A/1P	3740	MEDIA	GEN. LTG.
GEN. LTG.	LOBBY	2870	20A/1P	9		*		10	20A/1P	2935	CLASS	GEN. LTG.
GEN. LTG.	LOBBY	475	20A/1P	11			*	12	20A/1P	2785	CORR.	HALL LTG.
GEN. LTG.	LOBBY	324	20A/1P	13	*			14	20A/1P	3085	CORR.	HALL LTG.
EXTR. LTG	EXTERIOR	1980	20A/1P	15		*		16	20A/1P	4030	EXTERIOR	EXTR. LTG
GEN. LTG.	MULTI	438	20A/1P	17			*	18	20A/1P	4340	EXTERIOR	EXTR. LTG
GEN. LTG.	MULTI	740	20A/1P	19	*			20	20A/1P	3472	EXTERIOR	EXTR. LTG
SPARE		3601	20A/1P	21		*		22	20A/1P	3580	EXTERIOR	EXTR. LTG
SPARE		3601	20A/1P	23			*	24	20A/1P	500	EXTERIOR	SCHOOL SIGN
SPARE		3601	20A/1P	25	*			26	20A/1P	3601		SPARE
SPARE		3601	20A/1P	27		*		28	20A/1P	3601		SPARE
SPARE		3601	20A/1P	29			*	30	20A/1P	3601		SPARE
SPACE		2770		31	*			32	20A/1P	3601		SPARE
SPACE		2770		33		*		34	20A/1P	3601		SPARE
SPACE		2770		35			*	36	20A/1P	3604		SPARE
SPACE		2770		37	*			38		2770		SPACE
SPACE		2770		39		*		40		2770		SPACE
SPACE		2770		41			*	42		2770		SPACE

CONNECTED LOAD (KW) - A Ph.	39.70	TOTAL DESIGN LOAD (KW)	135.79
CONNECTED LOAD (KW) - B Ph.	44.60	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	37.34	TOTAL DESIGN LOAD (AMPS)	163

Panelboard Worksheet for Panel 1HE1

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				1HE1	Panel Location:			RM 01-141A		
Nominal Phase to Neutral Voltage------->				277	Phase:			3		
Nominal Phase to Phase Voltage-------->				480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	HALL LTG.	3	CORR.	1535	w	1.00	1535	1535	
2	A	KITCH/OFFICE	3	KITCH.	2985	w	1.00	2985	2985	
3	B	HALL LTG.	3	CORR.	2898	w	1.00	2898	2898	
4	B	MULTI-PURP	3	MULTI.	804	w	1.00	804	804	
5	C	OFFICE/STOR	3	OFFICE	2705	w	1.00	2705	2705	
6	C	GEN. LTG.	3	LOBBY	694	w	1.00	694	694	
7	A	EXTR. LTG	4	EXTERIOR	3686	w	1.00	3686	3686	
8	A	SPARE	9		3601	w	1.00	3601	3601	
9	B	SPARE	9		3601	w	1.00	3601	3601	
10	B	SPARE	9		3601	w	1.00	3601	3601	
11	C	SPARE	9		3601	w	1.00	3601	3601	
12	C	SPARE	9		3601	w	1.00	3601	3601	
13	A	SPARE	9		3601	w	1.00	3601	3601	
14	A	PANEL 1LEL	9	01-141A	3878	w	1.00	3878	3878	
15	B	SPARE	9		3601	w	1.00	3601	3601	
16	B	PANEL 1LEL	9	01-141A	3878	w	1.00	3878	3878	
17	C	SPARE	9		3601	w	1.00	3601	3601	
18	C	PANEL 1LEL	9	01-141A	3878	w	1.00	3878	3878	
PANEL TOTAL								55.7	55.7	Amps= 67.1

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					19.3	19.3	35%	69.6
PHASE TOTAL	B					18.4	18.4	33%	66.4
PHASE TOTAL	C					18.1	18.1	32%	65.3

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		11.6	11.6	1.25	14.5	14.5	1.00		
4	HID lighting		3.7	3.7	1.25	4.6	4.6	1.00		
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		40.4	40.4	1.00	40.4	40.4	1.00		
Total Demand Loads						59.6	59.6			

Spare Capacity		0%			0.0	0.0			
Total Design Loads					59.6	59.6	1.00	Amps=	71.7

Default Power Factor =	1.00	
Default Demand Factor =	100	%

Revised Panelboard 1HE1

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	1HE1	MIN. C/B AIC:	65K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	RM 01-141A	OPTIONS:	
SIZE/TYPE MAIN:	90A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
HALL LTG.	CORR.	1535	20A/1P	1	*			2	20A/1P	2985	KITCH.	KITCH/OFFICE
HALL LTG.	CORR.	2898	20A/1P	3		*		4	20A/1P	804	MULTI.	MULTI-PURP
OFFICE/STOR	OFFICE	2705	20A/1P	5			*	6	20A/1P	694	LOBBY	GEN. LTG.
EXTR. LTG	EXTERIOR	3686	20A/1P	7	*			8	20A/1P	3601	0	SPARE
SPARE	0	3601	20A/1P	9		*		10	20A/1P	3601	0	SPARE
SPARE	0	3601	20A/1P	11			*	12	20A/1P	3601	0	SPARE
SPARE	0	3601	20A/1P	13	*			14	40A/3P	3878	01-141A	PANEL 1LEL
SPARE	0	3601	20A/1P	15		*		16		3878	01-141A	PANEL 1LEL
SPARE	0	3601	20A/1P	17			*	18		3878	01-141A	PANEL 1LEL

CONNECTED LOAD (KW) - A Ph.	19.29	TOTAL DESIGN LOAD (KW)	59.58
CONNECTED LOAD (KW) - B Ph.	18.38	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	18.08	TOTAL DESIGN LOAD (AMPS)	72

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	1L1	Panel Location:	RM 01-141		
Nominal Phase to Neutral Voltage------->	120	Phase:	3		
Nominal Phase to Phase Voltage-------->	208	Wires:	4		

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
2	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
3	B	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
4	B	RECEPTS	1	CLASS	1260	w	1.00	1260	1260	
5	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
6	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
7	A	WASH/DRYER	8	KITCH	2520	w	1.00	2520	2520	
8	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
9	B	WASH/DRYER	8	KITCH	2520	w	1.00	2520	2520	
10	B	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
11	C	RECEPTS	1	CLASS	1200	w	1.00	1200	1200	
12	C	RECEPTS	1	CLASS	1980	w	1.00	1980	1980	
13	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
14	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
15	B	RECEPTS	1	CLASS	1260	w	1.00	1260	1260	
16	B	RECEPTS	1	CLASS	900	w	1.00	900	900	
17	C	RECEPTS	1	CLASS	1260	w	1.00	1260	1260	
18	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
19	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
20	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
21	B	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
22	B	SPARE	9		1560	w	1.00	1560	1560	
23	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
24	C	SPARE	9		1560	w	1.00	1560	1560	
25	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
26	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
27	B	RECEPTS	1	OFFICE	1080	w	1.00	1080	1080	
28	B	COPIER	8	OFFICE	1200	w	1.00	1200	1200	
29	C	RECEPTS	1	OFFICE	1080	w	1.00	1080	1080	
30	C	COPIER	8	OFFICE	1200	w	1.00	1200	1200	
31	A	REFRIG	8	KITCH	1200	w	1.00	1200	1200	
32	A	RECEPTS	1	CLASS	720	w	1.00	720	720	
33	B	RECEPTS	1	CLASS	900	w	1.00	900	900	
34	B	SPARE	9		1560	w	1.00	1560	1560	
35	C	SPARE	9		1560	w	1.00	1560	1560	
36	C	SPARE	9		1560	w	1.00	1560	1560	

37	A	RECEPTS	1	CLASS	540	w	1.00	540	540	
38	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
39	B	SPARE	9		1560	w	1.00	1560	1560	
40	B	RECEPTS	1	CLASS	900	w	1.00	900	900	
41	C	SPARE	9		1560	w	1.00	1560	1560	
42	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
43	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
44	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
45	B	RECEPTS	1	CLASS	900	w	1.00	900	900	
46	B	ROLL UP DR	8	MEDIA	1200	w	1.00	1200	1200	
47	C	DISP CASE	8	MEDIA	960	w	1.00	960	960	
48	C	ROLL UP DR	8	MEDIA	1200	w	1.00	1200	1200	
49	A	DISP CASE	8	MEDIA	960	w	1.00	960	960	
50	A	PROJ SCREEN	8	MEDIA	1200	w	1.00	1200	1200	
51	B	EWC	7	KITCH	960	w	1.00	960	960	
52	B	ROLL UP DR	8	MEDIA	1200	w	1.00	1200	1200	
53	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
54	C	SPARE	9		1560	w	1.00	1560	1560	
55	A	BCS PNL	8	MECH	600	w	1.00	600	600	
56	A	BCS PNL	8	MECH	600	w	1.00	600	600	
57	B	BAS CONT	8	MECH	600	w	1.00	600	600	
58	B	BAS CONT	8	MECH	600	w	1.00	600	600	
59	C	SPOT LTG	5	MECH	200	w	1.00	200	200	
60	C	FLAM STOR LT	5	MECH	300	w	1.00	300	300	
61	A	EF-2	6		720	w	1.00	720	720	
62	A	SPARE	9	MECH	800	w	1.00	800	800	
63	B	EF-3	6		480	w	1.00	480	480	
64	B	LIGHTS	5	MECH	960	w	1.00	960	960	
65	C	EF-10	6	MECH	480	w	1.00	480	480	
66	C	SPARE	9		600	w	1.00	600	600	
67	A	ELEV/PIT	8	MECH	600	w	1.00	600	600	
68	A	LASS	8	MECH	600	w	1.00	600	600	
69	B	ELEV/CAB	8	MECH	360	w	1.00	360	360	
70	B	TRACK LTG	4	MULTI	140	w	1.00	140	140	
71	C	ELEV/CONT	8	MECH	600	w	1.00	600	600	
72	C	TRACK LTG	4	MULTI	140	w	1.00	140	140	
73	A	IRRIG CTRL	8	MECH	960	w	1.00	960	960	
74	A	TRACK LTG	4	MULTI	140	w	1.00	140	140	
75	B	SPARE	9		1560	w	1.00	1560	1560	
76	B	TRACK LTG	4	MULTI	140	w	1.00	140	140	
77	C	SPARE	9		1560	w	1.00	1560	1560	
78	C	TRACK LTG	4	MULTI	140	w	1.00	140	140	
79	A	PANEL 1LC1	9	01-104	16440	w	1.00	16440	16440	
80	A	TRACK LTG	4	MULTI	140	w	1.00	140	140	
81	B	PANEL 1LC1	9	01-104	16440	w	1.00	16440	16440	

82	B	SPARE	9		1560	w	1.00	1560	1560	
83	C	PANEL 1LC1	9	01-104	16440	w	1.00	16440	16440	
84	C	SPARE	9		1560	w	1.00	1560	1560	
PANEL TOTAL								131.0	131.0	Amps= 363.9

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					40.8	40.8	31%	340.0
PHASE TOTAL	B					45.0	45.0	34%	375.3
PHASE TOTAL	C					45.2	45.2	34%	376.5

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		35.8	35.8	0.64	22.8	22.8	1.00		
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		0.0	0.0		0.0	0.0			
4	HID lighting		0.8	0.8	1.25	1.1	1.1	1.00		
5	incandescent lighting		1.5	1.5	1.25	1.8	1.8	1.00		
6	HVAC fans		1.7	1.7	0.95	1.6	1.6	1.00		
7	heating		1.0	1.0	1.00	1.0	1.0	1.00		
8	kitchen equipment		20.9	20.9	0.65	13.6	13.6	1.00		
9	unassigned		69.4	69.4	1.00	69.4	69.4	1.00		
Total Demand Loads						111.2	111.2			
Spare Capacity			0%			0.0	0.0			
Total Design Loads						111.2	111.2	1.00	Amps=	309

Default Power Factor =	1.00	
Default Demand Factor =	100	%

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 400A
SIZE/TYPE MAIN: 400A/3P C/B

PANEL TAG: 1L1
PANEL LOCATION: RM 01-141
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
RECEPTS	CLASS	1080	20A/1P	1	*			2	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	3		*		4	20A/1P	1260	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	5			*	6	20A/1P	1080	CLASS	RECEPTS
WASH/DRYER	KITCH	2520	30A/2P	7	*			8	20A/1P	1080	CLASS	RECEPTS
WASH/DRYER	KITCH	2520		9		*		10	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1200	20A/1P	11			*	12	20A/1P	1980	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	13	*			14	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1260	20A/1P	15		*		16	20A/1P	900	CLASS	RECEPTS
RECEPTS	CLASS	1260	20A/1P	17			*	18	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	19	*			20	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	21		*		22	20A/1P	1560		SPARE
RECEPTS	CLASS	1080	20A/1P	23			*	24	20A/1P	1560		SPARE
RECEPTS	CLASS	900	20A/1P	25	*			26	20A/1P	900	CLASS	RECEPTS
RECEPTS	OFFICE	1080	20A/1P	27		*		28	20A/1P	1200	OFFICE	COPIER
RECEPTS	OFFICE	1080	20A/1P	29			*	30	20A/1P	1200	OFFICE	COPIER
REFRIG	KITCH	1200	20A/1P	31	*			32	20A/1P	720	CLASS	RECEPTS
RECEPTS	CLASS	900	20A/1P	33		*		34	20A/1P	1560		SPARE
SPARE		1560	20A/1P	35			*	36	20A/1P	1560		SPARE
RECEPTS	CLASS	540	20A/1P	37	*			38	20A/1P	900	CLASS	RECEPTS
SPARE		1560	20A/1P	39		*		40	20A/1P	900	CLASS	RECEPTS
SPARE		1560	20A/1P	41			*	42	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	900	20A/1P	43	*			44	20A/1P	900	CLASS	RECEPTS
RECEPTS	CLASS	900	20A/1P	45		*		46	20A/1P	1200	MEDIA	ROLL UP DR
DISP CASE	MEDIA	960	20A/1P	47			*	48	20A/1P	1200	MEDIA	ROLL UP DR
DISP CASE	MEDIA	960	20A/1P	49	*			50	20A/1P	1200	MEDIA	PROJ SCREEN
EWC	KITCH	960	20A/1P	51		*		52	20A/1P	1200	MEDIA	ROLL UP DR

RECEPTS	CLASS	1080	20A/1P	53			*	54	20A/1P	1560		SPARE
BCS PNL	MECH	600	20A/1P	55	*			56	20A/1P	600	MECH	BCS PNL
BAS CONT	MECH	600	20A/1P	57		*		58	20A/1P	600	MECH	BAS CONT
SPOT LTG	MECH	200	20A/1P	59			*	60	20A/1P	300	MECH	FLAM STOR LT
EF-2		720	15A/1P	61	*			62	20A/1P	800	MECH	SPARE
EF-3		480	15A/1P	63		*		64	20A/1P	960	MECH	LIGHTS
EF-10	MECH	480	15A/1P	65			*	66	20A/1P	600		SPARE
ELEV/PIT	MECH	600	20A/1P	67	*			68	20A/1P	600	MECH	LASS
ELEV/CAB	MECH	360	20A/1P	69		*		70	20A/1P	140	MULTI	TRACK LTG
ELEV/CONT	MECH	600	20A/1P	71			*	72	20A/1P	140	MULTI	TRACK LTG
IRRIG CTRL	MECH	960	20A/1P	73	*			74	20A/1P	960	MULTI	TRACK LTG
SPARE		1560	20A/1P	75		*		76	20A/1P	140	MULTI	TRACK LTG
SPARE		1560	20A/1P	77			*	78	20A/1P	140	MULTI	TRACK LTG
PANEL 1LC1	01-104	16440	20A/1P	79	*			80	20A/1P	140	MULTI	TRACK LTG
PANEL 1LC1	01-104	16440	20A/1P	81		*		82	20A/1P	1560		SPARE
PANEL 1LC1	01-104	16440	20A/1P	83			*	84	20A/1P	1560		SPARE

CONNECTED LOAD (KW) - A Ph.	40.80	TOTAL DESIGN LOAD (KW)	111.22
CONNECTED LOAD (KW) - B Ph.	45.04	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	45.18	TOTAL DESIGN LOAD (AMPS)	309

Feeder Sizing

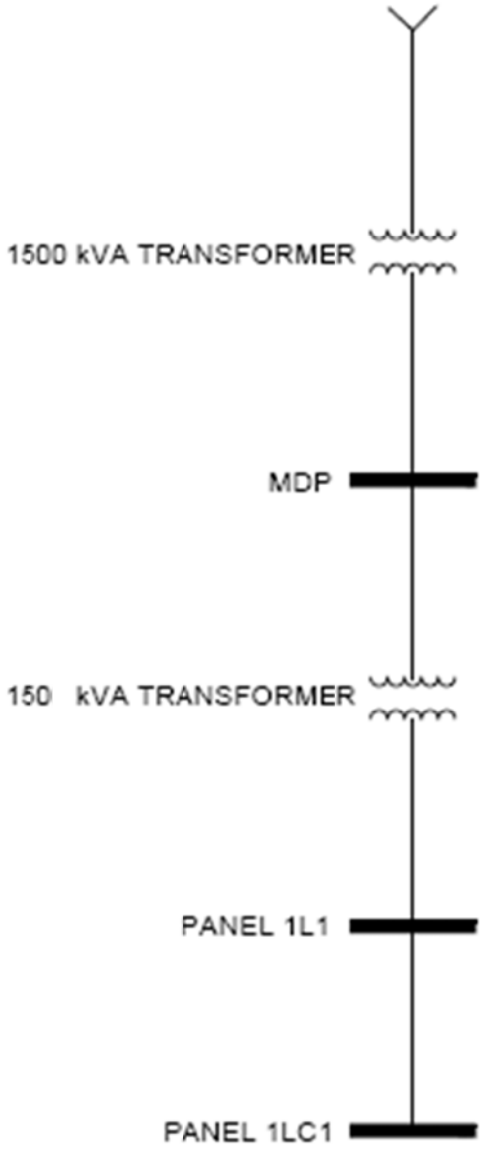
Panelboards			
Tag	Panel 1H1	Panel 1HE1	Panel 1L1
Voltage System	480/277	480/277	208/120
Calculated Design Load (kW)	135.8	59.6	111.2
Calculated Power Factor	1.00	1.00	1.0
Calculated Design Load (kVA)	135.8	59.6	111.2
Calculated Design Load (A)	163.4	71.7	309
Feeder			
Feeder Protection Size			
Number of Sets	1	1	2
Wire Size			
Phase	#3/0 AWG	#3 AWG	#3/0 AWG
Neutral	#3/0 AWG	#3 AWG	#3/0 AWG
Ground	#4 AWG	#8 AWG	#4 AWG
Wire Area			
Each Phase	0.2679	0.0973	0.3970
Total – All phases	0.8037	0.2919	2.382
Neutral	0.2679	0.0973	0.794
Ground	0.0824	0.0366	0.2316
Total – All Wires	1.154	0.4258	3.4076
Minimum Conduit Area	2.885	1.065	8.519
Conduit Size	2.00" RMC	1.25" RMC	3.00" RMC
Conduit Size (Table C.1)	2.00" RMC	1.00" RMC	2.50" RMC
Feeder Length	23'-6"	19'-10"	26'-6"
Final Voltage Drop (V)	0.625	0.591	0.717
Final Voltage Drop (%)	0.130	0.123	0.344
Was feeder re-sized?	Yes	Yes	Yes

Panelboard

Panel Specifications can be found in Appendix A

Overcurrent Device Coordination Study and Short Circuit

Determine whether the protection devices in this electrical system are important components required by NEC. Short circuit calculations are performed to determine whether the protective devices are sufficient. Short-circuit is the highest amperage that a device can run at. Therefore, NEC requires that the overcurrent device be able to endure this worst case scenario. The following information will determine the short circuit current of various segments of the electrical system. The following diagram shows the path that is examined to determine the available faults at various sections of this system. A coordination study is performed for the circuit breakers along the path examined.



Available fault at Secondary of Utility Transformer to MDP			
Inputs		**Outputs**	
System Voltage (V_{L-L})	480	$I_{FLA}=(KVA*1000)/(V_{L-L}*\sqrt{3})$	1804.22
Line Neutral Voltage (V_{L-N})	277	$I_{L-L-L}=)(I_{FLA}*100)/(Z))/PF$	53065.28
Utility Transformer (KVA)	1500	$f=(\sqrt{3}*L*I_{L-L-L})/(C*n*V_{L-L})$	0.053945
X/R Ratio	12	M=1/(1+f)	0.948816
Impedance(Z) in %	4		
Length (L) in ft.	50		
Number of Sets (n)	8		
Phase Conductor	500 kcmil		
Neutral Conductor	500 kcmil		
Conductor Constant	22,185		
Power Factor (PF)	0.85	**$I_{SCA-1}=I_{L-L-L}*M$**	**50349.2**
Available fault at MDP to Transformer 1L1			
Inputs		**Outputs**	
System Voltage (V_{L-L})	480	$f=(\sqrt{3}*L*I_{SCA-1})/(C*n*V_{L-L})$	0.424359
Line Neutral Voltage (V_{L-N})	277	M=1/(1+f)	0.70207
Length (L) in ft.	30		
Number of Sets (n)	1		
Phase Conductor	#3/0		
Neutral Conductor	#3/0		
Conductor Constant	12,844	**$I_{SCA-2}=I_{SCA-1}*M$**	**35348.68**
Available Fault at Transformer 1L1 to Panel 1L1			
Inputs		**Outputs**	
System Voltage (V_{L-L})	208	$f=(I_{SCA2}*V_P*\sqrt{3}*Z)/(100000*KVA)$	8.836095
Line Neutral Voltage (V_{L-N})	120	M=1/(1+f)	0.101666
Transformer (KVA)	150		
Impedance(Z) in %	4.51		
Length (L) in ft.	20		
Number of Sets (n)	2		
Phase Conductor	#3/0		
Neutral Conductor	#3/0		
Conductor Constant	12,844	**$I_{SCA-3}=(V_P/V_S)*M*I_{SCA-2}$**	**8293.32**

Available fault at PNL 1L1 To Panel 1LC1			
System Voltage (V_{L-L})	208	$f=(\sqrt{3}*L*I_{SCA-1})/(C*n*V_{L-L})$	0.161305
Line Neutral Voltage (V_{L-N})	120	M=1/(1+f)	0.861101
Length (L) in ft.	30		
Number of Sets (n)	1		
Phase Conductor	#3/0		
Neutral Conductor	#3/0		
Conductor Constant	12,844	**$I_{SCA-4}=I_{SCA-1}*M$**	**7141.382**

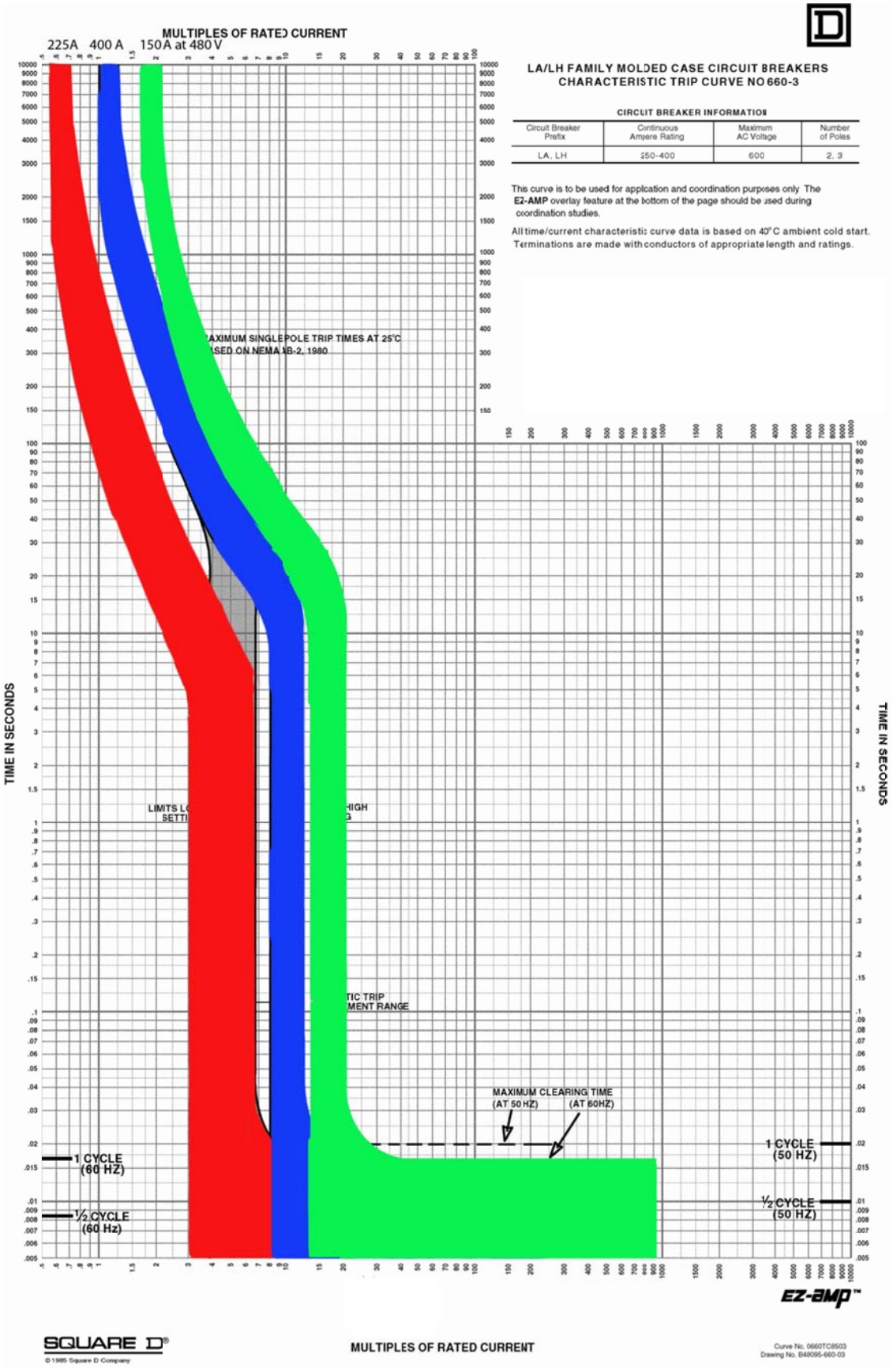
Short Circuit Study Results

Location	Available Fault	Existing AIC Rating	Standard Rating
MDP	50349 A	65 kA	60kA
Panel 1L1	8293 A	10kA	10kA
Panel 1LC1	7141 A	10 kA	10kA

Based on the analysis above, the existing design will protect the fault current. In the study conducted, panel 1L1 and Panel 1LC1 will have the same AIC Rating that currently exists. However, the calculations show that the AIC Rating of the MDP could decrease from 65kA to 60 kA.

Over-Current Device Coordination Study

The trip curves for the selected coordination devices have been are shown in the diagram below on the same graph to show their coordination. The 225A and 400A circuit breakers are 120/208V and the 150A breaker is 277/480V. The variation in voltage was needed to determine the proper location of each trip curve. The downstream 225A breaker will trip first followed by the upstream 400A breaker and the 150A breaker. The 400A breaker and the 150A breaker have a slight overlap and therefore are not completely coordinated but this is not an issue since they both feed the same load and when either breaker trips the power is lost to the load. The trip curves for these breakers are located in Appendix A.


MULTIPLES OF RATED CURRENT
225A 400 A 150A at 480 V
LA/LH FAMILY MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO 660-3
CIRCUIT BREAKER INFORMATION
Circuit Breaker Prefix
Continuous Ampere Rating
Maximum AC Voltage
Number of Poles
LA, LH
250-400
600
2, 3
This curve is to be used for application and coordination purposes only. The EZ-AMP overlay feature at the bottom of the page should be used during coordination studies.
All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.
TIME IN SECONDS
MAXIMUM CLEARING TIME
(AT 50 HZ) (AT 60HZ)
1 CYCLE (60 HZ)
½ CYCLE (60 Hz)
1 CYCLE (50 HZ)
½ CYCLE (50 HZ)
EZ-AMP™
SQUARE D®
©1985 Square D Company
MULTIPLES OF RATED CURRENT
Curve No. 0660TC8503
Drawing No. B48095-660-03

Electrical Depth #1: Emergency System Redesign

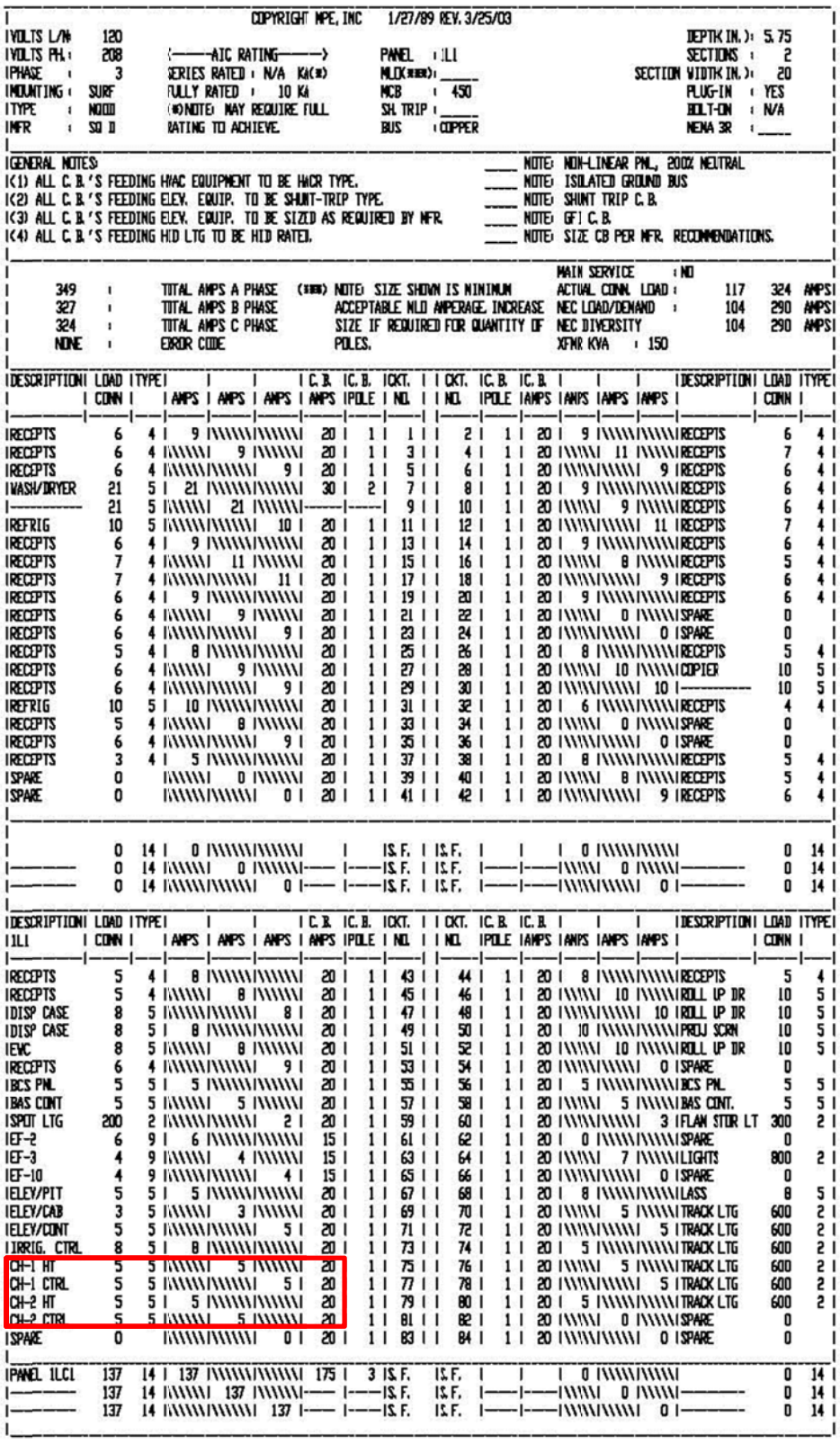
Emergency System Redesign

In addition to this building being an elementary school, it is used as an emergency shelter for the surrounding community. The majority of this time the emergency shelter will be used is during hurricane season, which takes place during the summer months. In terms of air circulation, the emergency system currently only has the fans from the air handling units fed from the emergency generator. Since the conditions during this time of the year in Florida are harsh, it might be beneficial to include the two chillers on the emergency system so that cool air may be circulated through the emergency shelter. This has the added benefit of providing humidity control during the power outage.

Currently the chillers are directly fed from the utility transformer. The redesign will allow the chillers to be fed from the generator. The chiller controls will be moved from a normal panel to an emergency panel and these panels and their branches will be resized.

Moving Chiller Controls to the Emergency System

There are four circuits on Panel 1L1 that are controls for the two chillers. These four circuits will be removed from this panel and moved to emergency equipment branch Panel 1LQ1. The four circuits removed from Panel 1L1 are outlined in red in the existing Panel Schedule below.



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VOLTS L/N	120			DEPTH IN.)	5.75
VOLTS PH.	208	<——AIC RATING——>	PANEL 1LC1	SECTIONS	2
PHASE	3	SERIES RATED N/A KA(##)	MLO(####) ____	SECTION WIDTH IN.)	20
MOUNTING	SURF	FULLY RATED 10 KA	MCB 450	PLUG-IN	YES
TYPE	NQOD	(##)NOTE: MAY REQUIRE FULL	SH. TRIP ____	BOLT-ON	N/A
MFR	SQ D	RATING TO ACHIEVE.	BUS COPPER	NEMA 3R	____

GENERAL NOTES:
(1) ALL C.B.'S FEEDING HVAC EQUIPMENT TO BE HACR TYPE.
(2) ALL C.B.'S FEEDING ELEV. EQUIP. TO BE SHUNT-TRIP TYPE.
(3) ALL C.B.'S FEEDING ELEV. EQUIP. TO BE SIZED AS REQUIRED BY MFR.
(4) ALL C.B.'S FEEDING HID LTG TO BE HID RATED.

____ NOTE: NON-LINEAR PNL, 200% NEUTRAL
____ NOTE: ISOLATED GROUND BUS
____ NOTE: SHUNT TRIP C.B.
____ NOTE: GFI C.B.
____ NOTE: SIZE CB PER MFR. RECOMMENDATIONS.

349	TOTAL AMPS A PHASE	(###) NOTE: SIZE SHOWN IS MINIMUM	MAIN SERVICE	NO		
327	TOTAL AMPS B PHASE	ACCEPTABLE NLO AMPERAGE INCREASE	ACTUAL CONN. LOAD	117	324	AMPS
324	TOTAL AMPS C PHASE	SIZE IF REQUIRED FOR QUANTITY OF	NEC LOAD/DEMAND	104	290	AMPS
NONE	ERROR CODE	POLES.	NEC DIVERSITY	104	290	AMPS
			XFMR KVA 150			

DESCRIPTION	LOAD CONN	TYPE	AMPS	AMPS	AMPS	C.B. AMPS	C.B. POLE	CKT. NO.	CKT. NO.	C.B. POLE	C.B. AMPS	AMPS	AMPS	AMPS	DESCRIPTION	LOAD CONN	TYPE
RECEPTS	6	4	9			20	1	1	2	1	20	9			RECEPTS	6	4
RECEPTS	6	4		9		20	1	3	4	1	20		11		RECEPTS	7	4
RECEPTS	6	4			9	20	1	5	6	1	20			9	RECEPTS	6	4
WASH/DRYER	21	5	21			30	2	7	8	1	20	9			RECEPTS	6	4
————	21	5		21		————	————	9	10	1	20		9		RECEPTS	6	4
REFRIG	10	5			10	20	1	11	12	1	20			11	RECEPTS	7	4
RECEPTS	6	4	9			20	1	13	14	1	20	9			RECEPTS	6	4
RECEPTS	7	4		11		20	1	15	16	1	20		8		RECEPTS	5	4
RECEPTS	7	4			11	20	1	17	18	1	20			9	RECEPTS	6	4
RECEPTS	6	4	9			20	1	19	20	1	20	9			RECEPTS	6	4
RECEPTS	6	4		9		20	1	21	22	1	20		0		SPARE	0	
RECEPTS	6	4			9	20	1	23	24	1	20			0	SPARE	0	
RECEPTS	5	4	8			20	1	25	26	1	20	8			RECEPTS	5	4
RECEPTS	6	4		9		20	1	27	28	1	20		10		COPIER	10	5
RECEPTS	6	4			9	20	1	29	30	1	20			10	————	10	5
REFRIG	10	5	10			20	1	31	32	1	20	6			RECEPTS	4	4
RECEPTS	5	4		8		20	1	33	34	1	20		0		SPARE	0	
RECEPTS	6	4			9	20	1	35	36	1	20			0	SPARE	0	
RECEPTS	3	4	5			20	1	37	38	1	20	8			RECEPTS	5	4
SPARE	0			0		20	1	39	40	1	20		8		RECEPTS	5	4
SPARE	0				0	20	1	41	42	1	20			9	RECEPTS	6	4
	0	14	0					I.S.F.	I.S.F.			0				0	14
————	0	14		0		————	————	I.S.F.	I.S.F.	————	————		0		————	0	14
————	0	14			0	————	————	I.S.F.	I.S.F.	————	————			0	————	0	14

DESCRIPTION 1LC1	LOAD CONN	TYPE	AMPS	AMPS	AMPS	C.B. AMPS	C.B. POLE	CKT. NO.	CKT. NO.	C.B. POLE	C.B. AMPS	AMPS	AMPS	AMPS	DESCRIPTION	LOAD CONN	TYPE
RECEPTS	5	4	8			20	1	43	44	1	20	8			RECEPTS	5	4
RECEPTS	5	4		8		20	1	45	46	1	20		10		ROLL UP DR	10	5
DISP CASE	8	5			8	20	1	47	48	1	20			10	ROLL UP DR	10	5
DISP CASE	8	5	8			20	1	49	50	1	20	10			PROJ SCRN	10	5
EWC	8	5		8		20	1	51	52	1	20		10		ROLL UP DR	10	5
RECEPTS	6	4			9	20	1	53	54	1	20			0	SPARE	0	
BCS PNL	5	5	5			20	1	55	56	1	20	5			BCS PNL	5	5
BAS CONT	5	5		5		20	1	57	58	1	20		5		BAS CONT.	5	5
SPOT LTG	200	2			2	20	1	59	60	1	20			3	FLAN STOR LT	300	2
EF-2	6	9	6			15	1	61	62	1	20	0			SPARE	0	
EF-3	4	9		4		15	1	63	64	1	20		7		LIGHTS	800	2
EF-10	4	9			4	15	1	65	66	1	20			0	SPARE	0	
ELEV/PIT	5	5	5			20	1	67	68	1	20	8			LASS	8	5
ELEV/CAB	3	5		3		20	1	69	70	1	20		5		TRACK LTG	600	2
ELEV/CONT	5	5			5	20	1	71	72	1	20			5	TRACK LTG	600	2
IRRIG. CTRL	8	5	8			20	1	73	74	1	20	5			TRACK LTG	600	2
CH-1 HT	5	5		5		20	1	75	76	1	20		5		TRACK LTG	600	2
CH-1 CTRL	5	5			5	20	1	77	78	1	20			5	TRACK LTG	600	2
CH-2 HT	5	5	5			20	1	79	80	1	20	5			TRACK LTG	600	2
CH-2 CTRL	5	5		5		20	1	81	82	1	20		0		SPARE	0	
SPARE	0				0	20	1	83	84	1	20			0	SPARE	0	
PANEL 1LC1	137	14	137			175	3	I.S.F.	I.S.F.			0				0	14
————	137	14		137		————	————	I.S.F.	I.S.F.	————	————		0		————	0	14
————	137	14			137	————	————	I.S.F.	I.S.F.	————	————			0	————	0	14

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	1L1	Panel Location:	RM 01-141		
Nominal Phase to Neutral Voltage------->	120	Phase:	3		
Nominal Phase to Phase Voltage-------->	208	Wires:	4		

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
2	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
3	B	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
4	B	RECEPTS	1	CLASS	1260	w	1.00	1260	1260	
5	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
6	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
7	A	WASH/DRYER	8	KITCH	2520	w	1.00	2520	2520	
8	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
9	B	WASH/DRYER	8	KITCH	2520	w	1.00	2520	2520	
10	B	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
11	C	RECEPTS	1	CLASS	1200	w	1.00	1200	1200	
12	C	RECEPTS	1	CLASS	1980	w	1.00	1980	1980	
13	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
14	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
15	B	RECEPTS	1	CLASS	1260	w	1.00	1260	1260	
16	B	RECEPTS	1	CLASS	900	w	1.00	900	900	
17	C	RECEPTS	1	CLASS	1260	w	1.00	1260	1260	
18	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
19	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
20	A	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
21	B	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
22	B	SPARE	9		1560	w	1.00	1560	1560	
23	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
24	C	SPARE	9		1560	w	1.00	1560	1560	
25	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
26	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
27	B	RECEPTS	1	OFFICE	1080	w	1.00	1080	1080	
28	B	COPIER	8	OFFICE	1200	w	1.00	1200	1200	
29	C	RECEPTS	1	OFFICE	1080	w	1.00	1080	1080	
30	C	COPIER	8	OFFICE	1200	w	1.00	1200	1200	
31	A	REFRIG	8	KITCH	1200	w	1.00	1200	1200	
32	A	RECEPTS	1	CLASS	720	w	1.00	720	720	
33	B	RECEPTS	1	CLASS	900	w	1.00	900	900	
34	B	SPARE	9		1560	w	1.00	1560	1560	
35	C	SPARE	9		1560	w	1.00	1560	1560	
36	C	SPARE	9		1560	w	1.00	1560	1560	

37	A	RECEPTS	1	CLASS	540	w	1.00	540	540	
38	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
39	B	SPARE	9		1560	w	1.00	1560	1560	
40	B	RECEPTS	1	CLASS	900	w	1.00	900	900	
41	C	SPARE	9		1560	w	1.00	1560	1560	
42	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
43	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
44	A	RECEPTS	1	CLASS	900	w	1.00	900	900	
45	B	RECEPTS	1	CLASS	900	w	1.00	900	900	
46	B	ROLL UP DR	8	MEDIA	1200	w	1.00	1200	1200	
47	C	DISP CASE	8	MEDIA	960	w	1.00	960	960	
48	C	ROLL UP DR	8	MEDIA	1200	w	1.00	1200	1200	
49	A	DISP CASE	8	MEDIA	960	w	1.00	960	960	
50	A	PROJ SCREEN	8	MEDIA	1200	w	1.00	1200	1200	
51	B	EWC	7	KITCH	960	w	1.00	960	960	
52	B	ROLL UP DR	8	MEDIA	1200	w	1.00	1200	1200	
53	C	RECEPTS	1	CLASS	1080	w	1.00	1080	1080	
54	C	SPARE	9		1560	w	1.00	1560	1560	
55	A	BCS PNL	8	MECH	600	w	1.00	600	600	
56	A	BCS PNL	8	MECH	600	w	1.00	600	600	
57	B	BAS CONT	8	MECH	600	w	1.00	600	600	
58	B	BAS CONT	8	MECH	600	w	1.00	600	600	
59	C	SPOT LTG	5	MECH	200	w	1.00	200	200	
60	C	FLAM STOR LT	5	MECH	300	w	1.00	300	300	
61	A	EF-2	6		720	w	1.00	720	720	
62	A	SPARE	9	MECH	800	w	1.00	800	800	
63	B	EF-3	6		480	w	1.00	480	480	
64	B	LIGHTS	5	MECH	960	w	1.00	960	960	
65	C	EF-10	6	MECH	480	w	1.00	480	480	
66	C	SPARE	9		600	w	1.00	600	600	
67	A	ELEV/PIT	8	MECH	600	w	1.00	600	600	
68	A	LASS	8	MECH	600	w	1.00	600	600	
69	B	ELEV/CAB	8	MECH	360	w	1.00	360	360	
70	B	TRACK LTG	4	MULTI	140	w	1.00	140	140	
71	C	ELEV/CONT	8	MECH	600	w	1.00	600	600	
72	C	TRACK LTG	4	MULTI	140	w	1.00	140	140	
73	A	IRRIG CTRL	8	MECH	960	w	1.00	960	960	
74	A	TRACK LTG	4	MULTI	140	w	1.00	140	140	
75	B	SPARE	9		1560	w	1.00	1560	1560	
76	B	TRACK LTG	4	MULTI	140	w	1.00	140	140	
77	C	SPARE	9		1560	w	1.00	1560	1560	
78	C	TRACK LTG	4	MULTI	140	w	1.00	140	140	
79	A	PANEL 1LC1	9	01-104	16440	w	1.00	16440	16440	

80	A	TRACK LTG	4	MULTI	140	w	1.00	140	140	
81	B	PANEL 1LC1	9	01-104	16440	w	1.00	16440	16440	
82	B	SPARE	9		1560	w	1.00	1560	1560	
83	C	PANEL 1LC1	9	01-104	16440	w	1.00	16440	16440	
84	C	SPARE	9		1560	w	1.00	1560	1560	
PANEL TOTAL								131.0	131.0	Amps= 1091.8

PHASE LOADING								
		kW	kVA	%	Amps			
PHASE TOTAL	A	40.8	40.8	31%	340.0			
PHASE TOTAL	B	45.0	45.0	34%	375.3			
PHASE TOTAL	C	45.2	45.2	34%	376.5			

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		35.8	35.8	0.64	22.8	22.8	1.00		
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		0.0	0.0		0.0	0.0			
4	HID lighting		0.8	0.8	1.25	1.1	1.1	1.00		
5	incandescent lighting		1.5	1.5	1.25	1.8	1.8	1.00		
6	HVAC fans		1.7	1.7	0.95	1.6	1.6	1.00		
7	heating		1.0	1.0	1.00	1.0	1.0	1.00		
8	kitchen equipment		20.9	20.9	0.65	13.6	13.6	1.00		
9	unassigned		69.4	69.4	1.00	69.4	69.4	1.00		
Total Demand Loads						111.2	111.2			
Spare Capacity			0%			0.0	0.0			
Total Design Loads						111.2	111.2	1.00	Amps=	309

Default Power Factor =	0.80	
Default Demand Factor =	100	%

PANELBOARD SCHEDULE

VOLTAGE:	208Y/120V,3PH,4W	PANEL TAG:	1L1	MIN. C/B AIC:	10K
SIZE/TYPE BUS:	400A	PANEL LOCATION:	RM 01-141	OPTIONS:	
SIZE/TYPE MAIN:	400A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
RECEPTS	CLASS	1080	20A/1P	1	*			2	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	3		*		4	20A/1P	1260	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	5			*	6	20A/1P	1080	CLASS	RECEPTS
WASH/DRYER	KITCH	2520	20A/1P	7	*			8	20A/1P	1080	CLASS	RECEPTS
WASH/DRYER	KITCH	2520	20A/1P	9		*		10	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1200	20A/1P	11			*	12	20A/1P	1980	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	13	*			14	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1260	20A/1P	15		*		16	20A/1P	900	CLASS	RECEPTS
RECEPTS	CLASS	1260	20A/1P	17			*	18	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	19	*			20	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	1080	20A/1P	21		*		22	20A/1P	1560		SPARE
RECEPTS	CLASS	1080	20A/1P	23			*	24	20A/1P	1560		SPARE
RECEPTS	CLASS	900	20A/1P	25	*			26	20A/1P	900	CLASS	RECEPTS
RECEPTS	OFFICE	1080	20A/1P	27		*		28	20A/1P	1200	OFFICE	COPIER
RECEPTS	OFFICE	1080	20A/1P	29			*	30	20A/1P	1200	OFFICE	COPIER
REFRIG	KITCH	1200	20A/1P	31	*			32	20A/1P	720	CLASS	RECEPTS
RECEPTS	CLASS	900	20A/1P	33		*		34	20A/1P	1560		SPARE
SPARE		1560	20A/1P	35			*	36	20A/1P	1560		SPARE
RECEPTS	CLASS	540	20A/1P	37	*			38	20A/1P	900	CLASS	RECEPTS
SPARE		1560	20A/1P	39		*		40	20A/1P	900	CLASS	RECEPTS
SPARE		1560	20A/1P	41			*	42	20A/1P	1080	CLASS	RECEPTS
RECEPTS	CLASS	900	20A/1P	43	*			44	20A/1P	900	CLASS	RECEPTS
RECEPTS	CLASS	900	20A/1P	45		*		46	20A/1P	1200	MEDIA	ROLL UP DR
DISP CASE	MEDIA	960	20A/1P	47			*	48	20A/1P	1200	MEDIA	ROLL UP DR
DISP CASE	MEDIA	960	20A/1P	49	*			50	20A/1P	1200	MEDIA	PROJ SCREEN
EWC	KITCH	960	20A/1P	51		*		52	20A/1P	1200	MEDIA	ROLL UP DR

RECEPTS	CLASS	1080	20A/1P	53			*	54	20A/1P	1560		SPARE
BCS PNL	MECH	600	20A/1P	55	*			56	20A/1P	600	MECH	BCS PNL
BAS CONT	MECH	600	20A/1P	57		*		58	20A/1P	600	MECH	BAS CONT
SPOT LTG	MECH	200	20A/1P	59			*	60	20A/1P	300	MECH	FLAM STOR LT
EF-2		720	15A/1P	61	*			62	20A/1P	800	MECH	SPARE
EF-3		480	15A/1P	63		*		64	20A/1P	960	MECH	LIGHTS
EF-10	MECH	480	15A/1P	65			*	66	20A/1P	600		SPARE
ELEV/PIT	MECH	600	20A/1P	67	*			68	20A/1P	600	MECH	LASS
ELEV/CAB	MECH	360	20A/1P	69		*		70	20A/1P	140	MULTI	TRACK LTG
ELEV/CONT	MECH	600	20A/1P	71			*	72	20A/1P	140	MULTI	TRACK LTG
IRRIG CTRL	MECH	960	20A/1P	73	*			74	20A/1P	960	MULTI	TRACK LTG
SPARE		1560	20A/1P	75		*		76	20A/1P	140	MULTI	TRACK LTG
SPARE		1560	20A/1P	77			*	78	20A/1P	140	MULTI	TRACK LTG
PANEL 1LC1	01-104	16440	20A/1P	79	*			80	20A/1P	140	MULTI	TRACK LTG
PANEL 1LC1	01-104	16440	20A/1P	81		*		82	20A/1P	1560		SPARE
PANEL 1LC1	01-104	16440	20A/1P	83			*	84	20A/1P	1560		SPARE

CONNECTED LOAD (KW) - A Ph.	40.80	TOTAL DESIGN LOAD (KW)	111.22
CONNECTED LOAD (KW) - B Ph.	45.04	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	45.18	TOTAL DESIGN LOAD (AMPS)	309

The four circuits removed from Panel 1L1 are being placed on Panel 1LQ1. The circuits affected are highlighted in the existing Panelboard below.

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VOLTS L/N: 120				DEPTH(IN.):	5.75
VOLTS PH.: 208	<------AIC RATING------->	PANEL	: 1LQ1	SECTIONS :	1
PHASE : 3	SERIES RATED : 10 KA(*)	MLO(***):	225	SECTION WIDTH(IN.):	20
MOUNTING : SURF	FULLY RATED : ______KA	MCB	: ______	PLUG-IN :	YES
TYPE : NQOD	(*)NOTE: MAY REQUIRE FULL	SH. TRIP	: ______	BOLT-ON :	N/A
MFR : SQ D	RATING TO ACHIEVE.	BUS	: COPPER	NEMA 3R :	_____

GENERAL NOTES:
(1) ALL C.B.'S FEEDING HVAC EQUIPMENT TO BE HACR TYPE.
(2) ALL C.B.'S FEEDING ELEV. EQUIP. TO BE SHUNT-TRIP TYPE.
(3) ALL C.B.'S FEEDING ELEV. EQUIP. TO BE SIZED AS REQUIRED BY MFR.
(4) ALL C.B.'S FEEDING HID LTG TO BE HID RATED.

_____ NOTE: NON-LINEAR PNL, 200% NEUTRAL
_____ NOTE: ISOLATED GROUND BUS
_____ NOTE: SHUNT TRIP C.B.
_____ NOTE: GFI C.B.
_____ NOTE: SIZE CB PER MFR. RECOMMENDATIONS.

			MAIN SERVICE	: NO		
138 :	TOTAL AMPS A PHASE	(***) NOTE: SIZE SHOWN IS MINIMUM	ACTUAL CONN. LOAD :	45	126	AMPS
138 :	TOTAL AMPS B PHASE	ACCEPTABLE MLO AMPERAGE. INCREASE	NEC LOAD/DEMAND :	36	99	AMPS
126 :	TOTAL AMPS C PHASE	SIZE IF REQUIRED FOR QUANTITY OF	NEC DIVERSITY	36	99	AMPS
NONE :	ERROR CODE	POLES.	XFMR KVA :	0		

DESCRIPTION	LOAD CONN	TYPE	AMPS	AMPS	AMPS	C.B. AMPS	C.B. POLE	CKT. NO.	CKT. NO.	C.B. POLE	C.B. AMPS	AMPS	AMPS	AMPS	DESCRIPTION	LOAD CONN	TYPE
COOLER COMP	9	7	9	\\\\\\	\\\\\\	20	3	1	2	2	20	10	\\\\\\	\\\\\\	ROLL REF	10	7
-----------	9	7	\\\\\\	9	\\\\\\	------	-----	3	4	-----	-----	\\\\\\	10	\\\\\\	-----------	10	7
-----------	9	7	\\\\\\	\\\\\\	9	------	-----	5	6	2	20	\\\\\\	\\\\\\	8	RECEPTS	5	4
FREEZER COMP	21	7	21	\\\\\\	\\\\\\	30	3	7	8	-----	-----	12	\\\\\\	\\\\\\	RECEPTS	8	4
-----------	21	7	\\\\\\	21	\\\\\\	------	-----	9	10	1	20	\\\\\\	8	\\\\\\	MLK COOL, REC	8	7
-----------	21	7	\\\\\\	\\\\\\	21	------	-----	11	12	1	20	\\\\\\	\\\\\\	6	COLD SERV CO	6	7
FREEZER EVAP	25	7	25	\\\\\\	\\\\\\	40	2	13	14	1	20	10	\\\\\\	\\\\\\	ROLL UP DR	10	5
-----------	25	7	\\\\\\	25	\\\\\\	------	-----	15	16	1	20	\\\\\\	10	\\\\\\	ROLL UP DR	10	5
COOLER EVAP	3	7	\\\\\\	\\\\\\	3	20	1	17	18	1	20	\\\\\\	\\\\\\	0	SPARE	0	
SLICER	10	7	10	\\\\\\	\\\\\\	20	1	19	20	1	20	13	\\\\\\	\\\\\\	COOLER	13	7
SPARE	0		\\\\\\	0	\\\\\\	20	1	21	22	1	20	\\\\\\	13	\\\\\\	FREEZER	13	7
SPARE	0		\\\\\\	\\\\\\	0	20	1	23	24	1	20	\\\\\\	\\\\\\	5	CLG REC	3	4
SPARE	0		0	\\\\\\	\\\\\\	20	1	25	26	1	20	8	\\\\\\	\\\\\\	RECEPTS	5	4
SPARE	0		\\\\\\	0	\\\\\\	20	1	27	28	2	35	\\\\\\	22	\\\\\\	CU-1	22	12
ICE MACH	14	7	\\\\\\	\\\\\\	14	20	1	29	30	-----	-----	\\\\\\	\\\\\\	22	-----------	22	12
KEF-1	8	9	8	\\\\\\	\\\\\\	20	3	31	32	2	15	5	\\\\\\	\\\\\\	FCU-1	5	10
-----------	8	9	\\\\\\	8	\\\\\\	------	-----	33	34	-----	-----	\\\\\\	5	\\\\\\	-----------	5	10
-----------	8	9	\\\\\\	\\\\\\	8	------	-----	35	36	1	20	\\\\\\	\\\\\\	0	SPARE	0	
KSF-1	7	9	7	\\\\\\	\\\\\\	20	3	37	38	1	20	0	\\\\\\	\\\\\\	SPARE	0	
-----------	7	9	\\\\\\	7	\\\\\\	------	-----	39	40	1	20	\\\\\\	0	\\\\\\	SPARE	0	
-----------	7	9	\\\\\\	\\\\\\	7	------	-----	41	42	1	20	\\\\\\	\\\\\\	0	SPARE	0	
	0	14	0	\\\\\\	\\\\\\			S.F.	S.F.			0	\\\\\\	\\\\\\		0	14
----------	0	14	\\\\\\	0	\\\\\\	-----	-----	S.F.	S.F.	-----	-----	\\\\\\	0	\\\\\\	----------	0	14
----------	0	14	\\\\\\	\\\\\\	0	-----	-----	S.F.	S.F.	-----	-----	\\\\\\	\\\\\\	0	----------	0	14

Revised Panel 1LQ1

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	1LQ1	Panel Location:	Kitchen		
Nominal Phase to Neutral Voltage------->	120	Phase:	3		
Nominal Phase to Phase Voltage-------->	208	Wires:	4		

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	COOLER COMP	8	KITCH	1080	w	1.00	1080	1080	
2	A	ROLL REF	8	KITCH	1200	w	1.00	1200	1200	
3	B	COOLER COMP	8	KITCH	1080	w	1.00	1080	1080	
4	B	ROLL REF	8	KITCH	1200	w	1.00	1200	1200	
5	C	COOLER COMP	8	KITCH	1080	w	1.00	1080	1080	
6	C	RECEPTS	1	KITCH	900	w	1.00	900	900	
7	A	FREEZER COMP	8	KITCH	2520	w	1.00	2520	2520	
8	A	RECEPTS	1	KITCH	1440	w	1.00	1440	1440	
9	B	FREEZER COMP	8	KITCH	2520	w	1.00	2520	2520	
10	B	MLK COOL, REC	8	KITCH	960	w	1.00	960	960	
11	C	FREEZER COMP	8	KITCH	2520	w	1.00	2520	2520	
12	C	COLD SERV CO	8	KITCH	720	w	1.00	720	720	
13	A	FREEZER EVAP	8	KITCH	3000	w	1.00	3000	3000	
14	A	ROLL UP DR	8	KITCH	1200	w	1.00	1200	1200	
15	B	FREEZER EVAP	8	KITCH	3000	w	1.00	3000	3000	
16	B	ROLL UP DR	8	KITCH	1200	w	1.00	1200	1200	
17	C	COOLER EVAP	8	KITCH	360	w	1.00	360	360	
18	C	SPARE	9		1560	w	1.00	1560	1560	
19	A	SLICER	8	KITCH	1200	w	1.00	1200	1200	
20	A	COOLER	8	KITCH	1560	w	1.00	1560	1560	
21	B	SPARE	9		1560	w	1.00	1560	1560	
22	B	FREEZER	8	KITCH	1560	w	1.00	1560	1560	
23	C	SPARE	9		1560	w	1.00	1560	1560	
24	C	CLG REC	1	KITCH	540	w	1.00	540	540	
25	A	SPARE	9		1560	w	1.00	1560	1560	
26	A	RECEPTS	1	KITCH	900	w	1.00	900	900	
27	B	SPARE	9		1560	w	1.00	1560	1560	
28	B	CU-1	8	KITCH	2640	w	1.00	2640	2640	
29	C	ICE MACHINE	8	KITCH	1680	w	1.00	1680	1680	
30	C	CU-1	8	KITCH	2640	w	1.00	2640	2640	
31	A	KEF-1	6	KITCH	960	w	1.00	960	960	
32	A	FCU-1	8	KITCH	600	w	1.00	600	600	
33	B	KEF-1	6	KITCH	960	w	1.00	960	960	
34	B	FCU-1	8	KITCH	600	w	1.00	600	600	
35	C	KEF-1	6	KITCH	960	w	1.00	960	960	
36	C	CH-1 HT	9	KITCH	600	w	1.00	600	600	

37	A	KSF-1	8	KITCH	840	w	1.00	840	840		
38	A	CH-1 CTRL	9	KITCH	600	w	1.00	600	600		
39	B	KSF-1	8	KITCH	840	w	1.00	840	840		
40	B	CH-2 HT	9	KITCH	600	w	1.00	600	600		
41	C	KSF-1	8	KITCH	840	w	1.00	840	840		
42	C	CH-2 CTRL	9	KITCH	600	w	1.00	600	600		
PANEL TOTAL								55.5	55.5	Amps=	462.5

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					18.7	18.7	34%	155.5
PHASE TOTAL	B					20.3	20.3	37%	169.0
PHASE TOTAL	C					16.6	16.6	30%	138.0

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		3.8	3.8	1.00	3.8	3.8	1.00		
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		0.0	0.0		0.0	0.0			
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		2.9	2.9	0.95	2.7	2.7	1.00		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		38.6	38.6	0.65	25.1	25.1	1.00		
9	unassigned		10.2	10.2	1.00	10.2	10.2	1.00		
Total Demand Loads						41.8	41.8			
Spare Capacity			0%			0.0	0.0			
Total Design Loads						41.8	41.8	1.00	Amps=	116.2

Default Power Factor =	0.80	
Default Demand Factor =	100	%

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A MLO

PANEL TAG: 1LQ1
PANEL LOCATION: Kitchen
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: PROVIDE FEED THROUGH LUGS FOR PANELBOARD 1L1B

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
COOLER COMP	KITCH	1080	20A/1P	1	*			2	20A/1P	1200	KITCH	ROLL REF
COOLER COMP	KITCH	1080	20A/1P	3		*		4	20A/1P	1200	KITCH	ROLL REF
COOLER COMP	KITCH	1080	20A/1P	5			*	6	20A/1P	900	KITCH	RECEPTS
FREEZER COMP	KITCH	2520	20A/1P	7	*			8	20A/1P	1440	KITCH	RECEPTS
FREEZER COMP	KITCH	2520	20A/1P	9		*		10	20A/1P	960	KITCH	MLK COOL, REC
FREEZER COMP	KITCH	2520	20A/1P	11			*	12	20A/1P	720	KITCH	COLD SERV CO
FREEZER EVAP	KITCH	3000	20A/1P	13	*			14	20A/1P	1200	KITCH	ROLL UP DR
FREEZER EVAP	KITCH	3000	20A/1P	15		*		16	20A/1P	1200	KITCH	ROLL UP DR
COOLER EVAP	KITCH	360	20A/1P	17			*	18	20A/1P	1560		SPARE
SLICER	KITCH	1200	20A/1P	19	*			20	20A/1P	1560	KITCH	COOLER
SPARE		1560	20A/1P	21		*		22	20A/1P	1560	KITCH	FREEZER
SPARE		1560	20A/1P	23			*	24	20A/1P	540	KITCH	CLG REC
SPARE		1560	20A/1P	25	*			26	20A/1P	900	KITCH	RECEPTS
SPARE		1560	20A/1P	27		*		28	20A/1P	2640	KITCH	CU-1
ICE MACHINE	KITCH	1680	20A/1P	29			*	30	20A/1P	2640	KITCH	CU-1
KEF-1	KITCH	960	20A/1P	31	*			32	20A/1P	600	KITCH	FCU-1
KEF-1	KITCH	960	20A/1P	33		*		34	20A/1P	600	KITCH	FCU-1
KEF-1	KITCH	960	20A/1P	35			*	36	20A/1P	600	KITCH	CH-1 HT
KSF-1	KITCH	840	20A/1P	37	*			38	20A/1P	600	KITCH	CH-1 CTRL
KSF-1	KITCH	840	20A/1P	39		*		40	20A/1P	600	KITCH	CH-2 HT
KSF-1	KITCH	840	20A/1P	41			*	42	20A/1P	600	KITCH	CH-2 CTRL

CONNECTED LOAD (KW) – A Ph.	18.66	TOTAL DESIGN LOAD (KW)	41.83
CONNECTED LOAD (KW) - B Ph.	20.28	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	16.56	TOTAL DESIGN LOAD (AMPS)	116

Tag	Panel 1L1	Panel 1LQ1
Voltage System	208/120	208/120
Calculated Design Load (kW)	111.2	41.8
Calculated Power Factor	1.0	1.0
Calculated Design Load (kVA)	111.2	41.8
Calculated Design Load (A)	309	116.2
Feeder Protection Size		
Number of Sets	2	1
Phase	#3/0 AWG	#1/0 AWG
Neutral	#3/0 AWG	#1/0 AWG
Ground	#4 AWG	#6 AWG
Each Phase	0.3970	0.1855
Total – All phases	2.382	0.5565
Neutral	0.794	0.1855
Ground	0.2316	0.0507
Total – All Wires	3.4076	0.7927
Minimum Conduit Area	1.065	1.9818
Conduit Size	1.25” RMC	1.5” RMC
Conduit Size (Table C.1)	1.00” RMC	1.25” RMC
Feeder Length	19’-10”	151’-10”
Final Voltage Drop (V)	0.591	3.971
Final Voltage Drop (%)	0.123	1.91
Was feeder re-sized?	Yes	Yes

Single-Line Diagram

A revised single line diagram can be found in Appendix C. This will include a revised feeder schedule and include the resized disconnects and circuit breakers.

Sizing Generator

To size the generator, Generac’s Power Design Pro was used. The generator is feeding three different loads: the life safety branch, the equipment branch, and the two chillers. For this design, an engineering decision was made to only load the generator between 70% and 80% of its capacity. Therefore, based on the loads of the three circuits fed by the generator, the best solution is to use a 700kW generator that will run at 72% of its capacity.

Electrical Depth #2: Photovoltaic Study

Photovoltaics were not initially installed in Crystal Lake Elementary school to decrease its need for electric power. This analysis will develop a suitable Photovoltaic array system for this building that will be mounted on the roof and will determine the benefits of implementing this system and analyze how many years until the system pays for itself. To determine the payback period RETscreen4 was used to perform the energy analysis of the system to be implemented.

Background

This photovoltaic array will be located on the roof of Crystal Lake Elementary School in Lake Mary, FL. The desired size of this system was 500kW; however, the limited roof space decreased the size of the photovoltaic array. It will be mounted on the west facing roof that has a slope of .17. The best scenario would be to have the array facing south; however, due to the design of the roof structure this was impossible to achieve. If this system is implemented it should significantly decrease the reliance of this building on power from Progress Energy.

This analysis will use the maximum size system possible for this rooftop to produce the maximum amount of power possible. Then, the energy savings will be compared to the cost of electricity from the utility to determine how many years until the system pays for itself in savings. This will determine whether this system is a viable option for Crystal Lake Elementary School. The figure below shows the amount of sunny days in Orlando, Florida (which is 10 miles north of Orlando, FL).

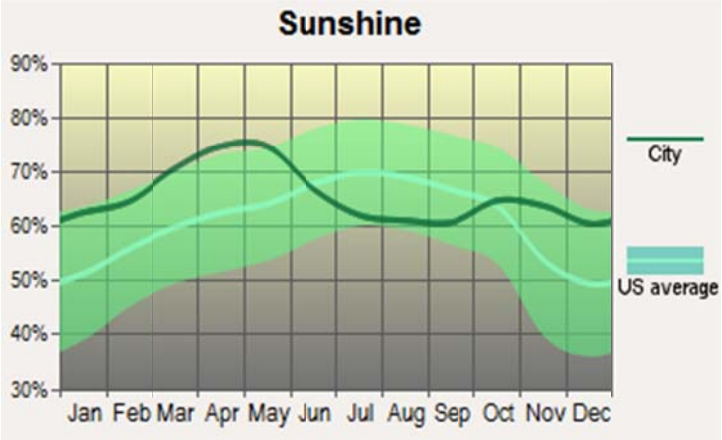


Figure 48: Percent of sunny days in Orlando, FL
http://www.city-data.com/city/Orlando-Florida.html

Typically, this region has more sunny days than the average United States city and the results of implementing a PV array should be positive.

System

The desired design would give a Photovoltaic array that can produce 500KW of power, decreasing the utility usage by 600A. However, the roof area does not provide enough surface area to place the necessary number of panels to produce 500kW of energy. Therefore, utilizing the entire surface area of the west roof, the system will produce 322.56kW of power. This will be done using four arrays: two with 31 strings of 8 modules and two with 32 strings of 8 modules. There will be four circuit breaks (one for each array) and four inverters (one for each array) that will feed into a photovoltaic panel that will send energy back to the Main Distribution Panel.

The designed system will use 1,008 SunPower series E19/ 320 solar panels and 4 Selectria PVI 95kW inverters to supply the desired 322.56kW. The number of panels used was determined by the available roof area and the module area. The roof area is 24,115.65 ft^2 and the panel area is 17.56 ft^2. Based on the specifications of the inverter, which can be found at the end of this report, there are 2-48 available poles on the specified inverter. For this particular design, there will be 2 arrays that use 31 poles and 2 arrays that use 32 poles.

To determine the maximum number of modules per string it was necessary to calculate the maximum voltage of the array and compare it to the maximum input voltage. The maximum voltage of the array will occur at the lowest temperature. Therefore, the minimum design temperature was determined from ASHRAE 90.7 based on the location of this building: Lake Mary, FL. It was determined that the minimum design temperature for this area is 5.7°C. The open circuit voltage change for the module selected is -.1766V/°C. The calculation to determine the maximum number of modules per string follows.

V_{oc}=64.8V at 25ºC from the Module Specifications that can be found at the end of this report.
Rate of Change=-.1766V/ ºC
ASHRAE min. Temperature=5.7ºC
Change in temperature from STC: 5.7ºC-25ºC=-19.3ºC

Change in V_{oc}:
-.1766V/ ºC* -19.3ºC = 3.41V

New V_{oc}:
64.8V + 3.41 V = 68.21V at 5.7ºC

There are 8 modules in series with a max input voltage of 68.21
8 * 68.21V = 545.67 V

The maximum input voltage of the inverter must be greater than 545.67V in order to work properly. The inverter chosen has a maximum input voltage of 600V and therefore is sufficient.

Due to the size of this system it is necessary that each string be fused. Therefore this system will require 126 fuses. The calculation to determine the size of the fuses follows.

I_{sc}=6.24 A , which is found on the manufacturers specification sheet at the end of this report

Sizing: 6.24 A * 1.25 * 1.25 = 9.75 A per String

One 15 amp fuse will be used on each string due to the manufacturers fuse rating.

This system will have 1 disconnect for each array with a total of 4 arrays. The calculation to determine the size of the disconnect is below.

Two arrays have 31 strings.

I_{sc}=6.24 A

Sizing: 6.24 A * 31 Strings * 1.25 * 1.25 = 302.25 A

Two arrays have 32 strings.

I_{sc}=6.24 A

Sizing: 6.24 A * 32 Strings * 1.25 * 1.25 = 312 A

Based on this calculations all four arrays will use a 350A disconnect switch.

As a check to ensure that this system will function correctly a calculation to determine if the array meets the maximum current specifications of the inverter was performed. This calculation follows.

Max Input current of the inverter = 287 A

Maximum Input Current of Connected PV array with NEC 125% factor = 287*1.25 = 358.75 A

Short Circuit current at STC = 6.24 A

Total Current of 31 string array = 6.24 * 31 = 193.44 A

Total Current of 32 string array = 6.24 * 32 = 199.68 A

The Maximum Current is 125% greater than the current at STC.

Maximum Current of 31 string array at STC = 193.44 A * 1.25 = 241.8 A

Maximum Current of 32 string array at STC = 199.68 A * 1.25 = 249.6 A

Therefore, the maximum input current of the inverter used is 358.75 A and both the 31 string and the 32 string array produce well under this maximum, and this system will work.

It is recommended that the power loss in the wire be less than 2%. Therefore, it is necessary to determine the maximum length that the wire between the modules and the inverter can be before it reaches this limit. The calculation for the wire sizing and this maximum length follows.

Amps the wire is rated for: 6.24A * 1.25 * 1.25 = 9.75 A

At 90°C, use a 18 AWG wire rated for 14 amps is adequate. However, the minimum recommended size is 12 AWG rated for 30 A and therefore this will be used instead.

Using 62 wires for the 31 string array, with 12 AWG wire loses 2.05 ohms/kFT

Using 64 wires for the 32 string array, with 12 AWG wire loses 2.05 ohms/kFT

Maximum Power current at STC from the module specifications = 5.86 A

Watts/(8 modules per string strings * 320 watts per module)=0.02

Watts=51.2 W

$2 * (2.05 \text{ ohms/kFT}) * (\text{kFT}) * (5.86 \text{ A})^2 = 51.2 \text{ W}$

0.2287 Kft=363.66 feet is the length when the wire reaches 2%. Therefore, the maximum length that this wire can be is 363.66 ft.

Finally, it is necessary to size the circuit breaker of the PV system. This calculation follows.

Output current of inverter: 92 A

92A * 1.25 = 115 A

Therefore, use the next size up circuit breaker which is a 125 A circuit breaker. There will be four circuit breakers: one for each inverter.

Figure 49: Location of Proposed Photovoltaic Array

A wiring diagram of the photovoltaic array can be found at the end of this report.

RETscreen was used to generate the financial analysis of this system. Following are various screen shots from the program to show the required inputs of the analysis system to determine the payback period.

Photovoltaic			
Power capacity	kW	322.56	
Manufacturer		Sunpower	
Model		E19/320	1008 unit(s)
Capacity factor	%	24.3%	
Electricity exported to grid	MWh	686.6	

Figure 50: RETscreen Input data for the PV array used for Crystal Lake Elementary School.

	Unit	Climate data location	Project location
Latitude	°N	28.8	28.8
Longitude	°E	-81.2	-81.2
Elevation	m	17	17
Heating design temperature	°C	5.7	
Cooling design temperature	°C	33.9	
Earth temperature amplitude	°C	12.2	

Month	Air temperature	Relative humidity	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days	Cooling degree-days
	°C	%	kWh/m²/d	kPa	m/s	°C	°C-d	°C-d
January	15.6	70.4%	3.22	101.9	3.3	15.3	74	174
February	16.3	68.1%	3.86	101.8	3.7	16.8	48	176
March	18.4	65.2%	4.94	101.7	3.9	18.7	0	260
April	21.2	64.6%	6.08	101.6	3.7	21.0	0	336
May	24.4	66.0%	6.50	101.5	3.3	24.3	0	446
June	26.5	72.4%	6.09	101.5	3.0	26.3	0	495
July	27.6	71.7%	6.28	101.6	2.6	27.1	0	546
August	27.2	74.3%	5.76	101.5	2.6	26.8	0	533
September	26.0	74.8%	4.97	101.4	2.9	25.6	0	480
October	23.1	72.9%	4.23	101.6	3.1	22.5	0	406
November	19.5	72.4%	3.39	101.7	3.3	19.3	0	285
December	16.0	72.4%	2.90	101.9	3.1	16.0	62	186
Annual	21.8	70.4%	4.86	101.6	3.2	21.7	184	4,324
Measured at	m				10.0	0.0		

Figure 51: RETscreen climate Information for Lake Mary, FL

Cost Analysis

The following information indicates the initial cost of a 167 W grid connected system according to RS Means 2011. This system was chosen for analysis since it is the only grid connected system available in RS Means. Therefore, it is assumed that this data is similar to that of the system used for this study.

Initial Cost Data					
Type	Quantity of Modules	Price per Quantity	Price for one unit	Total Number of Units Used	Total Cost
167 W Photovoltaic Module	60	96,500	1,608.33	1,008	$1,621,200

Table 20: Price data include material cost, and instillation cost. (RS Means 2011, Section D5090 430 0100)

According to a report generated by the Powering the South, Renewable Energy Policy Project, January 2003, the annual average PV capacity is 23.4%. This assumes 13 cents/kWh peak and 3% escalation. Reference: http://www.repp.org/articles/static/1/binaries/REPP_FL_100202.pdf

Utility Savings			
Size of Array	Amount of Electricity Produced by Array (MWh)	Utility rate per MWh*	Total Savings
322.56 KW (1008 units)	686.6	$115.14	79,055.124
***Utility rate is based on the rates of Progress Energy. The average annual cost for Crystal Lake Elementary school from July 2009-June 2010.**			

Since this building requires more energy than the photovoltaic arrays are supposed to produce. It is not anticipated that this building will receive any utility credits for a surplus of energy.

There are many incentives to installing a PV array in Lake Mary, FL. As of 2006, the Florida Energy Act provides a Solar Energy Systems Incentives Program that encourages businesses to purchase solar photovoltaic systems.

Incentives		
	$/Watt Rebate	**Total Savings**
Florida State Grants[1]	$4/Watt (322.56 kW)[2]	$100,000
	% Credit	**Total Savings**
Federal Grants[3]	30% of initial cost	$486,360
[1]Florida State Grants are provided by the Solar Energy Systems Incentives Program and can be found here: http://www.epa.gov/renewableenergyland/incentives/fl_incentives.pdf **[2]Florida State Grants provide $4/Watt to a maximum of $100,000** **[3]Federal Grants are provided from the federal government under U.S. Code Title 26 (Section 48(a)(3)) and can be found at: http://www.getsolar.com/commercial_federal-incentives-for-commercial-solar.php**		

Annual O&M cost is 0.35% of the total installed cost for this grid tied system. This data can be found at: http://www.nrel.gov/docs/fy10osti/48853.pdf

The following screen shots are from RETscreen and provide the output information for the financial analysis of the photovoltaic array used.

Financial Analysis

Financial parameters		
Inflation rate	%	3.0%
Project life	yr	20
Debt ratio	%	0%
Initial costs		
Power system	$	1,621,200
Other	$	
Total initial costs	$	1,621,200
Incentives and grants	$	586,360
Annual costs and debt payments		
O&M (savings) costs	$	5,674
Fuel cost - proposed case	$	0
	$	
Total annual costs	$	5,674
Annual savings and income		
Fuel cost - base case	$	0
Electricity export income	$	79,058
	$	
Total annual savings and income	$	79,058
Financial viability		
Pre-tax IRR - assets	%	6.7%
Simple payback	yr	14.1
Equity payback	yr	11.6

Figure 52: RETsceen financial analysis output information

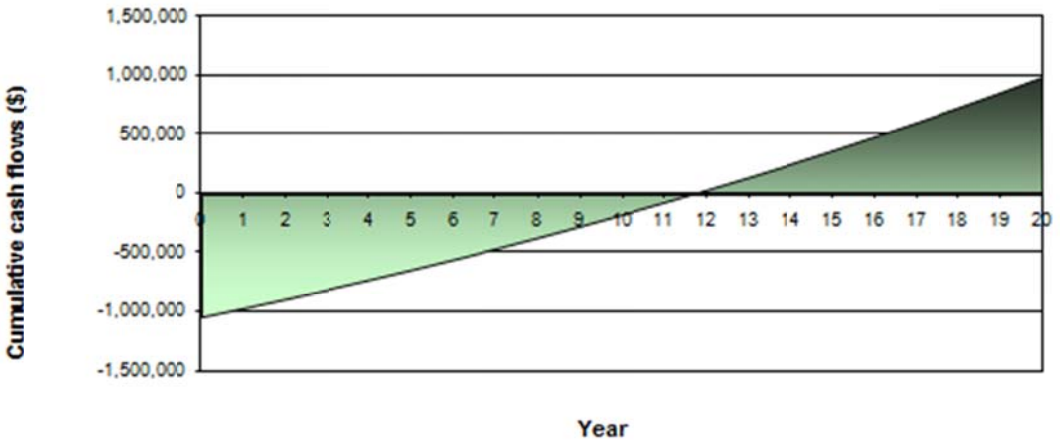


Figure 53: RETsceen payback analysis graph

Recommendations

Due to the location of this building in Lake Mary, FL, this building is in a prime location to receive a large amount of sunlight. This location is generally above the average. After using RETscreen4 to determine the payback period for this system in Lake Mary, FL, it was determined that to place a 323.56 kW photovoltaic array on the roof of Crystal Lake Elementary School will pay for itself in 14.1 years. After analyzing this data, it would be recommended that this school implement a photovoltaic array.

According to the manufacturer's data, the modules selected are guaranteed to work for 25 years. With a 14.1 year payback period, this school will have 10.9 years of financial profit from applying this system.

A significant factor in the financial success of this photovoltaic array is the significant amount of incentives offered from both Florida State and the Federal Government. Without these incentives the payback would have been much worse and possibly this system would not be recommended.

Acoustical Breadth

Overview

The Multipurpose Room has three primary functions: auditorium space, cafeteria space, and emergency shelter. It is located in the center of the first floor of the building and is accessible from the main lobby at the entrance of the building. This is a large open space with a partition wall to give the option of dividing the room into two spaces.

Due to the large amounts of open space, there is a danger of having an acoustical problem that would be undesirable for all three functions of this space. In order to ensure that acoustics in not a problem within this space the reverberation time will be calculated to determine if it is at the desirable level for this multipurpose room. Proposed solutions will be provided to improve the acoustical conditions within the space.

Space Overview

Area: 5250 ft^2

Length: Approximately 99 ft.

Width: Approximately 65 ft.

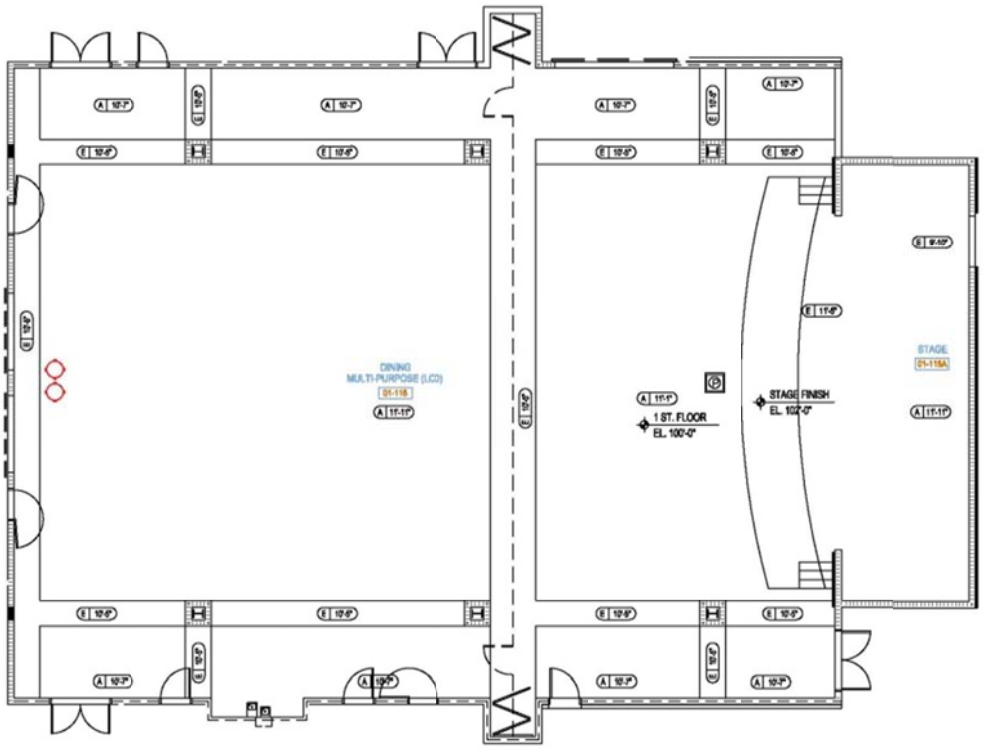
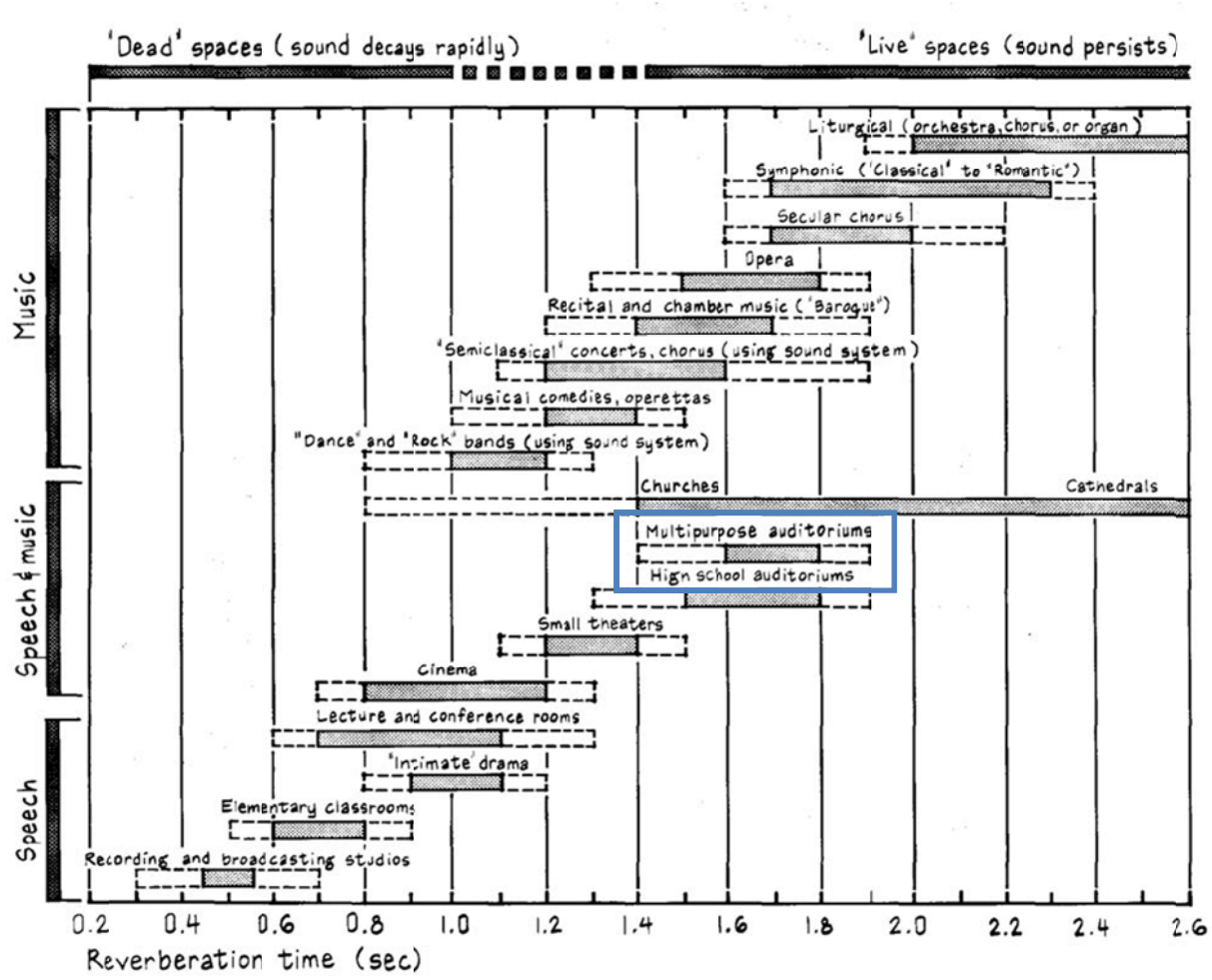


Figure 54: Multipurpose Room Floor Plan

Design Criteria



This space is a Multipurpose Auditorium, and must be designed to the appropriate reverberation time. Since this space will be used for speech and musical purposes, a moderate reverberation time is desired. The desired mid-frequency is 1.7 seconds, this is the average of the reverberation time at 500 Hz and 1000 Hz. However, the acceptable range is 1.4 seconds to 1.9 seconds. The chart above indicates the desirable reverberation time range for all room types. To determine the existing reverberation time, Sabine's formula will be used to determine the reverberation times at 500 and 1000 Hz. The chart below gives all the target values used for this acoustical study

Existing Acoustical Conditions

Location	Material	Hz	Absorption Coefficient (α)	Area (ft^2)	Sα
Ceiling	Acoustical Ceiling Tile	**500**	0.83	4217	3500
		1000	0.99		4175
Ceiling	Gypsum board	**500**	0.05	2006	100
		1000	0.04		80
Wall	Gypsum Wall Board	**500**	0.05	3369	337
		1000	0.04		236
Floor	Vinyl Composition Tile	**500**	0.03	5250	158
		1000	0.03		158
Stage Floor	Wood	**500**	0.10	1193	119
		1000	0.07		84
Seats	Assume values similar to students, informally dressed, seated in tablet-arm chairs	**500**	0.49	498	244
		1000	0.84		418
Air (Coefficient per 1000 ft^2)		**500**	0	69,200 ft^3	0
		1000	8 sabins/1000ft^3		554
Total Absorption $\Sigma S\alpha$		**500**	4458		
		1000	5603		
Reverberation Time=0.05*(V/Sα) V=69,200		**500**	0.78		
		1000	0.62		

Analysis of Results

Based on the existing conditions, the average reverberation time is 0.725 seconds. This is much lower than the desired 1.7 seconds. 0.725 seconds is adequate for spaces where speech is the only concern However, this multipurpose room needs to be designed to be adequate for both speech and music. Therefore, changes need to be made to the existing materials in order to achieve and average reverberation time in 500 and 100 Hz to be 1.7 seconds. In order to achieve this, the highlighted sections above will be edited; this change will be shown in the Revised Design section below. The ceiling plan below shows the current layout of the acoustical ceiling tile in green and gypsum board in white.

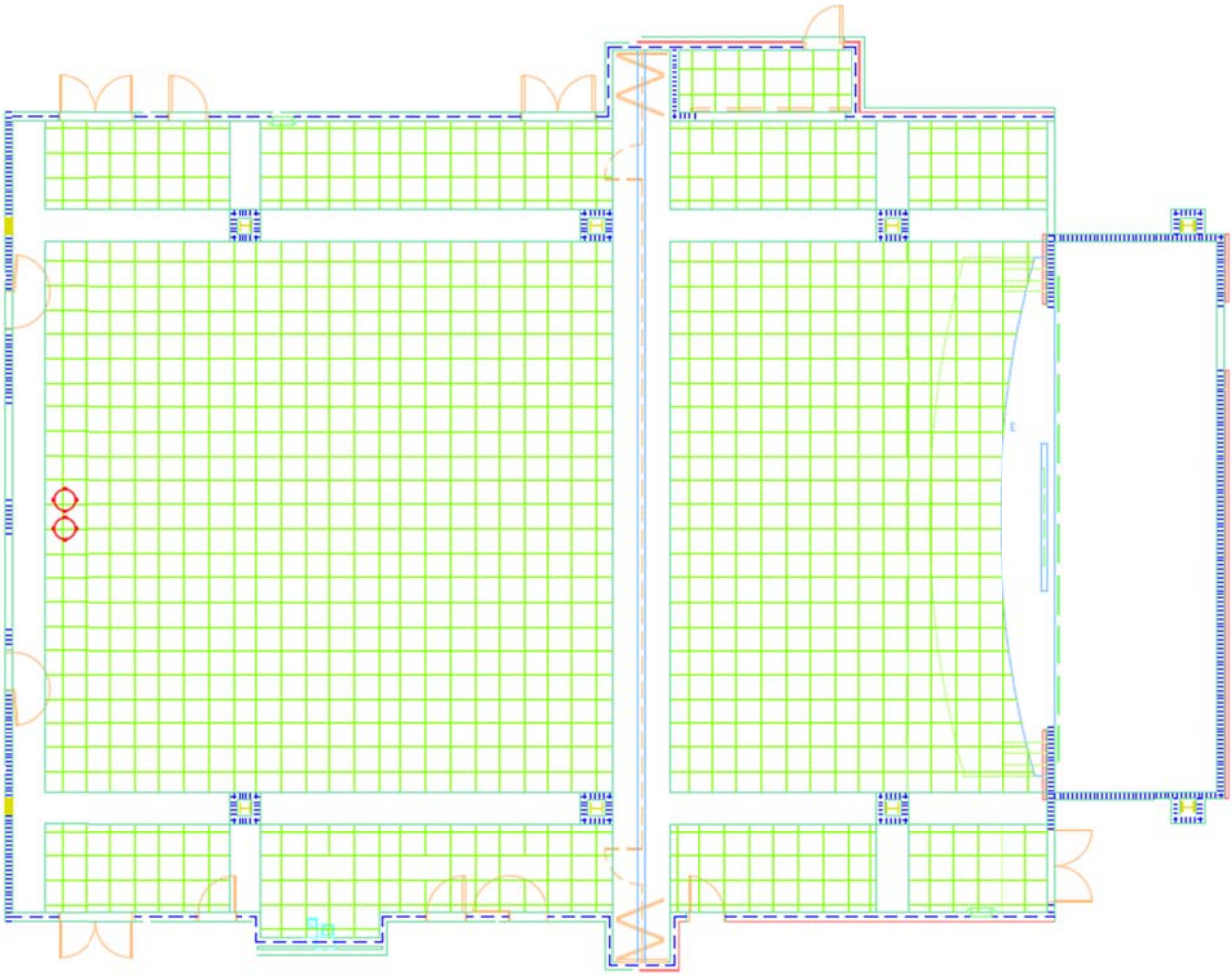


Figure 55: Multipurpose Room Exiting Ceiling Plan

Revised Design

In order to increase the reverberation time to the desired level, the area of the acoustical ceiling tile and gypsum wall board used will be changed to the numbers below.

Location	Material	Hz	Absorption Coefficient (α)	Area (ft^2)	Sα
Ceiling	Acoustical Ceiling Tile	**500**	0.83	1081	898
		1000	0.99		1071
Ceiling	Gypsum board	**500**	0.05	5142	257
		1000	0.04		206
Wall	Gypsum Wall Board	**500**	0.05	3369	337
		1000	0.04		236
Floor	Vinyl Composition Tile	**500**	0.03	5250	158
		1000	0.03		158
Stage Floor	Wood	**500**	0.10	1193	119
		1000	0.07		84
Seats	Assume values similar to students, informally dressed, seated in tablet-arm chairs	**500**	0.49	498	244
		1000	0.84		418
Air (Coefficient per 1000 ft^2)		**500**	0	69,200 ft^3	0
		1000	8 sabins/1000ft^3		554
Total Absorption Σ Sα		**500**	1810		
		1000	2624		
Reverberation Time=0.05*(V/Sα) V=69,200		**500**	1.91		
		1000	1.32		

The new design gives an average reverberation time of 1.62 seconds, which is very close to the desired level of 1.7 seconds and still within the optimal range of 1.6 seconds to 1.8 seconds. Making these changes is advantageous to this elementary school. The optimal design concept is to ensure that this building is cost effective and efficient, since it is a government building. Therefore, there are no new building materials added to the design, just an adjustment to the existing design. This changes the appearance of the space. The reflected ceiling plan below shows the new ceiling plan. The acoustical ceiling tile is shown in green and the gypsum board is shown in white.

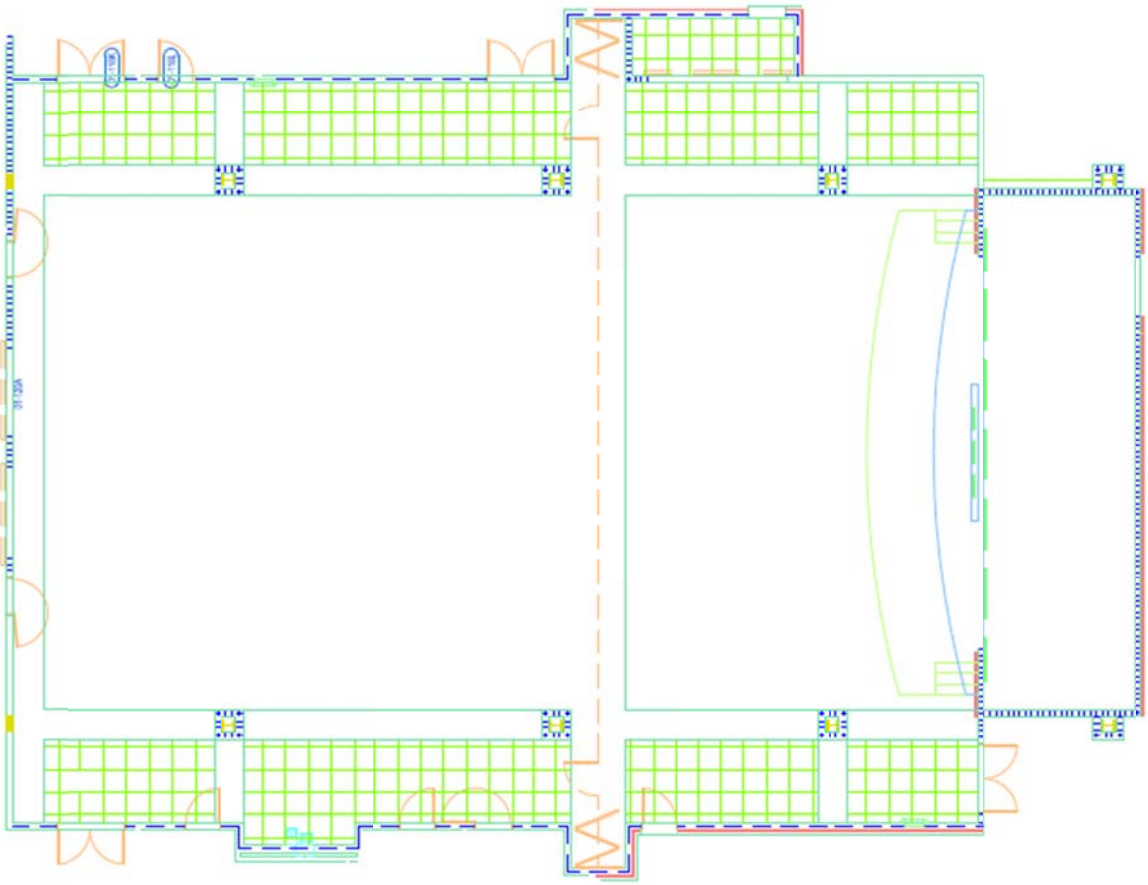


Figure 56: Multipurpose Room Revised Ceiling Plan

Noise Reduction is Revised Design

The noise reduction between the original design and the revised design can be calculated using the formula:

$$NR = 10*\log (a_1/a_2), \text{ where } a_1=\sum S\alpha_1 \text{ and } a_2=\sum S\alpha_2$$

$$NR=+3.56$$

There will be an increase in noise by 3.56 dB. Humans are capable of noticing a change in loudness of 3dB or more; therefore, people within this space will notice that is louder in the revised design as opposed to the existing design.

Structural Breadth

Introduction

After analyzing the addition of photovoltaic panels to one-half of the roof of Crystal Lake Elementary School, it was determined that the use of photovoltaics is cost effective and will save this school in energy costs. However, a structural analysis of the joists and joist girders is needed to determine if the existing roof system can handle this added load or if the increased load will change the structural materials and ultimately increase the cost of adding a photovoltaic system. This study will focus on the joists and joists girders that support the roof.

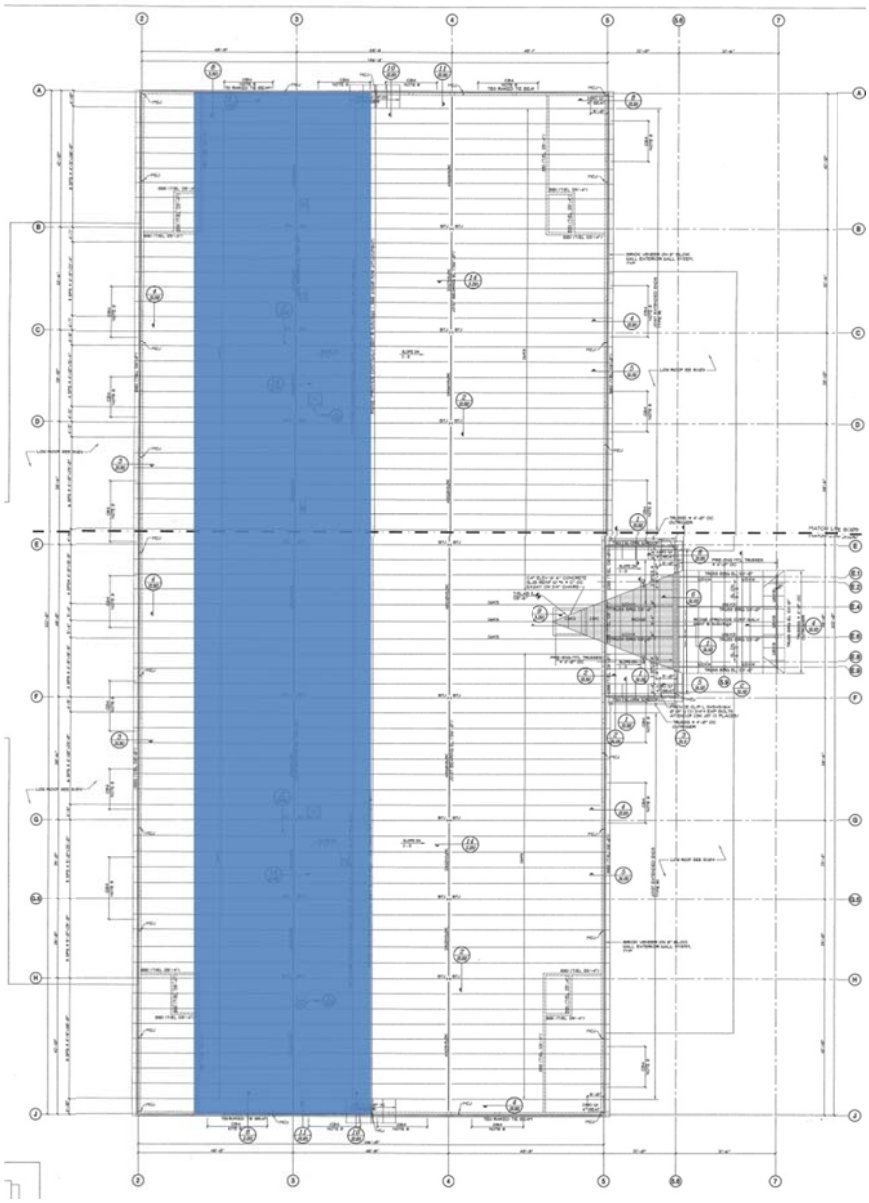


Figure 57: Existing Roof Structure with PV Panel Location

Loads

Adding Photovoltaic panels on my roof will increase my roof load. According to manufacturer information 1 panel weighs 41 lbs and has an area of 17.56 ft^2. The panels cover the majority of my rooftop and for a conservative calculation a uniform load of 41 lbs/17.56 ft^2 (or 2.33 lbs/ft^2) will be applied.

To determine whether the existing structure can support the additional load, all the different joist girders and joist combinations will be analyzed. This information is presented below.

Materials						
Segment	Material	**Size**	**Self-Weight (plf)**	**Tributary Width**	**Self-Weight (psf)**	**Supported Load**
A	**Existing Joist**[1]	26K9	12.2 plf	4'-10"	2.52	330 plf
	Existing Joist Girder[2]	44G9N9.0K	28 plf	48'-8"	0.575	9 kips
B	**Existing Joist**[1]	26K9	12.2 plf	4'-7"	2.66	330 plf
	Existing Joist Girder[2]	32G7N9.0K	24 plf	48'-8"	0.493	9 kips
C	**Existing Joist**[1]	26K9	12.2 plf	4'-9"	2.57	330 plf
	Existing Joist Girder[2]	28G5N9.0K	16 plf	48'-8"	0.329	9 kips
D	**Existing Joist**[1]	26K9	12.2 plf	4'-9"	2.57	330 plf
	Existing Joist Girder[2]	40G8N9.0K	26 plf	48'-8"	0.534	9 kips
E	**Existing Joist**[1]	26K9	12.2 plf	4'-9"	2.57	330 plf
	Existing Joist Girder[2]	48G10N9.0K	37 plf	48'-8"	0.760	9 kips
F	**Existing Joist**[1]	26K9	12.2 plf	4'-9"	2.57	330 plf
	Existing Joist Girder[2]	28G6N9.0K	20 plf	48'-8"	0.411	9 kips

[1]Data from Steel Joist Institute LRFD Load Table for Open Web Steel Joists, K-series
[2]Data from Steel Joist Institute LRFD Weight Table for Joist Girders

The table below shows the loads used to determine the roof load.

Loads		
Dead Load	Superimposed Dead Load	15 psf
	Self-weight	Varies[2]
	Prefinished 24 Ga. Metal Roof Decking	2.26 psf≈3 psf
	Roofing Material[1]	5 psf
	Photovoltaic Panel Load	2.33 psf≈3psf
Live Load	Live Load	20 psf

[1]The roofing material is unknown and 5 psf is assumed for calculation purposes.
[2]Self Weight is found in Table Above

Analysis of Segment A

Joist

1.2*Dead Load + 1.6*Live Load

W=1.2*(15 psf + 3 psf + 5 psf + 3 psf + 2.52 psf)+ 1.6*(20 psf) = 66.224 psf

W*Tributary Width = 66.224 psf * 4.58 ft = 303.53 plf < 330 plf ; good for live load deflection

Joist Girder

Supported Load = Load*Tributary Width/2

66.224 psf*4.83 ft = 319.86*(48.66ft/2) = 7.782 kips < 9 kips ; therefore will support

Analysis of Segment B

Joist

1.2*Dead Load + 1.6*Live Load

W=1.2*(15 psf + 3 psf + 5 psf + 3 psf + 2.66 psf)+ 1.6*(20 psf) = 66.392 psf

W*Tributary Width = 66.392 psf * 4.83 ft = 303.53 plf < 330 plf ; good for live load deflection

Joist Girder

Supported Load = Load*Tributary Width/2

66.392 psf*4.83 ft = 320.01*(48.66ft/2) = 7.786 kips < 9 kips ; therefore will support

Analysis of Segment C, D, E, F

Joist

1.2*Dead Load + 1.6*Live Load

W=1.2*(15 psf + 3 psf + 5 psf + 3 psf + 2.57 psf)+ 1.6*(20 psf) = 66.284 psf

W*Tributary Width = 66.284 psf * 4.75 ft = 314.849 plf < 330 plf ; good for live load deflection

Joist Girder

Supported Load = Load*Tributary Width/2

66.284 psf*4.75 ft = 314.849*(48.66ft/2) = 7.660 kips < 9 kips ; therefore will support

After calculation the loads above, it is determined that the existing joist can support 330 plf and this structural support does not need to be changed to support the added girders can support the new design with photovoltaic panels. Therefore, all of the joist girders will remain the same and they can all support 9 kips.

After calculation the loads above, it is determined that the existing joists can support 330 plf and therefore this structural support does not need to be changed for the implementation of the new photovoltaic system on the roof.

Analysis

After analyzing the effects of adding a photovoltaic system to the room of Crystal Lake Elementary School, it has been determined that there will not be an additional construction cost since the existing structural system will remain as designed.

The calculations above have determined that the existing joists can support 330 plf and the added load does not exceed this amount. Therefore, the joists will not be changed. The existing joist girders can support 9 kips and the added load does not exceed this amount. Therefore, the joist girders will not be changed. Thus, the implementation of a Photovoltaic system is cost effective and will still have a payback period of 14.1 years on a system that is expected to last for 25 years as described in the electrical depth #2: Photovoltaics.

Conclusions

This report emphasizes the lighting and electrical redesign for four different types of spaces. The design emphasis is on energy efficiency and cost effectiveness. The covered entrance and covered walkway lighting design is meant to provide security to the school, as well as graze the building facade material while lighting up the pathways leading to the entrance to the building. Once a visitor has entered the building the lighting in the lobby brings the outside in by using the same wall sconce luminaire making a smooth transition from the exterior to the interior. In the multipurpose room the lighting design provides a solution that is sufficient for an auditorium, cafeteria, and emergency shelter, while maintaining an energy efficient design. Lastly, the primary classroom lighting design provides a bright, uniform space to promote learning.

For comfort purposes, the chillers are placed on the emergency system so that cool air can be circulated during times when the multipurpose room is used as a shelter. An acoustical study in the multipurpose room is performed to determine that the existing ceiling material should be changed to satisfy the reverberation time requirements of this space type.

With an emphasis on energy efficiency, a photovoltaic array is designed for the roof to decrease the energy usage of the building. The results determine that the use a photovoltaic array will be beneficial to this building and will eventually save Seminole County in energy costs. Additionally, a structural analysis of the roof structure with the designed photovoltaic array on the roof is performed to determine that the existing roof structure can support the added load from the photovoltaic system.

Acknowledgements

I would like to thank the following companies, people, and Architectural Engineering Faculty for their continued support throughout the duration of this design project:

Seminole County Public Schools

Dana Chester

Matern Engineering

Doug Matern

Doug Matern, Jr.

Ryan Strandquest

Architectural Engineering Faculty

Dr. Richard Mistrick

Ted Dannerth

Robert Holland

Kevin Parfitt

In addition, I would like to think thank my friends and family for their continued support. I especially want to thank my fellow lighting/electrical students for their help through the duration of this project.

Appendix A: Appendix A: Luminaire, Lamp, and Equipment Specifications

LUMINAIRE SPECIFICATION

PROJECT : _____ DATE : _____

LOCATION : _____

QUANTITY : _____ NOTE : _____

91123-SFMB-70
Mustang surface high bay luminaire

IP54 /EN 60598/CLASS I / / /IK07

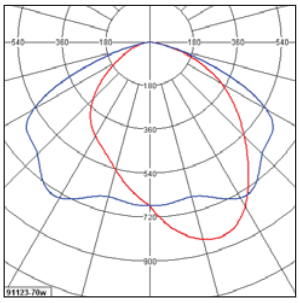
Product Type
Ceiling luminaires.

Product Information
Small sizes rectangular shape surface high bay area light and cut-off light distribution also medium and large square sizes bi-symmetrical light distribution for metal halide lamps or sodium vapour discharge lamps and mercury vapour discharge 70-400w. A high quality reflector design creates broad spread light distribution. Main application for lighting of sports, warehouse, factories, under canopies and petrol stations.

Material Characteristics
Aluminium housing with high corrosion resistance. Single cable entry PG 13.5. Stainless steel screws. Durable silicone rubber gasket and clear toughened glass with hinge aluminium frame for in-position lamp replacement. Anodized high purity aluminium reflector. Main housing is powder paint with high corrosion resistance with chemical chromatised protection.

Physical Data
Length: 450 mm.
Height: 150 mm.
Weight: 7.9 Kg.

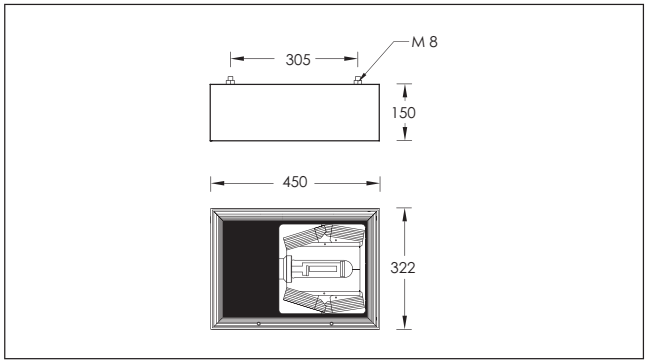
Colour
- ☐ Black - RAL 9011
- ☐ White - RAL 9003
- ☐ Matt Silver - RAL 9006
- ☐ Dark Grey - RAL 7043
- ☐ Metallic Silver - RAL 9006
- ☐ Custom - RAL _____



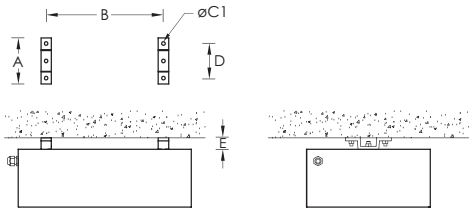
Reflector
Small Cut-off reflector.

Lamp
HIE 70w. E27 4900 lm.

Note
- Integral control gear.



Mounting Detail



	A	B	C1	D	E	Kg
SFMB	120	305	10	90	30	0.2

Branch : Business contact address / Showroom
2912 Ladprao Rd., Klongjun, Bangkapi,
Bangkok 10240 Thailand
Email : info@ligmanlighting.com

Tel : +66 (0) 2 7339140 (9 lines)
Fax : +66 (0) 2 7339153 (Administration)
+66 (0) 2 7339154 (Overseas Sales)
+66 (0) 2 7339150 (Domestic Sales)

Head office : Chachoengsao factory office
17/2 Moo 4, Monthong, Bangnampreaw,
Chachoengsao 24150 Thailand

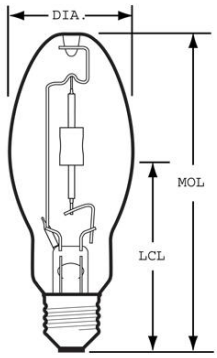
Tel : +66 (0) 38 581676-81
Fax : +66 (0) 38 581415
Email : factory@ligmanlighting.com
Website : www.ligmanlighting.com

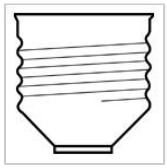
GE Lighting

22124 - CMH70/C/U/830MED

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide BD17

a product of ecomagination





GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	BD17
Base	Medium Screw (E26)
Bulb Finish	Coated
Rated Life	15000 hrs
Bulb Material	Hard glass
Lamp Enclosure Type (LET)	Enclosed fixtures only
LEED-EB MR Credit	97 picograms Hg per mean lumen hour

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	6000
Mean Lumens	4000
Nominal Initial Lumens per Watt	85
Color Temperature	3000 K
Color Rendering Index (CRI)	80
Effective Arc Length	0.28125 cm

ELECTRICAL CHARACTERISTICS

Wattage	70
Burn Position	Universal burning position
Open Circuit Voltage (peak lead ballast)	332 V
Open Circuit Voltage (RMS lag ballast)	225 V
Warm Up Time to 90% (MIN)	2 min
Warm Up Time to 90% (MAX)	5 min
Hot Restart Time to 90%	15 min
Hot Restart Time to 90% (MAX)	15 min

DIMENSIONS

Maximum Overall Length (MOL)	5.43 cm
Nominal Length	5.43 cm
Bulb Diameter (DIA)	2.125 cm
Bulb Diameter (DIA) (MAX)	2.125 cm
Light Center Length (LCL)	3.37 cm

PRODUCT INFORMATION

Product Code	22124
Description	CMH70/C/U/830MED
ANSI Code	C98/M139/M98
Standard Package	Case
Standard Package GTIN	10043168221242
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168221245

CAUTIONS & WARNINGS

R- WARNING: This lamp can cause serious skin burn and eye inflammation from shortwave ultraviolet radiation if outer envelope of the lamp is broken or punctured, and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available. Visit the FDA website for more information: http://www.fda.gov/cdrh/radhealth/products/urburns.html

Caution

- Lamp may shatter and cause injury if broken
  - Dispose of lamp in a closed container.
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

- Risk of Fire
  - Keep combustible materials away from lamp.
  - Use in fixture rated for this product.
- Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Use in enclosed fixture rated for this product.
  - Use only properly rated ballast.
- Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.
- Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.
- A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.

NOTES

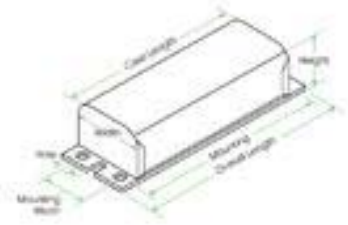
- Rated life based on 11 hours per start

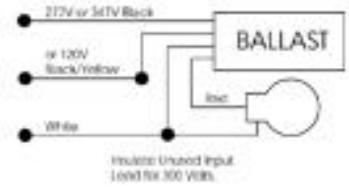
GE Lighting

86578 - 11210506CTC000C

GE HID Magnetic F-Can Ballast

- For applications requiring quieter or cooler operation than provided by standard coil & coil ballasts.
- Excellent sound-deadening and heat transfer qualities.





GENERAL CHARACTERISTICS

Application	1- 70w M98 120/277 Enclosed & Potted
Category	High Intensity Discharge
Ballast Type	Magnetic - F-Can
Type	Standard
Line Voltage Regulation (+/-)	5 %
Ballast Factor	Normal
Circuit Type	HX-HPF
Sound Rating	B (25-30 decibels)
Insulation Class	90C
Distance to Lamp	20 ft
Additional Info	Thermally protected

PRODUCT INFORMATION

Product Code	86578
Description	11210506CTC000C
Standard Package	Master
Standard Package GTIN	30043168865785
Standard Package Quantity	4
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	4
UPC	043168865784

DIMENSIONS

Case dimensions	
Length (L)	11.8 in(298.45 mm)
Width (W)	3.2 in(80.96 mm)
Height (H)	2.6 in(66.68 mm)
Mounting dimensions	
Mount Length (M)	11.1 in(282.97 mm)
Mount Width (X or F)	2.0 in(50.80 mm)
Mount Slots (MS)	0.2 in(5.95 mm)
Weight	11 lb
Exit Type	Side
Remote Mounting Distance	20 ft
Remote Mounting Wire Gauge	18 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1		12 in (NaNmm)
Black/Yellow	1		12 in (NaNmm)
Red	1		12 in (NaNmm)
White	1		12 in (NaNmm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	60 Hz

SAFETY & PERFORMANCE

- cUL Listed
- UL Listed

SPECIFICATIONS BY LAMP & LINE VOLTAGE

Lamp	# of Lamps	Specifications by Line Voltage	System Wattage	Nominal Current	Ballast Factor	Ballast Efficiency	Max.Input Current	Starting Current	Open Circuit Voltage	Drop Out Voltage	Power factor	Min.starting temperature	Fuse rating	UL bench top rise
M98	1	120	90.0	0.78A	1	0.778	2A	0.6A	250V	66V	0.9	-22.0°F	6	
M98	1	277	90.0	0.35A	1	0.778	0.9A	0.27A	250V	152V	0.9	-22.0°F	3	

CAUTIONS & WARNINGS

Warning

- Risk of Electric Shock
  - Properly ground ballast and fixture.
  - Turn power off before servicing--see instructions.

NOTES

- Anchor bracket / Tab provided for splice box (SB-4 Not included)

WARRANTY INFORMATION

GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

LUMUX

Date :	Project :	Type:
Agency :	Distributor :	

Description : This Wall Mounted with fully shielded light source for up or down lighting for indoor or outdoor application is constructed from low copper aluminum die cast and tempered clear glass. This unit Fully gasketed with molded silicon rubber. Suitable for wet locations.
ETL listed.

SPECIFICATION:

Housing : Low copper aluminum die cast.
Vandal resistance stainless steel screws.
Silicon gasketed for weather tight operation.

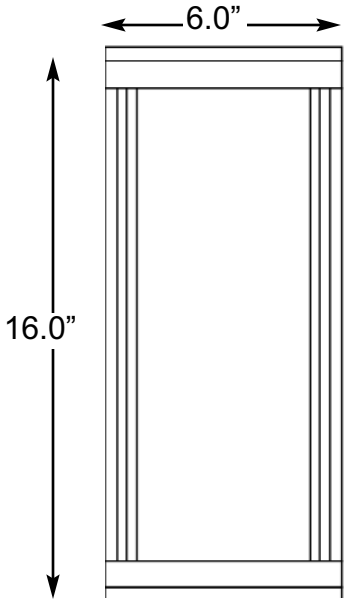
Diffuser : Clear glass.

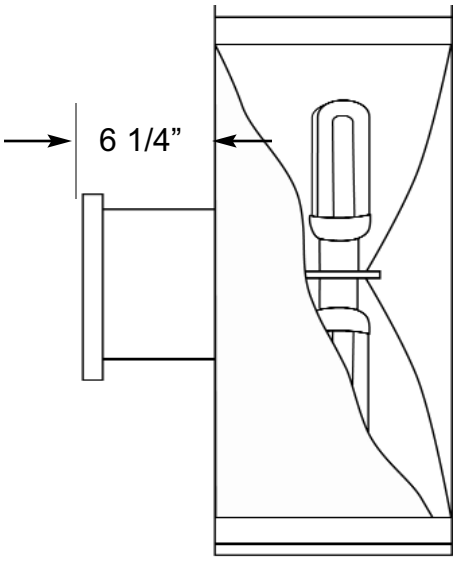
Electrical : Voltage : 120 / 277
Lamp: (2) Compact Fluorescent
Socket : G23-2, G24Q
Ballast : Class P, Electronic Ballast

Installation: Unit's back plate is 5.0"x 7 1/2" (Width x Length) will cover any standard J-Box.

Lumux - UD410

DIMENSIONS:





Lumux reserves the right to modify the above details to reflect changes in the cost of materials and/or design without prior notice.

Lumux Lighting Inc	877-895-5552	Rev : B	Drawing Number UD410

LUMUX

Date :	Project :	Type:
Agency :	Distributor :	

ORDERING GUIDE:

UD410 / XXX / XXX / xxx / xxx

XXX	XXX	xxx	xxx
PL9, PL2x9 PL13, PL2x13 PL18, PL2x18 PL26 ,PL2x26 PL32,PL2x32 PL42,PL2x42	120 277	White Black Silver Bronze RAL (optional)	Option Up only Down only

Unit could be specified for UP only or Down only. If not specified would be up and down.

Lumux - UD410

PROJECT NOTES:

Comments

Approval

Lumux reserves the right to modify the above details to reflect changes in the cost of materials and/or design without prior notice.

Lumux Lighting Inc	877-895-5552	Rev :B	Drawing Number UD410

GE Lighting

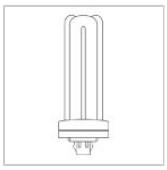
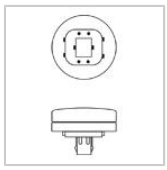
97634 - F42TBX/830/A/ECO

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering

Photo Not Available

Energy Savings


GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24-q4
Rated Life	17000 hrs
Starting Temperature	-18 °C (-0 °F)
Cathode Resistance	2.7 Ohm
LEED-EB MR Credit	66 picograms Hg per mean lumen hour
Rated Life (rapid start) @ Time	17000.0 @ 3.0/20000.0 @ 12.0 h
Additional Info	Dimmable with appropriate dimming ballast./End of Life Protection (EOL)/TCLP compliant
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3200
Mean Lumens	2690
Nominal Initial Lumens per Watt	76
Color Temperature	3000 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Wattage	42
Voltage	120
Current (max)	5.25 A
Open Circuit Voltage (after preheating)	265 V
Open Circuit Voltage	515 V
Lamp Current	0.32 A
Preheat Voltage	4.25 V
Current Crest Factor	1.7
Supply Current Frequency	20000 Hz

DIMENSIONS

Maximum Overall Length (MOL)	6.4000 in(162.6 mm)
Nominal Length	6.400 in(162.6 mm)
Base Face to Top of Lamp	5.770 in(146.6 mm)

PRODUCT INFORMATION

Product Code	97634
Description	F42TBX/830/A/ECO
ANSI Code	60901-IEC-7442-2
Standard Package	Case
Standard Package GTIN	10043168976340
Standard Package Quantity	10
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168976343

CAUTIONS & WARNINGS

Caution

- Lamp may shatter and cause injury if broken
  - Remove and install by grasping only plastic portion of the lamp.

NOTES

- 4-Pin lamp minimum starting temperature is a function of the ballast. Most ballasts are rated with a minimum starting temperature of 50 degrees F (10 C). Ballasts are also available that provide reliable starting to 0 degrees F (-18C) and -20 F (-29C).
- Amalgam product experience stable brightness over a wider temperature range and in various operating positions.
- Based on 60Hz reference circuit.
- Fluorescent lamp lumens decline during life

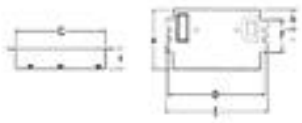
GE Lighting

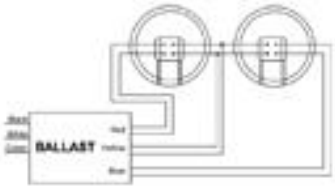
47506 - C242UNVBES-IP

GE CFL Electronic Program / Rapid Start Ballast

- Electronic compact fluorescent ballasts for all general fluorescent applications
- Low profile case

This product is no longer manufactured. Remaining stock will be sold.





GENERAL CHARACTERISTICS

Application	2- 42 / 36 / 32 / 26 / 24 watt CFL UNV Bottom Exit w Studs
Category	Compact Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Series
Line Voltage Regulation (+/-)	10 %
Ambient Temperature (MAX)	122 °F(50 °C)
Case Temperature	75 °C(167 °F)
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Additional Info	Auto-restart/Thermally protected/Universal voltage

PRODUCT INFORMATION

Product Code	47506
Description	C242UNVBES-IP
Standard Package	Master
Standard Package GTIN	30043168475069
Standard Package Quantity	10
Sales Unit	Individual Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168475068

DIMENSIONS

Case dimensions	
Length (L)	4.2 in(107.95 mm)
Width (W)	3.0 in(75.69 mm)
Height (H)	1.0 in(25.40 mm)
Mounting dimensions	
Bracket Length (BL)	4.9 in(125.48 mm)
Mount Length (M)	4.6 in(117.09 mm)
Mount Width (X or F)	1.6 in(39.37 mm)
Weight	0.9 lb
Exit Type	Bottom
Remote Mounting Distance	12 ft
Remote Mounting Wire Gauge	18 AWG

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	50 Hz/60 Hz

SAFETY & PERFORMANCE

- CSA
- FCC - CLASS A Non-Consumer
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type CC
- UL Type HL

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
FT55W/4P	1	120	46	0.38 A	0.83	1.80	99	1.7	10	0.0 / -18
FT55W/4P	1	277	46	0.17 A	0.83	1.80	95	1.7	10	0.0 / -18
FT36W/4P	2	120	64	0.43 A	0.83	NaN	99	1.7	10	0.0 / -18
FT36W/4P	2	277	64	0.19 A	0.83	NaN	97	1.7	10	0.0 / -18
FT24W/4P	2	120	51	0.43 A	1.02	2.00	95	1.7	10	0.0 / -18
FT24W/4P	2	277	50	0.19 A	1.02	2.04	95	1.7	10	0.0 / -18
FC9T5-22W/4P	1	120	66	0.54 A	0.98	1.48	97	1.7	10	0.0 / -18
FC9T5-22W/4P	1	277	64	0.24 A	0.98	NaN	97	1.7	10	0.0 / -18
FC9T5-22W/4P	2	120	50	0.42 A	1.05	2.10	95	1.7	10	0.0 / -18
FC9T5-22W/4P	2	277	50	0.19 A	1.05	2.10	95	1.7	10	0.0 / -18
FC12T5-55W/4P	1	120	44	0.36 A	0.83	1.89	99	1.7	10	0.0 / -18
FC12T5-55W/4P	1	277	43	0.17 A	0.83	1.93	93	1.7	10	0.0 / -18
FC12T5-40W/4P	1	120	66	0.54 A	0.98	1.48	97	1.7	10	0.0 / -18
FC12T5-40W/4P	1	277	64	0.24 A	0.98	NaN	97	1.7	10	0.0 / -18
FC12T5-40W/4P	2	120	80	0.65 A	0.98	1.22	98	1.6	10	0.0 / -18
FC12T5-40W/4P	2	277	79	0.29 A	0.98	1.24	98	1.6	10	0.0 / -18
CFTR70W/4P	1	120	73	0.61 A	1.00	1.37	98	1.6	10	0.0 / -18
CFTR70W/4P	1	277	72	0.27 A	1.00	1.39	95	1.6	10	0.0 / -18
CFTR57W/4P	1	120	58	0.52 A	1.00	1.72	98	1.6	10	0.0 / -18

CFTR57W/4P	1	277	57	0.20 A	1.00	1.75	98	1.6	10	0.0 / -18
CFTR42W/4P	1	120	45	0.4 A	1.00	2.22	93	1.6	10	0.0 / -18
CFTR42W/4P	1	277	45	0.18 A	1.00	2.22	93	1.6	10	0.0 / -18
CFTR42W/4P	2	120	91	0.76 A	0.98	1.08	98	1.6	10	0.0 / -18
CFTR42W/4P	2	277	90	0.32 A	0.98	1.09	98	1.6	10	0.0 / -18
CFTR32W/4P	2	120	69	0.58 A	1.00	1.45	98	1.6	10	0.0 / -18
CFTR32W/4P	2	277	67	0.26 A	1.00	1.49	98	1.6	10	0.0 / -18
CFTR26W/4P	2	120	56	0.46 A	1.02	1.82	95	1.6	10	0.0 / -18
CFTR26W/4P	2	277	55	0.2 A	1.02	1.85	95	1.6	10	0.0 / -18
CFS28W/4P	2	120	64	0.54 A	1.00	NaN	97	1.6	10	0.0 / -18
CFS28W/4P	2	277	63	0.24 A	1.00	1.59	97	1.6	10	0.0 / -18
CFM36W/4P	1	120	33	0.28 A	0.98	2.97	99	1.7	15	0.0 / -18
CFM36W/4P	1	277	33	0.14 A	0.98	2.97	90	1.7	15	0.0 / -18
CFM36W/4P	2	120	68	0.57 A	0.90	1.32	95	1.7	10	0.0 / -18
CFM36W/4P	2	277	67	0.24 A	0.90	1.34	95	1.7	10	0.0 / -18

CAUTIONS & WARNINGS

Warning

• Risk of Electric Shock

- Properly ground ballast and fixture.
- Turn power off before servicing--see instructions.

NOTES

• 42W applications also operate on 125VDC input, (+)L (-)N

WARRANTY INFORMATION

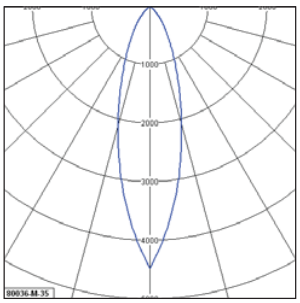
GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

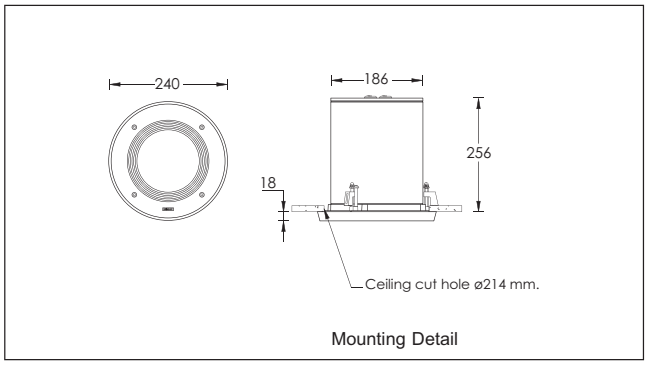
LUMINAIRE SPECIFICATION

PROJECT : _____ DATE : _____

LOCATION : _____

QUANTITY : _____ NOTE : _____





Mounting Detail

80036-M-35

Robust 1 recessed exterior downlight round dia 240 mm.

IP65 /EN 60598/CLASS I / / /IK10

Product Type

Ceiling luminaires.

Product Information

AA robust 1 round design front frame recessed exterior downlight use compact fluorescent lamp, halogen main voltage lamp and discharge lamp. Easy to installation and relamping. The luminaires are designed for all area of interior and exterior lighting. Robust 1 aluminium powder painted front frame. Robust 1 are ballproof and suitable for sports facilities.

Material Characteristics

Die-cast aluminium housing with high corrosion resistance. Stainless steel screws. Two cable entry. Durable silicone rubber gasket and clear toughened glass. Powder painted with high corrosion resistance with chemical chromatised protection.

Physical Data

Dia: 240 mm.
Height: 256 mm.
Weight: 4.5 Kg.

Colour

- ☐ Black - RAL 9011
- ☐ White - RAL 9003
- ☐ Matt Silver - RAL 9006
- ☐ Dark Grey - RAL 7043
- ☐ Metallic Silver - RAL 9006
- ☐ Custom - RAL _____

Reflector

Medium beam 26°

Lamp

HIT-CE 35w. G12 3300 lm.

Note

- Remoted control gear box is included for the luminaires use lamp source from 100w. to 150w.

Branch : Business contact address / Showroom
2912 Ladprao Rd., Klongjun, Bangkapi,
Bangkok 10240 Thailand
Email : info@ligmanlighting.com

Tel : +66 (0) 2 7339140 (9 lines)
Fax : +66 (0) 2 7339153 (Administration)
+66 (0) 2 7339154 (Overseas Sales)
+66 (0) 2 7339150 (Domestic Sales)

Head office : Chachoengsao factory office
17/2 Moo 4, Monthong, Bangnampreaw,
Chachoengsao 24150 Thailand

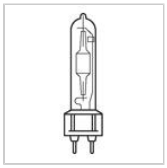
Tel : +66 (0) 38 581676-81
Fax : +66 (0) 38 581415
Email : factory@ligmanlighting.com
Website : www.ligmanlighting.com

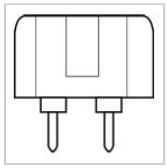
GE Lighting

20153 - CMH39TUVCU830G12

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4.5

a product of ecomagination





GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4.5
Base	Bi-Pin (G12)
Rated Life	16500 hrs
Bulb Material	Quartz
Lamp Enclosure Type (LET)	Enclosed fixtures only
LEED-EB MR Credit	127 picograms Hg per mean lumen hour
Additional Info	UV control

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3400
Mean Lumens	2300
Nominal Initial Lumens per Watt	87
Color Temperature	3000 K
Color Rendering Index (CRI)	84

ELECTRICAL CHARACTERISTICS

Wattage	39
Burn Position	Universal burning position
Warm Up Time to 90%	2 min
Warm Up Time to 90% (MAX)	2 min
Hot Restart Time to 90% (MIN)	10 min
Hot Restart Time to 90% (MAX)	15 min

DIMENSIONS

Maximum Overall Length (MOL)	3.56 cm
Light Center Length (LCL)	2.18 cm

PRODUCT INFORMATION

Product Code	20153
Description	CMH39TUVCU830G12
ANSI Code	C130/M130
Standard Package	Case
Standard Package GTIN	10043168201534
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168201537

CAUTIONS & WARNINGS

R- WARNING: This lamp can cause serious skin burn and eye inflammation from shortwave ultraviolet radiation if outer envelope of the lamp is broken or punctured, and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available. Visit the FDA website for more information: http://www.fda.gov/cdrh/radhealth/products/urburns.html

Caution

- Lamp may shatter and cause injury if broken
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

- A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.
- Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.
- Risk of Fire
  - Keep combustible materials away from lamp.
  - Use fused or thermally protected ballast - see instructions.
  - Use in fixture rated for this product.
- Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Operate lamp only in specified position.
  - Use in enclosed fixture rated for this product.
  - Use only properly rated ballast.
- Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.

NOTES

- Rated life is 15,000 hours on magnetic ballasts.

Revised: 3/5/2009

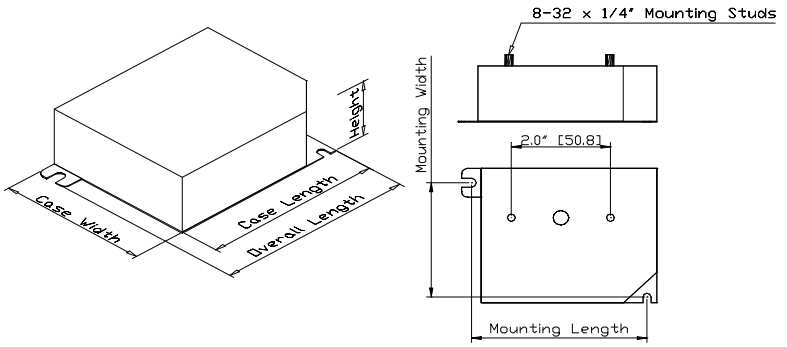
PHILIPS ADVANCE

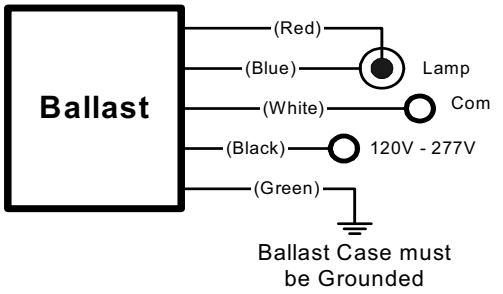
e-Vision® Electronic Ballast for Metal Halide Lamps

Catalog Number: IMH-39-G
For 39W Metal Halide Lamps
ANSI M130
120-277 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

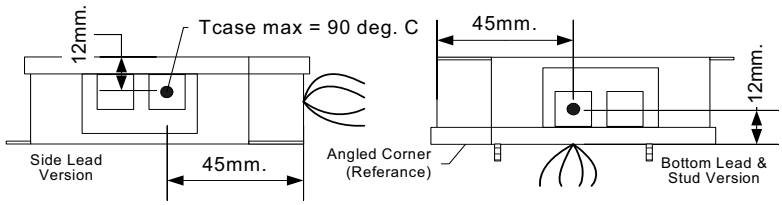
Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
39W Watt Lamp, ANSI Code M130 Minimum Starting Temp -30°C/-20°F										
1	39	120	IMH-39-G-XXX	0.39	46	0.9	3	G	0.9	5
		277		0.18	45					





Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
G	97mm [3.8"]	90mm [3.5"]	77mm [3.0"]	30mm [1.2"]	87mm [3.4"]	67mm [2.6"]



Case Temperature Measurement Location

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 90°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 9 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp
6. Connect the red lead to the center terminals of the lamp when using screw base lamps

***Ordering Information**

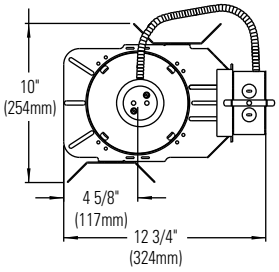
Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

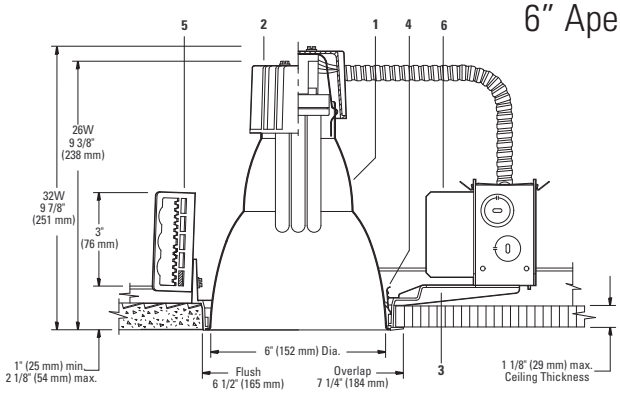
Data is based on tests performed by Philips Advance in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

Philips Lighting Electronics N.A.
10275 West Higgins Road • Rosemont, IL 60018 • www.philips.com/advance
Tel: 800-322-2086 • Fax: 800-423-1882 • Customer Support: 800-372-3331 • OEM Support: 866-915-5886

Calculite® CFL Open Downlight **8021**

6" Aperture Triple Tube Vertical Lamp





Ceiling Cutout: 6 9/16" (167 mm) Dia.

Reflector Trim

8021 CCLW	Comfort Clear™, White Flange
8021 CCLP	Comfort Clear™, Polished Flange
8021 CCL	Comfort Clear™, Molded Trim Ring
8021 ☐	Add suffix. See options for other finishes.

Frame-In Kit

S6132BU	6" aperture, 1 lamp 26/32W Triple Tube CFL (120/277V) 4-Pin (Amalgam)
Standard Dimming Options:	
S6132B ☐	
CU3	Lightolier PowerSpec 3% Dimming (120/277V)
J1LD3	Lutron 5% Dimming (120V)
J2LD3	Lutron 5% Dimming (277V)
JUM7	Mark 7 Dimming (120/277V)
J1MX	Mark 10 Dimming (120V)
J2MX	Mark 10 Dimming (277V)
Other dimming product available, please consult factory	

Remodeler Frame-In Kits

6126BURM	6" aperture, 1 lamp 26W Triple Tube CFL (120/277V) 4-Pin (Amalgam)
6132BURM	6" aperture, 1 lamp 26/32W Triple Tube CFL (120/277V) 4-Pin (Amalgam)

Features

1. **Reflector:** 16 ga. Alzak® aluminum, 50° visual cutoff to lamp and lamp image, medium distribution. Comfort Clear™ low iridescence finish. Self-flanged or flangeless with molded white trim ring (field paintable).
2. **Socket Cup:** Effectively dissipates heat and positions lamp holder. Snaps onto reflector neck to assure consistently correct optical alignment without tools.
3. **Mounting Frame:** Galvanized steel for dry or plaster ceilings. Accepts other 6" Triple Tube reflectors (see S6132BU Spec Sheet).
4. **Retaining Springs:** Precision-tooled steel friction springs secure reflector to mounting frame for quick, tool-less installation.
5. **Mounting Brackets:** 16 ga. steel. Adjust from inside of fixture. Use 3/4" or 1 1/2" lathing channel, 1/2" EMT, or optional mounting bars.
6. **Ballast/J-Box:** Electronic 120V-277V. UL listed for through branch circuit wiring with max of (8) No. 12 AWG, 90°c supply conductors. Outboard mounted to reduce heat transfer and maintain lamp efficacy and life. Service from below without tools.

Electrical

Note: For ballast electrical data and latest lamp/ballast compatibility refer to **"Ballast"** specification sheet for complete electrical data.
UL Listed for through branch circuit wiring with max of (8) No 12 AWG, 90 degree C supply conductors.

Options and Accessories

Comfort Clear™ Finishes[1]		**Other Finishes**	
Diffuse	**CCD**	White	**WH**
Champagne Bronze	**CCZ**	Specular Clear	**CL**
Multigroove	**MG**		

[1]Specify desired flange. **W** White, **P** Polished, Blank - Molded Ring

Options and Accessories (continued)

Emergency Ltg. Kit	**FA EM3E***
	FA EM4*
Fuse (Slow Blow)	Add suffix **F**
Existing/Thk. Ceiling	**FA EC6***
Emergency	Add suffix **EM***
Chicago Plenum	Use S6132BULC

*See Spec. Sheets: FAEM, FAEC

Mounting Bars & Accessories; see Specification Sheet MBA.
Sloped Ceiling Adapters; see Specification Sheet SCA.

IC Frame available; see **C6CFL32** Specification Sheet.

Labels

UL Listed for damp locations.

Alzak® is a registered trademark of ALCOA.
US Patent Pending.

Job Information **Type:**

Job Name:

Cat. No.:

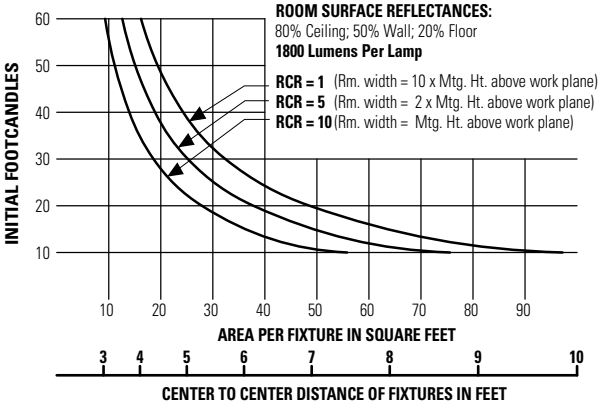
Lamp(s):

Notes:

631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

PHILIPS
LIGHTOLIER®

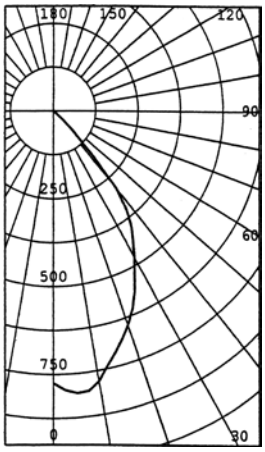
26W
Quick Calculator



This quick calculator chart determines the number and spacing of 1 lt.- 26W TTT units with Comfort Clear™ reflector, for any level of illumination.

Spacing Ratio = 1.0

REPORT NO: LSI 14025
LIGHTOLIER RECESSED FLUORESCENT LUMINAIRE,
WITH COMFORT CLEAR™ REFLECTOR
ONE 26 WATT CPFL GE LAMP,
CAT# F26TBX/SPX35-835.
LUMEN RATING = 1800 LMS.



EFFICIENCY=48.1%
DATE: 4-23-99
CIE TYPE DIRECT
LUMINOUS DIAMETER: 6.000
THIS REPORT BASED ON LM-1 AND
OTHER PERTINENT IES PROCEDURES.

ZONAL SUMMARY

ANGLE	CP	LUMENS
0	775	
5	806	77
10	780	
15	708	199
20	646	
25	566	258
30	478	
35	402	245
40	285	
45	78	81
50	13	
55	4	4
60	2	
65	1	2
70	1	
75	1	1
80	0	
85	0	0

ZONAL LUMENS AND PERCENTAGES

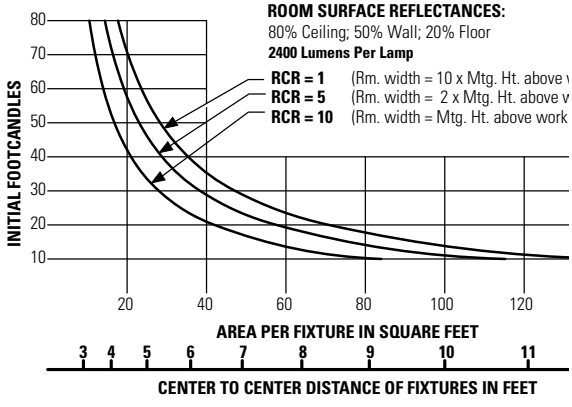
ZONE	LUMENS	%LAMP	%LUMINAIRE
0-30	533	29.66	61.66
0-40	778	43.25	89.92
0-60	863	47.98	99.75
0-90	865	48.10	100.00
40-90	87	4.85	10.08
60-90	2	.12	.25
90-180	0	.00	.00
0-180	865	48.10	100.00

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

ROOM CAVITY RATIO	80			70			50			30			10			
	WALL OF REFLECTANCE															
	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.54	.53	.52	.53	.52	.51	.51	.50	.49	.49	.48	.48	.47	.47	.46	.46
2	.50	.49	.47	.50	.48	.47	.48	.47	.46	.47	.46	.45	.45	.45	.44	.43
3	.47	.45	.44	.47	.45	.43	.46	.44	.43	.44	.43	.42	.43	.42	.41	.41
4	.45	.42	.40	.44	.42	.40	.43	.41	.40	.42	.41	.39	.41	.40	.39	.38
5	.42	.39	.37	.42	.39	.37	.41	.39	.37	.40	.38	.37	.39	.38	.36	.36
6	.40	.37	.35	.39	.37	.35	.39	.36	.35	.38	.36	.34	.37	.36	.34	.34
7	.37	.34	.33	.37	.34	.32	.36	.34	.32	.36	.34	.32	.35	.33	.32	.31
8	.35	.32	.30	.34	.32	.30	.34	.32	.30	.34	.31	.30	.33	.31	.30	.29
9	.33	.30	.28	.32	.30	.28	.32	.30	.28	.32	.29	.28	.31	.29	.28	.27
10	.31	.28	.26	.30	.28	.26	.30	.28	.26	.30	.27	.26	.29	.27	.26	.25

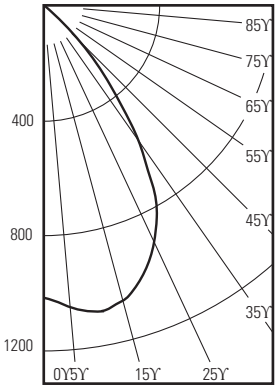
32W
Quick Calculator



This quick calculator chart determines the number and spacing of 1 lt.- 32W TTT un with Comfort Clear™ reflector, for any level of illumination

Spacing Ratio = 1.1

REPORT PREPARED FOR: LIGHTOLIER 04-27-1999
REPORT NO: LRL 499-9G
LAMPS: 1 PLT-32 LUMENS: 2400
DESCRIP.: 6" DIA X 10" HT RECESSED DOWNLIGHT
WITH COMFORT CLEAR™ REFLECTOR. VERTICAL
LAMP.



EFFICIENCY=52.7%
DATE: 4-27-99
CIE TYPE DIRECT
LUMINOUS DIAMETER: 6.000
THIS REPORT BASED ON LM-1 AND
OTHER PERTINENT IES PROCEDURES.

ZONAL SUMMARY

ZONE	AVG* ZONAL DEG.	C.P. LUMENS
180	0	
175	0	0
165	0	0
155	0	0
145	0	0
135	0	0
125	0	0
115	0	0
105	0	0
95	0	0
90	0	0
85	1	1
75	1	1
65	3	3
55	9	8
45	99	77
35	563	354
25	904	418
15	1063	301
5	1066	102
0	1035	

ZONAL LUMENS AND PERCENTAGES

ZONE	LUMENS	% LAMP	%LUMINAIRE
0–30	821	34.2	64.9
0–40	1175	49.0	92.9
0–60	1260	52.5	99.6
0–90	1265	52.7	100.0
40–90	90	3.8	7.1
60–90	5	0.2	0.4
90–120	0	0.0	0.0
90–150	0	0.0	0.0
90–180	0	0.0	0.0
0–180	1265	52.7	100.0

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

ROOM CAVITY RATIO	80			70			50			30			10			
	WALL OF REFLECTANCE															
	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.59	.58	.57	.58	.57	.56	.56	.55	.54	.54	.53	.53	.52	.52	.51	.50
2	.56	.54	.53	.55	.54	.52	.54	.52	.51	.52	.51	.50	.51	.50	.49	.48
3	.53	.51	.50	.53	.51	.49	.51	.50	.49	.50	.49	.48	.49	.48	.47	.46
4	.51	.48	.47	.50	.48	.46	.49	.47	.46	.48	.46	.45	.47	.46	.45	.44
5	.48	.46	.44	.48	.45	.44	.47	.45	.43	.46	.44	.43	.45	.44	.43	.42
6	.46	.43	.42	.46	.43	.41	.45	.43	.41	.44	.42	.41	.44	.42	.41	.40
7	.44	.41	.39	.43	.41	.39	.43	.41	.39	.42	.40	.39	.42	.40	.39	.38
8	.41	.39	.37	.41	.39	.37	.41	.38	.37	.40	.38	.37	.40	.38	.36	.36
9	.39	.36	.35	.39	.36	.35	.38	.36	.35	.38	.36	.34	.38	.36	.34	.34
10	.35	.32	.31	.35	.32	.31	.35	.32	.30	.34	.32	.30	.34	.32	.30	.30

Job Information **Type:**

631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

PHILIPS
LIGHTOLIER®

GE Lighting

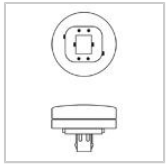
97617 - F26TBX/841/A/ECO

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering

Photo Not Available

Energy Savings



GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24q-3
Rated Life	17000 hrs
Starting Temperature	0 K (32 °F)
Cathode Resistance	2.7 Ohm
LEED-EB MR Credit	115 picograms Hg per mean lumen hour
Rated Life (rapid start) @ Time	17000.0 @ 3.0/20000.0 @ 12.0 h
Additional Info	Dimmable with appropriate dimming ballast./End of Life Protection (EOL)/TCLP compliant
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1800
Mean Lumens	1530
Nominal Initial Lumens per Watt	69
Color Temperature	4100 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Wattage	26
Voltage	120
Current (max)	5.25 A
Open Circuit Voltage (after preheating)	265 V
Open Circuit Voltage Across Starter	198 V
Lamp Current	0.42 A
Preheat Voltage	4.25 V
Supply Current Frequency	20000 Hz

DIMENSIONS

Maximum Overall Length (MOL)	5.2 cm
Nominal Length	5.2 cm
Bulb Diameter (DIA)	0.406 cm
Bulb Diameter (DIA) (MAX)	

PRODUCT INFORMATION

Product Code	97617
Description	F26TBX/841/A/ECO
ANSI Code	60501-IEC-3426-1
Standard Package	Case
Standard Package GTIN	10043168976173
Standard Package Quantity	10
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168976176

CAUTIONS & WARNINGS

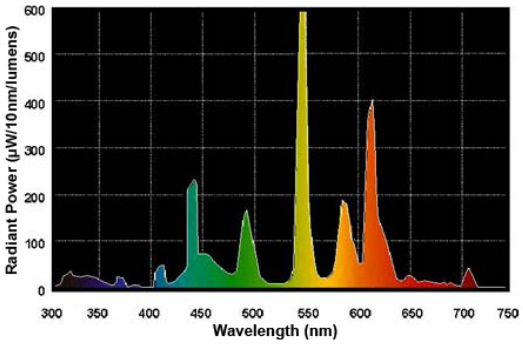
Caution

• Lamp may shatter and cause injury if broken

- Remove and install by grasping only plastic portion of the lamp.

GRAPHS & CHARTS

Spectral Power Distribution



NOTES

• 4-Pin lamp minimum starting temperature is a function of the ballast. Most ballasts are rated with a minimum starting temperature of 50 degrees F (10 C). Ballasts are also available that provide reliable starting to 0 degrees F (-18C) and -20 F (-29C).

• Amalgam product experience stable brightness over a wider temperature range and in various operating positions.

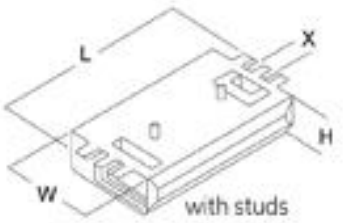
• Based on 60Hz reference circuit.

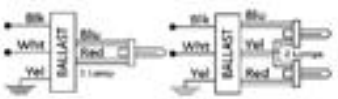
• Fluorescent lamp lumens decline during life

71434 - GEC218-MVPS-3W

GE CFL Multi-Volt ProLine™ Electronic Program / Rapid Start Ballast

- Multi-Voltage technology means a single ballast handles voltage from 108V to 305V
- Programmed starting for extended lamp life
- End-of-Lamp-Life Protection
- Color Coded Poke-In Connectors simplifies wiring
- 3-Way Ballast Kit (-3W) includes mounting plate, lead wires, extraction tool and mounting hardware for side exit, bottom exit or bottom exit with studs mounting





GENERAL CHARACTERISTICS

Application	2 or 1- CFQ18W/G24q 120-277V Proline PS 3 Way Kit
Category	Compact Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Series
Line Voltage Regulation (+/-)	10 %
Case Temperature	70 °C(158 °F)
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Auto-restart/Thermally protected/Universal voltage

PRODUCT INFORMATION

Product Code	71434
Description	GEC218-MVPS-3W
Standard Package	Master
Standard Package GTIN	10043168714348
Standard Package Quantity	10
Sales Unit	Individual Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168714341

DIMENSIONS

Case dimensions	
Length (L)	5.0 in(127.00 mm)
Width (W)	2.4 in(60.96 mm)
Height (H)	1.0 in(25.40 mm)
Mounting dimensions	
Mount Length (M)	4.6 in(117.60 mm)
Weight	1.1 lb
Exit Type	Poke-in
Remote Mounting Distance	20 ft
Remote Mounting Wire Gauge	18 AWG

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	50 Hz/60 Hz

SAFETY & PERFORMANCE

- CSA
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type CC
- UL Type HL
- FCC Part 18 Class B at 120 volts

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
CFTR26W/4P	1	120	28	0.24 A	1.00	3.57	99	1.6	12	-20.0 / -29
CFTR26W/4P	1	277	28	0.1 A	1.00	3.57	96	1.6	12	-20.0 / -29
CFTR18W/4P	1	120	20	0.17 A	1.05	NaN	97	1 1/2	10	-20.0 / -29
CFTR18W/4P	1	277	20	0.08 A	1.05	NaN	97	1 1/2	10	-20.0 / -29
CFTR18W/4P	2	120	39	0.33 A	1.05	2.69	97	1 1/2	10	-20.0 / -29
CFTR18W/4P	2	277	39	0.14 A	1.05	2.69	97	1 1/2	10	-20.0 / -29
CFS28W/4P	1	120	31	0.26 A	1.00	3.23	99	1 1/2	10	-20.0 / -29
CFS28W/4P	1	277	31	0.11 A	1.00	3.23	97	1 1/2	10	-20.0 / -29
CFS21W/4P	1	120	20	0.16 A	0.90	NaN	97	1 1/2	15	-20.0 / -29
CFS21W/4P	1	277	20	0.07 A	0.90	NaN	97	1 1/2	15	-20.0 / -29
CFS21W/4P	2	120	40	0.33 A	0.91	2.28	99	1 1/2	10	-20.0 / -29
CFS21W/4P	2	277	40	0.14 A	0.91	2.28	99	1 1/2	10	-20.0 / -29
CFS16W/4P	2	120	37	0.31 A	1.00	2.70	99	1 1/2	10	-20.0 / -29
CFS16W/4P	2	277	37	0.13 A	1.00	2.70	99	1 1/2	10	-20.0 / -29
CFQ26W/4P	1	120	28	0.24 A	1.00	3.57	99	1.6	12	-20.0 / -29
CFQ26W/4P	1	277	28	0.1 A	1.00	3.57	96	1.6	12	-20.0 / -29
CFQ18W/4P	1	120	19	0.07 A	0.95	5.00	99	1 1/2	10	-20.0 / -29
CFQ18W/4P	1	277	19	0.31 A	0.95	5.00	99	1 1/2	10	-20.0 / -29
CFQ18W/4P	2	120	35	0.3 A	1.00	2.86	97	1 1/2	10	-20.0 / -29
CFQ18W/4P	2	277	35	0.13 A	1.00	2.86	97	1 1/2	10	-20.0 / -29

DUPLUX® 126/8 226/8

recessed compact fluorescent downlight/wallwashers

FEATURES

Duplux 126/8 and Duplux 226/8 are highly efficient 8" aperture low brightness downlights, for use with one or two 26-watt compact fluorescent lamps. Duplux 226/8 provides shielding angles of 35° parallel to and 40° perpendicular to the lamps. Recess depth is only 6 9/16".

One housing allows interchangeable use of downlight and wallwash reflectors, permitting housings to be installed first and reflectors to be installed or changed at any time.

Duplux 226/8 uses two 26-watt, 4-pin lamps providing 3600 lumens (nearly as many as a 200-watt incandescent), a 10,000-hour life, a color rendering index (CRI) of 85, and color temperatures as warm as 2700°K (nearly duplicating the color qualities of incandescent).

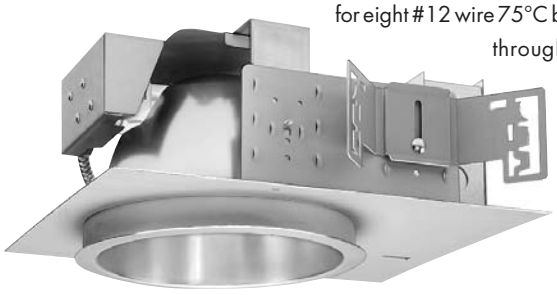
Reflectors are available in clear, natural aluminum in three finishes: **EvenTone**, our standard clear finish, partially diffuse, anti-iridescent and gently luminous in appearance; **OptiTone**, semi-specular and anti-iridescent, with minimum brightness and maximum efficiency; and **EasyTone**, diffuse and luminous. Additionally, reflectors are available in champagne gold, wheat, pewter, and bronze. Wallwash (120°) and double wallwash (2x120°) reflectors are also available.

Duplux 126/8 and Duplux 226/8 include pairs of mounting bars (¾" x 27" C channel). Specialty bars for wood joist and T-bar installations are available as accessories.

APPLICATIONS

Fixtures are recommended for downlighting or wallwashing in offices, stores, banks, schools, hospitals and airports, as well as lobbies and public areas. The shallow recess depth allows mounting in constricted plenum situations.

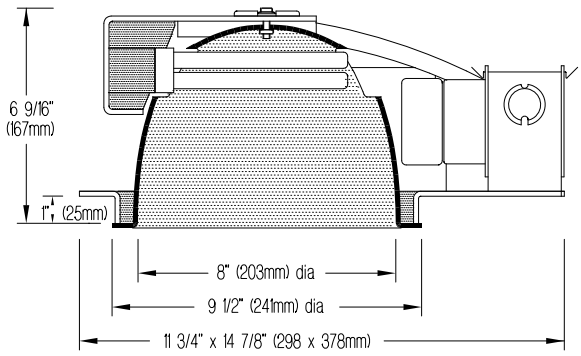
Fixtures are c UL us listed for Damp Location (may not be suitable for some outdoor environments). Fixtures are prewired with high power factor Class P electronic ballast, suitable for use in a fire rated ceiling, and approved for eight #12 wire 75°C branch circuit pull-through wiring. Removal of the reflector allows access to the ballast and junction box.



MODIFICATIONS AVAILABLE

Contact factory with quantity for pricing; orders may require shop drawing approval.

CHP-: fixture suitable for **Chicago Plenum**; add CHP- as prefix to Product Code.
CONC-: fixture suitable for poured-in-place **concrete**; add CONC- as prefix to Product Code.
EXP-: 'European-style' **install-from-below** fixture; add EXP- as prefix to Product Code.
+2"CLG: fixture suitable for installation in **2" thick ceiling** material; add +2"CLG to Product Code.



Requires ceiling opening of 8 15/16" (227mm)

PRODUCT CODE

For complete product code, list basic unit and select one item from each following box.

Basic Unit ..... DPLX 126/8 or DPLX 226/8

Reflector Type
Downlight ..... no suffix
Wallwash ..... WW
Double Wallwash ..... DWW

Voltage
120 volt service ..... 120 277 volt service 277

Reflector and Flange Color	*Overlap*
EvenTone Clear	VOL
OptiTone Clear	COL
EasyTone Clear	ECOL
Champagne Gold	GOL
Wheat	WHOL
Pewter	POL
Bronze	ZOL

Other reflector finishes are available on special order.

Standard reflector flange continues reflector finish. White painted flanges and custom painted flanges are available on special order. Add WF (white flange) or CCF (custom color flange).

OPTIONS

Specify by adding to the basic unit.

Dimmable 3-wire ballast ..... – DM

Emergency battery pack operates one lamp in event of power outage. Fixture footprint increases to 11¾ x 17 5/8" (298 x 448mm). Additional 1¼" (32mm) is required to remove EM pack through aperture. Not for outdoor application ..... – EM

⅛" (3mm) thick **clear acrylic shield**, spring-mounted within reflector ..... – PS

▶ For combinations of the Options above, contact factory or Edison Price Lighting representative.
▶ A modified fixture suitable for 347-volt service is available on special order. Contact factory.
▶ Decorative reflector rings are available on special order. Contact factory.

EDISON PRICE LIGHTING
41-50 22ND STREET, LIC NY 11101 TEL 718.685.0700 FAX 718.786.8530 www.epl.com

DUPLUX 226/8

EDISON PRICE LIGHTING

PHOTOMETRIC REPORT

Report No. 37444. Original Independent Testing Laboratories, Inc. (ITL) test report furnished upon request.

Luminaire .....recessed compact fluorescent downlight with spun aluminum reflector
Lamps.....two 26-watt double-tube, 4-pin, G24q-3 base, 1800 lumens each
Efficiency 70.2%
Spacing Criterion.....1.6

Photometric Report for Duplux I26/8 available on request.

BALLAST INFORMATION

Voltage	*120*	*277*
Input Watts	54	59
Line Current (A)	.45	.22
Power Factor (%)	>99	>99
Min. Starting Temp* (°F)	0	0

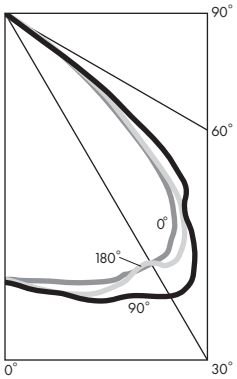
**Consult lamp manufacturers for specific temperatures.*

ZONAL LUMEN SUMMARY

Zone	*Lumens*	*% Lamp*	*% Fixture*
0 - 30°	951	26.4	37.6
0 - 40°	1662	46.2	65.8
0 - 60°	2524	70.1	99.9
0 - 90°	2526	70.2	100.0
90 -180°	0	0.0	0.0
0 -180°	2526	70.2	100.0

CANDLEPOWER DISTRIBUTION *(Candela)*

Vertical Angle	*Horizontal Angle*				
	0.0	*45.0*	*90.0*	*135.0*	*180.0*
0	1012	1012	1012	1012	1012
5	1012	1015	1032	1041	1044
15	1054	1080	1114	1119	1098
25	1088	1173	1177	1172	1100
35	1076	1100	1221	1117	1134
45	773	878	962	925	831
55	177	181	170	184	147
65	2	2	2	2	0
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



LUMINANCE DATA *(Candela/m²)*

Vertical Angle	*Average 0° Longitude*	*Average 90° Longitude*
45	32676	40675
55	9239	8876
65	140	140
75	0	0
85	0	0

To convert cd/m² to footlamberts, multiply by 0.2919.

COLOR MULTIPLIERS

OptiTone (C)	1.00	Wheat (WH)	.79
EvenTone (V)	.95	Pewter (P)	.81
EasyTone (EC)	.88	Bronze (Z)	.58
Champagne Gold (G)	.97		

COEFFICIENTS OF UTILIZATION – ZONAL CAVITY METHOD

Effective Floor Cavity Reflectance 20%

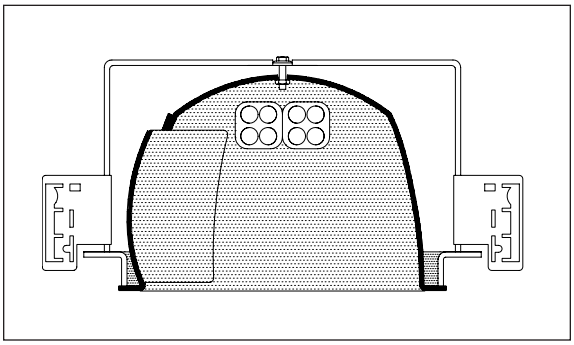
Ceiling Reflectance (%)	80				70				50			30			10			0
Wall Reflectance (%)	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
Room Cavity Ratio																		
0	84	84	84	84	82	82	82	82	78	78	78	75	75	75	72	72	72	70
1	79	77	75	73	77	75	74	72	73	71	70	70	69	68	67	67	66	64
2	75	71	68	65	73	70	67	64	67	65	63	65	63	62	63	62	60	59
3	70	65	61	58	69	64	60	58	62	59	57	60	58	56	59	57	55	54
4	66	60	55	52	64	59	55	52	57	54	51	56	53	50	55	52	50	49
5	61	55	50	46	60	54	50	46	53	59	46	51	48	45	50	47	45	44
6	57	50	45	41	56	49	45	41	48	44	41	47	43	41	46	43	40	39
7	53	45	40	37	52	45	40	36	44	39	36	43	39	36	42	38	36	35
8	49	41	36	32	48	40	36	32	40	35	32	39	35	32	38	34	32	31
9	45	37	32	28	44	36	32	28	36	31	28	35	31	28	34	31	28	27
10	42	33	28	25	41	33	28	25	32	28	25	32	27	25	31	27	24	23

DUPLUX 226/8 WW

WALLWASH INFORMATION

Distance From Ceiling (Feet)	*3' From Wall; 3' O.C.*		*4' From Wall; 4' O.C.*	
	Below Fixture	*Between Fixtures*	*Below Fixture*	*Between Fixtures*
1	26	24	12	11
2	32	29	17	16
3	39	37	19	17
4	41	40	22	21
5	36	36	23	23
6	29	29	22	22
7	22	22	19	19
8	17	17	16	16
9	13	13	13	13
10	10	10	11	11

All vertical footcandles are initial values with no contribution from ceiling or floor reflectances. Computation performed with a total of five wallwashers.



GE Lighting

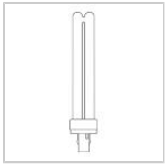
97613 - F26DBX/841/ECO4P

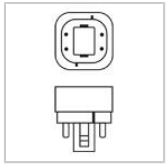
GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering

Photo Not Available

Energy Savings





GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	G24q-3
Rated Life	17000 hrs
Starting Temperature	0 °C (32 °F)
Cathode Resistance	2.7 Ohm
LEED-EB MR Credit	115 picograms Hg per mean lumen hour
Rated Life (rapid start) @ Time	20000.0 @ 12.0 h
Additional Info	Dimmable with appropriate dimming ballast./End of Life Protection (EOL)/TCLP compliant
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1800
Mean Lumens	1530
Nominal Initial Lumens per Watt	69
Color Temperature	4100 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Wattage	26
Voltage	120
Current (max)	5.25 A
Open Circuit Voltage (after preheating)	240 V
Open Circuit Voltage Across Starter	198 V
Lamp Current	0.325 A
Preheat Voltage	4.25 V
Current Crest Factor	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	6.4000 in(162.6 mm)
Nominal Length	6.400 in(162.6 mm)
Base Face to Top of Lamp	5.800 in(147.3 mm)

PRODUCT INFORMATION

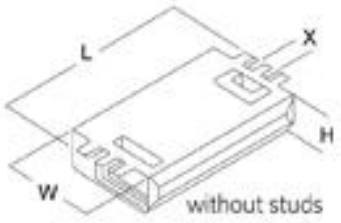
Product Code	97613
Description	F26DBX/841/ECO4P
ANSI Code	60901-IEC-2562-2
Standard Package	BUNDLE
Standard Package GTIN	
Standard Package Quantity	50
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	50
UPC	043168976138

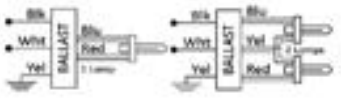
GE Lighting

71440 - GEC242-MVPS-SE

GE CFL Multi-Volt ProLine™ Electronic Program / Rapid Start Ballast

- Multi-Voltage technology means a single ballast handles voltage from 108V to 305V
- Programmed starting for extended lamp life
- End-of-Lamp-Life Protection
- Color Coded Poke-In Connectors simplifies wiring
- Dual-Entry Connectors accessible from bottom or side





GENERAL CHARACTERISTICS

Application	2- 42 / 36 / 32 / 28/ 26 / 24 watt Side Exit 120-277V Proline PS
Category	Compact Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Series
Line Voltage Regulation (+/-)	10 %
Case Temperature	90 °C(194 °F)
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Auto-restart/Thermally protected/Universal voltage

PRODUCT INFORMATION

Product Code	71440
Description	GEC242-MVPS-SE
Standard Package	Master
Standard Package GTIN	10043168714409
Standard Package Quantity	10
Sales Unit	Individual Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168714402

DIMENSIONS

Case dimensions	
Length (L)	5.0 in(127.00 mm)
Width (W)	3.0 in(76.20 mm)
Height (H)	1.4 in(35.05 mm)
Mounting dimensions	
Mount Length (M)	4.6 in(117.60 mm)
Weight	0.57 lb
Exit Type	Poke-in
Remote Mounting Distance	12 ft
Remote Mounting Wire Gauge	18 AWG

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	50 Hz/60 Hz

SAFETY & PERFORMANCE

- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type HL
- FCC Part 18 Class B at 120 volts
- Meets ANSI/IEEE C62.41 Cat. A

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
FT55W/4P	1	120	43	0.36 A	0.71	1.65	99	1.7	10	-20.0 / -29
FT55W/4P	1	277	44	0.16 A	0.72	1.64	96	1.7	12	-20.0 / -29
FT40W/4P	1	120	45	0.37 A	1.00	2.22	99	1.7	10	-20.0 / -29
FT40W/4P	1	277	45	0.17 A	1.00	2.22	96	1.7	12	-20.0 / -29
FT40W/4P	2	120	82	0.69 A	0.95	1.16	99	1.7	10	-20.0 / -29
FT40W/4P	2	277	82	0.3 A	0.95	1.16	98	1.7	10	-20.0 / -29
FT39W/4P	1	120	45	0.37 A	1.00	2.22	99	1.7	10	-20.0 / -29
FT39W/4P	2	120	82	0.69 A	0.95	1.16	99	1.7	10	-20.0 / -29
FT39W/4P	1	277	45	0.17 A	1.00	2.22	96	1.7	12	-20.0 / -29
FT39W/4P	2	277	82	0.3 A	0.95	1.16	98	1.7	10	-20.0 / -29
FT36W/4P	1	120	33	0.27 A	0.80	2.42	99	1.7	10	-20.0 / -29
FT36W/4P	1	277	33	0.13 A	0.80	2.42	94	1.7	15	-20.0 / -29
FT36W/4P	2	120	63	0.52 A	0.78	1.24	99	1.7	10	-20.0 / -29
FT36W/4P	2	277	62	0.23 A	0.79	1.27	98	1.7	10	-20.0 / -29
FT24W/4P	1	120	26	0.22 A	0.92	3.54	99	1.7	10	-20.0 / -29
FT24W/4P	1	277	27	0.1 A	0.92	3.41	92	1.7	15	-20.0 / -29
FT24W/4P	2	120	54	0.45 A	1.00	1.85	99	1.7	10	-20.0 / -29
FT24W/4P	2	277	54	0.2 A	1.00	1.85	97	1.7	12	-20.0 / -29
FC9T5-22W/4P	1	120	28	0.23 A	1.10	3.93	99	1.7	10	-20.0 / -29
FC9T5-22W/4P	2	120	52	0.44 A	1.10	2.12	99	1.7	10	-20.0 / -29
FC9T5-22W/4P	1	277	28	0.11 A	1.11	3.96	93	1.7	12	-20.0 / -29
FC9T5-22W/4P	2	277	52	0.19 A	1.10	2.12	97	1.7	12	-20.0 / -29

FC9T5+FC12T5	1	120	67	0.55 A	0.90	1.34	99	1.7	10	-20.0 / -29
FC9T5+FC12T5	1	277	67	0.25 A	0.90	1.34	98	1.7	10	-20.0 / -29
FC12T5-40W/4P	1	120	37	0.31 A	0.84	2.27	99	1.7	10	-20.0 / -29
FC12T5-40W/4P	2	120	70	0.59 A	0.80	1.14	99	1.7	10	-20.0 / -29
FC12T5-40W/4P	2	277	70	0.26 A	0.81	1.16	98	1.7	10	-20.0 / -29
FC12T5-40W/4P	1	277	37	0.14 A	0.84	2.27	95	1.7	15	-20.0 / -29
CFTR70W/4P	1	120	73	0.61 A	1.00	1.37	99	1.7	10	-20.0 / -29
CFTR70W/4P	1	277	73	0.27 A	1.00	1.37	97	1.7	12	-20.0 / -29
CFTR57W/4P	1	120	58	0.49 A	1.00	1.72	99	1.7	10	-20.0 / -29
CFTR57W/4P	1	277	58	0.22 A	1.00	1.72	97	1.7	12	-20.0 / -29
CFTR42W/4P	1	120	47	0.4 A	1.00	2.13	99	1.7	10	-20.0 / -29
CFTR42W/4P	1	277	47	0.18 A	1.00	2.13	96	1.7	10	-20.0 / -29
CFTR42W/4P	2	277	93	0.38 A	1.00	1.08	98	1.7	10	-20.0 / -29
CFTR42W/4P	2	120	94	0.77 A	1.00	1.06	99	1.7	10	-20.0 / -29
CFTR32W/4P	1	120	42	0.35 A	0.96	2.29	99	1.7	10	-20.0 / -29
CFTR32W/4P	1	277	42	0.13 A	0.96	2.29	96	1.7	12	-20.0 / -29
CFTR32W/4P	2	277	63	0.23 A	0.95	1.51	98	1.7	12	-20.0 / -29
CFTR32W/4P	2	120	63	0.53 A	0.95	1.51	99	1.7	10	-20.0 / -29
CFTR26W/4P	1	120	32	0.27 A	1.00	NaN	99	1.7	10	-20.0 / -29
CFTR26W/4P	1	277	32	0.13 A	1.00	NaN	95	1.7	12	-20.0 / -29
CFTR26W/4P	2	120	54	0.45 A	0.90	1.67	99	1.7	10	-20.0 / -29
CFTR26W/4P	2	277	54	0.21 A	0.90	1.67	97	1.7	12	-20.0 / -29
CFS55W/4P	1	120	33	0.28 A	0.49	1.48	99	1.7	10	-20.0 / -29
CFS55W/4P	1	277	32	0.13 A	0.49	NaN	94	1.7	10	-20.0 / -29
CFS28W/4P	1	120	34	0.29 A	1.00	2.94	99	1.7	10	-20.0 / -29
CFS28W/4P	1	277	34	0.14 A	1.00	2.94	93	1.7	15	-20.0 / -29
CFS28W/4P	2	120	60	0.5 A	0.95	1.58	99	1.7	10	-20.0 / -29
CFS28W/4P	2	277	60	0.22 A	0.97	1.62	98	1.7	10	-20.0 / -29
CFQ26W/4P	1	120	32	0.27 A	1.00	NaN	99	1.7	10	-20.0 / -29
CFQ26W/4P	1	277	32	0.13 A	1.00	NaN	95	1.7	12	-20.0 / -29
CFQ26W/4P	2	120	54	0.45 A	0.90	1.67	99	1.7	10	-20.0 / -29
CFQ26W/4P	2	277	54	0.21 A	0.90	1.67	97	1.7	12	-20.0 / -29
CFM36W/4P	1	120	33	0.27 A	0.80	2.42	99	1.7	10	-20.0 / -29
CFM36W/4P	1	277	33	0.13 A	0.80	2.42	94	1.7	15	-20.0 / -29
CFM36W/4P	2	120	63	0.52 A	0.78	1.24	99	1.7	10	-20.0 / -29
CFM36W/4P	2	277	62	0.23 A	0.79	1.27	98	1.7	10	-20.0 / -29

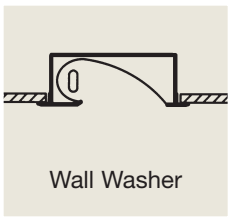
WARRANTY INFORMATION

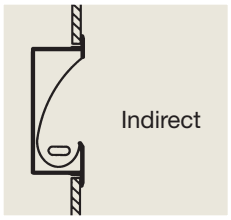
GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

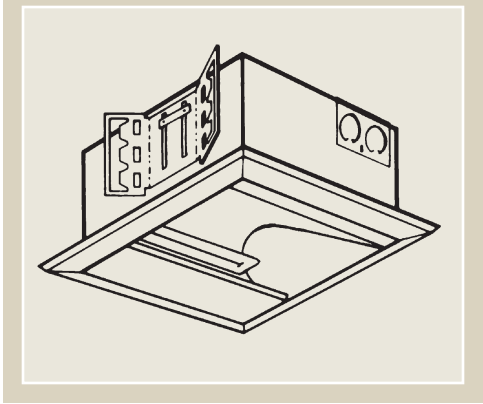
ELP
ENGINEERED LIGHTING PRODUCTS

AK SERIES

RECESSED Wall Washer For Plaster or Drywall







Project
Wilbur Medical Plaza
Tarzana, California

Interior Designer
McCabe Design
Long Beach, California

Specifier
McCabe Design
Long Beach, California

Photographer
Michael Sean
South Pasadena, California

Lighting
139 BXWW-AK, 39 watts

Ideal placement is 24˝ to 36˝ from the front edge of fixture to the surface you are lighting, for 8´ to 12´ ceilings.

System

High-performance wall wash fixtures with exceptional lamp shielding from the normal viewing angle. The shallow 3-1/2˝ design also allows wall installation in a standard 4˝ wall to wash the ceiling or floor with light. Formed, high purity aluminum reflectors provide even, unscalloped illumination.

AK SERIES

TYPE:

CATALOG #:

JOB:

RECESSED Wall Washer for Plaster or Drywall

Specifications

Recessed wall washer for use with PL, Quad, Triple Tube, Biax, T-5 and T-8 fluorescent lamps and the T-10 incandescent lamp. All fixtures are 3-1/2″ deep with the exception of the double lamp T-8 fixtures, which are 5″. Both have integral ballast.

The shallow 3-1/2″ fixture may be recessed into a standard 4″ wall to wash the ceiling or floor with light. By lining the "wall recess" with gypsum, the wall installation may also be modified to maintain a one hour fire rating (SEE INSTRUCTIONS).

The one-piece, formed reflector is high-purity aluminum (99.9%) with 95% reflectance. It is easily removable without tools for access to the ballast and wiring. Reflector design provides even, unscalloped illumination with complete lamp shielding even when viewed directly beneath the fixture (Triple Tube lamps not entirely shielded).

TGIC polyester powder coated housing is made of 22 gauge CRS with cover and knock-outs that provide quick wire access to side or back of fixture for through wiring. All fluorescent fixtures are supplied standard with Luminaire Disconnect. Trim is extruded aluminum.

Continuous Mount – If fixtures are being mounted in a continuous row add "CC" (if in ceiling) or "CW" (if in wall) to the catalog number and provide row configuration, so proper trims may be provided, i.e.: (18) 240BXWW-AK -CC for (6) 12′ rows.

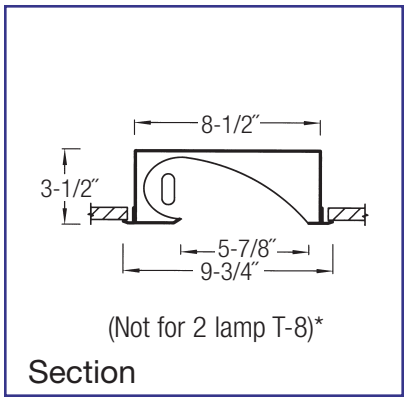
Rough-In Dimensions = (Entire length of row, add all "B" lengths + 1/2″) x 9-1/8″. Dimensions do *not* apply to Trimless installations.

UL/CUL Damp Location listed.

U.S. Patent #5,142,459

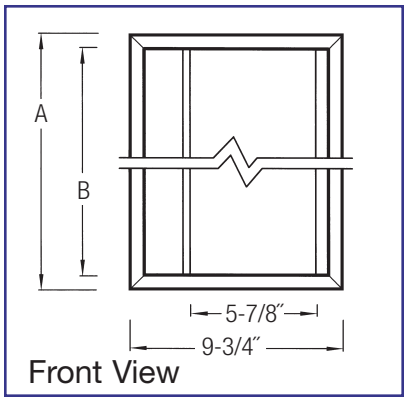
Options

Ballast	120 or 277 HPF Electronic (Standard) Dimming (Some models) -DM Emergency (Some models) -EPP
Finish	White (Standard) Anti-Microbial White -MB Custom -Custom
Reflectors	Diffuse Silver (Standard) Specular Silver -SP Stepped Diffuse Silver -ST Painted White -W *(To eliminate a clear lamp image in Up light installations that may occur at certain viewing angles, we suggest you use a White or Stepped reflector, OR standard reflector with Frosted Mini Lens)*
Lens *(Fluorescent only)*	Clear Lexan Mini Lens -ML Frosted Lexan Mini Lens -MLF Clear Lexan Full Lens -FL** Frosted Lexan Full Lens -FLF**
Louver	Diffuse Silver Parallel Blade -LV
Trimless	Gypsum/Drywall Installation -TLD Plaster Installation -TLP *(See TRIMLESS sheet for dimensions)*
Hospital	Hospital Grade Features -HG (Full Lens; Gasket; Anti-Microbial Paint)



(Not for 2 lamp T-8)*

Section



Front View

Model No.	A	B	Rough-in Dimensions	Lamp
160 INWW-AK	9-3/4″	8-1/2″	9-1/8″ x 9″	60 watt T-10 Inc.
113 PLWW-AK	9-3/4″	8-1/2″	9-1/8″ x 9″	13 watt PL
213 PLWW-AK	19-1/4″	18″	9-1/8″ x 18-1/2″	(2) 13 watt PL
126 QDWW-AK	9-3/4″	8-1/2″	9-1/8″ x 9″	26 watt Quad
226 QDWW-AK	19-1/4″	18″	9-1/8″ x 18-1/2″	(2) 26 watt Quad
118 TTWW-AK	9-3/4″	8-1/2″	9-1/8″ x 9″	18 watt Triple Tube
218 TTWW-AK	19-1/4″	18″	9-1/8″ x 18-1/2″	(2) 18 watt Triple Tube
126 TTWW-AK	9-3/4″	8-1/2″	9-1/8″ x 9″	26 watt Triple Tube
226 TTWW-AK	19-1/4″	18″	9-1/8″ x 18-1/2″	(2) 26 watt Triple Tube
132 TTWW-AK	9-3/4″	8-1/2″	9-1/8″ x 9″	32 watt Triple Tube
232 TTWW-AK	19-1/4″	18″	9-1/8″ x 18-1/2″	(2) 32 watt Triple Tube
142 TTWW-AK	9-3/4″	8-1/2″	9-1/8″ x 9″	42 watt Triple Tube
157 TTWW-AK	13-1/4″	12″	9-1/8″ x 12-1/2″	57 watt Triple Tube
242 TTWW-AK	19-1/4″	18″	9-1/8″ x 18-1/2″	(2) 42 watt Triple Tube
118 BXWW-AK	13-1/4″	12″	9-1/8″ x 12-1/2″	18 watt Biax
127 BXWW-AK	15-1/4″	14″	9-1/8″ x 14-1/2″	27 watt Biax
139 BXWW-AK	19-1/4″	18″	9-1/8″ x 18-1/2″	39 watt Biax
140 BXWW-AK	24-3/16″	22-15/16″	9-1/8″ x 23-1/2″	40 watt Biax
150 BXWW-AK	24-3/16″	22-15/16″	9-1/8″ x 23-1/2″	50 watt Biax
155 BXWW-AK	24-3/16″	22-15/16″	9-1/8″ x 23-1/2″	55 watt Biax
239 BXWW-AK	37-1/4″	36″	9-1/8″ x 36-1/2″	(2) 39 watt Biax
240 BXWW-AK	48-3/16″	46-15/16″	9-1/8″ x 47-1/2″	(2) 40 watt Biax
250 BXWW-AK	48-3/16″	46-15/16″	9-1/8″ x 47-1/2″	(2) 50 watt Biax
255 BXWW-AK	48-3/16″	46-15/16″	9-1/8″ x 47-1/2″	(2) 55 watt Biax
114 T-5WW-AK	24-3/16″	22-15/16″	9-1/8″ x 23-1/2″	14 watt T-5
214 T-5WW-AK	24-3/16″	22-15/16″	9-1/8″ x 23-1/2″	(2) 14 watt T-5
124 T-5WW-AK	24-3/16″	22-15/16″	9-1/8″ x 23-1/2″	24 watt T-5 HO
224 T-5WW-AK	24-3/16″	22-15/16″	9-1/8″ x 23-1/2″	(2) 24 watt T-5 HO
121 T-5WW-AK	37-1/4″	36″	9-1/8″ x 36-1/2″	21 watt T-5
221 T-5WW-AK	37-1/4″	36″	9-1/8″ x 36-1/2″	(2) 21 watt T-5
139 T-5WW-AK	37-1/4″	36″	9-1/8″ x 36-1/2″	39 watt T-5 HO
239 T-5WW-AK	37-1/4″	36″	9-1/8″ x 36-1/2″	(2) 39 watt T-5 HO
128 T-5WW-AK	48-3/16″	46-15/16″	9-1/8″ x 47-1/2″	28 watt T-5
228 T-5WW-AK	48-3/16″	46-15/16″	9-1/8″ x 47-1/2″	(2) 28 watt T-5
154 T-5WW-AK	48-3/16″	46-15/16″	9-1/8″ x 47-1/2″	54 watt T-5 HO
254 T-5WW-AK	48-3/16″	46-15/16″	9-1/8″ x 47-1/2″	(2) 54 watt T-5 HO
117 T-8WW-AK	25-1/4″	24″	9-1/8″ x 24-1/2″	17 watt T-8
125 T-8WW-AK	37-1/4″	36″	9-1/8″ x 36-1/2″	25 watt T-8
132 T-8WW-AK	49-1/4″	48″	9-1/8″ x 48-1/2″	32 watt T-8
217 T-8WW-AK*	25-1/4″	24″	10-5/8″ x 24-1/2″	(2) 17 watt T-8
225 T-8WW-AK*	37-1/4″	36″	10-5/8″ x 36-1/2″	(2) 25 watt T-8
232 T-8WW-AK*	49-1/4″	48″	10-5/8″ x 48-1/2″	(2) 32 watt T-8

* T-8 Double lamp housing is 10″W x 5″Ht. ** Full Lens Option is not available for Continuous mount units (end to end rows).

10768 Lower Azusa Rd., El Monte, CA 91731 • TEL: 626-579-0943 • FAX: 626-579-6803
E-MAIL: contact@elplighting.com • WEB: www.elplighting.com

GE Lighting

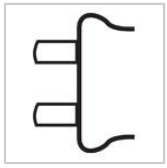
46673 - F14W/T5/841/ECO

GE Ecolux® Starcoat® T5

• Passes TCLP, which can lower disposal costs.

a product of ecomagination

High Color Rendering



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken

- Wear safety glasses and gloves when handling lamp.
- Do not use excessive force when installing lamp.

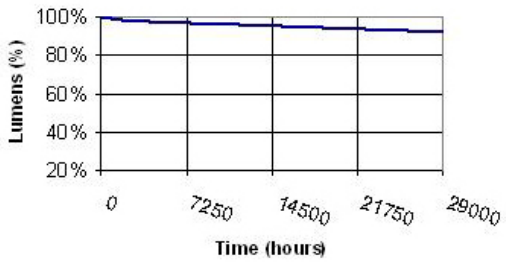
Warning

• Risk of Electric Shock

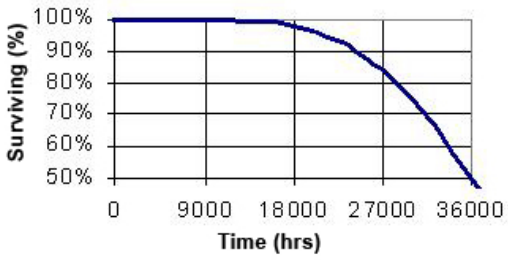
- Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Lumen Maintenance



Lamp Mortality



GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	30000.0 @ 3.0/36000.0 @ 12.0 h
Bulb Material	Soda lime
Starting Temperature	-20 °C (-4 °F)
LEED-EB MR Credit	67 picograms Hg per mean lumen hour
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1350
Mean Lumens	1240
Nominal Initial Lumens per Watt	96
Color Temperature	4100 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.7

ELECTRICAL CHARACTERISTICS

Wattage	14
Voltage	82
Open Circuit Voltage (rapid start) Min @ Temperature	230 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor	1.7

DIMENSIONS

Maximum Overall Length (MOL)	22.1700 in(563.1 mm)
Nominal Length	21.600 in(548.6 mm)
Bulb Diameter (DIA)	0.625 in(15.9 mm)
Bulb Diameter (DIA) (MAX)	0.670 in(17.0 mm)
Max Base Face to Base Face (A)	21.610 in(548.9 mm)
Face to End of Opposing Pin (B) (MIN)	21.790 in(553.5 mm)
Face to End of Opposing Pin (B) (MAX)	21.890 in(556.0 mm)

PRODUCT INFORMATION

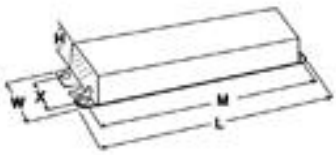
Product Code	46673
Description	F14W/T5/841/ECO
Standard Package	Case
Standard Package GTIN	10043168466735
Standard Package Quantity	40
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	40
UPC	043168466738

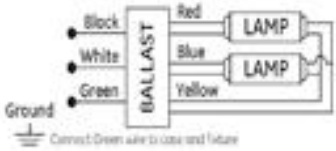
GE Lighting

99655 - GE228MVPS-A

GE LFL UltraStart® Electronic Program / Rapid Start Ballast

- High Efficiency T5 ballast with Continuous Cathode Cutout Technology
- Lower Maintenance Costs with Parallel Lamp Operation
- Fast Starting Time <700ms
- Multi-Voltage technology means a single ballast handles voltage from 108V to 305V
- Auto-Restart withstands temporary losses in power without the need to cycle power
- UltraCool™ Operation 90C case rating
- Anti-Striation Control for better light quality, with no striations.





GENERAL CHARACTERISTICS

Application	2 or 1 - F14-F35HE 120 to 277 UltraStart PRS Normal Light .95 BF A Can
Category	Linear Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Parallel
Line Voltage Regulation (+/-)	10 %
Case Temperature	90 °C(194 °F)
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Auto-restart/End of Life Protection (EOL)/Thermally protected/Universal voltage

PRODUCT INFORMATION

Product Code	99655
Description	GE228MVPS-A
Standard Package	Case
Standard Package GTIN	10043168996553
Standard Package Quantity	10
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168996556

DIMENSIONS

Case dimensions	
Length (L)	9.5 in(241.30 mm)
Width (W)	1.7 in(43.18 mm)
Height (H)	1.2 in(30.48 mm)
Mounting dimensions	
Mount Length (M)	8.9 in(226.06 mm)
Mount Slots (MS)	0.2 in(6.35 mm)
Weight	1.49 lb
Exit Type	Side
Remote Mounting Distance	8 ft
Remote Mounting Wire Gauge	18 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Left/Right	25.0 (635mm)
Blue	2	Left/Right	34.0 (864mm)
Green	1	Left/Right	3.5 (89mm)
Red	2	Left/Right	34.0 (864mm)
White	1	Left/Right	25.0 (635mm)
Yellow	2	Left/Right	45 (1143mm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	50 Hz/60 Hz

SAFETY & PERFORMANCE

- CSA
- FCC - CLASS A Non-Consumer
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type CC
- UL Type HL
- RoHs Compliant
- Meets ANSI Standard C82.11-Cons 2002
- Meets ANSI Standard C62.41-1991
- High Temperature Rated: Suitable for high temperature applications
- 70C max case temp 5 yr warranty or 90C max case temp 3 yr warranty

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
F35T5/WM	1	120	44	0.36 A	1.08	2.45	99	1 1/2	9	5.0 / -15
F35T5/WM	1	277	43	0.17 A	1.08	2.51	92	1 1/2	8	5.0 / -15
F35T5/WM	2	120	70	0.59 A	0.94	1.34	99	1.6	8	5.0 / -15
F35T5/WM	2	277	69	0.26 A	0.94	1.36	96	1.6	9	5.0 / -15
F35T5/HE	1	120	46	0.39 A	1.11	2.41	99	1.6	8	5.0 / -15
F35T5/HE	1	277	46	0.18 A	1.11	2.41	93	1.6	8	5.0 / -15
F35T5/HE	2	120	74	0.62 A	0.95	1.28	99	1.7	9	5.0 / -15

F35T5/HE	2	277	73	0.27 A	0.95	1.30	97	1.7	8 1/2	5.0 / -15
F28T5/WM	1	120	36	0.3 A	1.08	3.00	99	1 1/2	10	5.0 / -15
F28T5/WM	2	120	57	0.48 A	0.95	1.67	99	1.6	9	5.0 / -15
F28T5/WM	1	277	36	0.15 A	1.08	3.00	90	1 1/2	10	5.0 / -15
F28T5/WM	2	277	56	0.21 A	0.95	1.70	95	1.6	9	5.0 / -15
F28T5/HL	1	120	37	0.31 A	1.09	2.95	99	1 1/2	10	5.0 / -15
F28T5/HL	2	120	60	0.5 A	0.96	1.60	99	1.6	8	5.0 / -15
F28T5/HL	1	277	37	0.15 A	1.09	2.95	91	1 1/2	10	5.0 / -15
F28T5/HL	2	277	59	0.23 A	0.96	1.63	96	1.6	9.3	5.0 / -15
F28T5/HE	1	120	37	0.31 A	1.09	2.95	99	1 1/2	10	5.0 / -15
F28T5/HE	1	277	37	0.15 A	1.09	2.95	91	1 1/2	10	5.0 / -15
F28T5/HE	2	277	59	0.23 A	0.96	1.63	96	1.6	9.3	5.0 / -15
F28T5/HE	2	120	60	0.5 A	0.96	1.60	99	1.6	8	5.0 / -15
F21T5/WM	2	120	45	0.38 A	1.01	2.24	99	1 1/2	9	5.0 / -15
F21T5/WM	1	120	29	0.24 A	1.15	3.97	99	1 1/2	10	5.0 / -15
F21T5/WM	1	277	29	0.12 A	1.15	3.97	85	1 1/2	9	5.0 / -15
F21T5/WM	2	277	45	0.18 A	1.01	2.24	93	1 1/2	8	5.0 / -15
F21T5/HE	1	120	31	0.26 A	1.16	3.74	99	1 1/2	9	5.0 / -15
F21T5/HE	2	120	48	0.4 A	1.01	2.10	99	1 1/2	9	5.0 / -15
F21T5/HE	2	277	48	0.18 A	1.01	2.10	94	1 1/2	9	5.0 / -15
F21T5/HE	1	277	31	0.13 A	1.16	3.74	86	1 1/2	10	5.0 / -15
F14T5/WM	1	120	22	0.18 A	1.15	5.23	99	1 1/2	9	5.0 / -15
F14T5/WM	2	120	32	0.27 A	0.99	NaN	99	1 1/2	9	5.0 / -15
F14T5/WM	1	277	22	0.1 A	1.15	5.23	NaN	1 1/2	9	5.0 / -15
F14T5/WM	2	277	32	0.13 A	0.99	NaN	87	1 1/2	9	5.0 / -15
F14T5/HE	1	120	23	0.19 A	1.20	5.22	99	1 1/2	9	5.0 / -15
F14T5/HE	1	277	23	0.11 A	1.20	5.22	78	1 1/2	10	5.0 / -15
F14T5/HE	2	120	34	0.29 A	1.03	3.03	99	1 1/2	9	5.0 / -15
F14T5/HE	2	277	34	0.14 A	1.03	3.03	89	1 1/2	10	5.0 / -15

WARRANTY INFORMATION

GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

Voice™

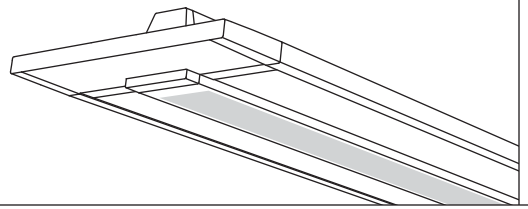
LEDALITE

Suspended

Direct/Indirect

1 T5

mesoOptics® RESPONSE® airwave™



Project Name

Spec Type

Notes

Order Guide

Some combinations of product options may not be available. Consult factory for assistance with your specification.

7306	F01			–		–		–		–		–	
Product Series & Type	Lamping	Lower Optics	Upper Optics		Run Length		Wiring		Voltage		Ballast		Color & Finish
Voice Suspended Direct/ Indirect	1 T5	**I** Slot Perf	**N** 60% Up / 40% Down **G** 20% Up / 80% Down **J** 100% Down		*Enter the total run length in feet (4ft increments)*		**1** 1 cct **3** 1 cct w/ Emergency cct **5** 1 cct w/ Battery Pack **7** 1 cct Dimming		**1** 120V **2** 277V **3** 347V		**E** Standard Ballast Consult website for ballast manufacturer information		**W** Standard White
					See details on reverse		Consult website for complete list of standard wiring options						

Mounting Hardware

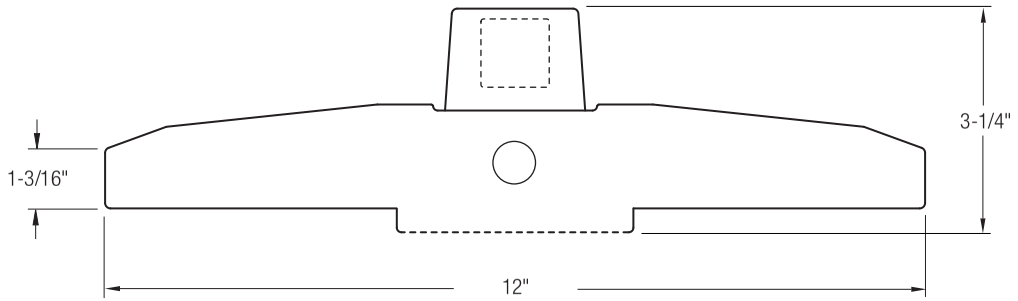
Mount Type	Suspension Length
Consult separate mounting spec sheet for mount type options	*Enter distance from ceiling to top of fixture in inches*

Upgrades & Accessories

Please indicate with check mark.

- ☐ Lamps Included
- ☐ Lamps Included and Installed
- ☐ Flat Endcap
  See details on reverse
- ☐ Dust Cover
  Available with upper optics option N (options G & J include integral dust cover)

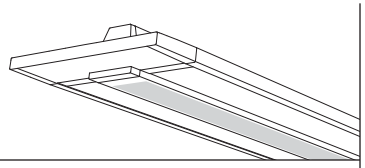
- ☐ Response Daylight (Integrated Controls)
  For details visit www.ledalite.com/response



Phone: 604.888.6811 Fax: 800.665.5332 Web: www.ledalite.com

Voice™

Suspended
Direct/Indirect
1 T5



Photometry

Optics IN 60% Up / 40% Down

Report Summary

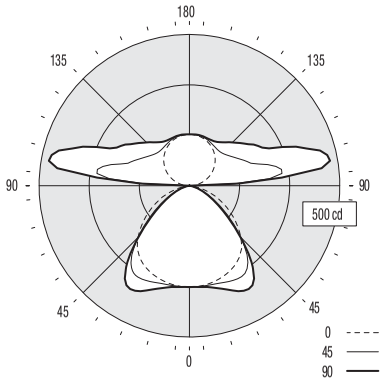
Efficiency 72.2%
Peak Candela Value* 475 @ 100°
Peak to Zenith Ratio* 2.8 : 1

Report # 9900872
Filename 7306F01IN.ies
* Between 90-180° vertical angle

Meets RP-1-04 recommendations for VDT-Intensive spaces

Candela Distribution

Vertical Angle	Horizontal Angle 0	22.5	45	67.5	90	Zonal Lumens
0	335	335	335	335	335	
5	334	334	334	335	336	33
15	327	329	336	345	350	96
25	313	321	345	372	385	160
35	289	302	334	367	375	207
45	242	242	242	249	239	187
55	177	160	137	129	121	130
65	110	90	63	63	59	75
75	49	30	17	19	18	27
85	6	0	0	0	0	2
90	0	0	0	0	0	
95	19	135	267	280	309	201
105	44	127	270	407	450	274
115	73	109	199	269	292	193
125	98	112	169	223	239	152
135	121	127	153	190	202	123
145	140	143	153	168	176	98
155	154	156	160	164	167	75
165	164	165	167	169	170	48
175	169	169	169	170	170	16
180	170	170	170	170	170	



46% Up / 54% Down

Coefficients of Utilization (%)

Ceiling:	80				70			50			0
Wall:	70	50	30	10	70	50	30	50	30	10	0
0 RCR	77	77	77	77	70	70	70	58	58	58	31
1	70	68	65	63	64	62	60	51	50	48	27
2	64	59	55	52	59	54	51	45	43	41	23
3	59	52	47	43	54	48	44	40	37	34	20
4	54	46	41	37	49	43	38	36	32	29	17
5	49	41	36	31	45	38	33	32	28	25	15
6	46	37	31	27	42	34	29	29	25	22	13
7	42	33	28	24	38	31	26	26	22	19	12
8	39	30	25	21	36	28	23	24	20	17	10
9	36	27	22	19	33	25	21	22	18	15	9
10	34	25	20	17	31	23	19	20	16	14	8

Based on a floor reflectance of 0.2

Avg. Luminance (cd/m²)

Vertical Angle	Horizontal Angle 0	45	90
55	933	722	638
65	787	451	422
75	572	199	210
85	208	0	0

IES files for this and other photometric options can be downloaded online at www.ledalite.com

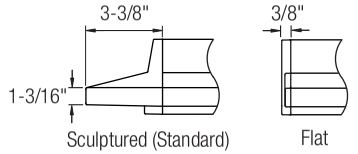
Additional Information

Modules

Module length excludes endcaps. Nominal mount spacing for individually mounted modules.

Module	Mount Spacing
4ft	4' 0"
8ft	8' 0"

Endcap



Sculptured (Standard) Flat

Specifications

Due to continuing product improvements, Ledalite reserves the right to change specifications without notice.

Housing
18 gauge die-formed cold-rolled steel, precision formed and welded.

Weight
Maximum 5.5 lb/ft.

Optical System
Optical frame is constructed from 20 gauge die-formed cold-rolled steel. The optical lens assembly consists of flat acrylic panels with a layer of MesoOptics® film that provides high-angle glare control and high efficiency. The panels are secured to a perforated center basket using an acrylic lens. Optical door frame is secured to housing with safety straps. Frame can be removed from housing using a lift-and-shift mechanism. No hardware is visible. Standard distribution is 60% up/ 40% down. Also available in 20% up / 80% down and 100% down distributions.

Endcaps
Available with sculptured die-cast endcaps (standard) or flat die-cast endcaps (optional).

Joints
Self-aligning joining system with hands-free pre-joining wire access.

Mounting
Aircraft cable gripper is tamper-resistant and provides infinite vertical adjustment capability. Aircraft cable, crimp and cable gripper independently tested to meet stringent safety requirements. Continuous run mounting on T-bar grid is limited to 32ft runs, but is unlimited in other ceiling types.

Electrical
Factory pre-wired to section ends with quick-wire connectors.

Ballast
Electronic.

Approvals
Certified to UL and CSA standards.

Finish
High-quality powder coat. Available in Ledalite Standard White only (textured matte finish).

GE Lighting

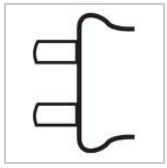
46705 - F28W/T5/835/ECO

GE Ecolux® Starcoat® T5

• Passes TCLP, which can lower disposal costs.

a product of ecomagination

High Color Rendering



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken

- Wear safety glasses and gloves when handling lamp.
- Do not use excessive force when installing lamp.

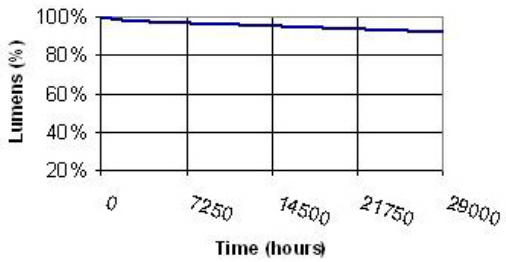
Warning

• Risk of Electric Shock

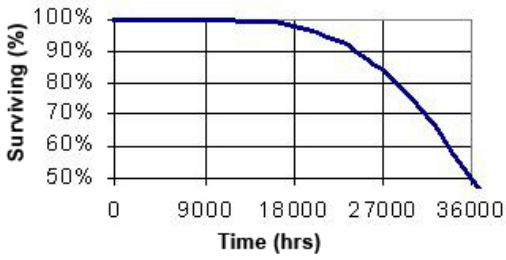
- Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Lumen Maintenance



Lamp Mortality



GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	28
Voltage	167
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	30000.0 @ 3.0/36000.0 @ 12.0 h
Bulb Material	Soda lime
Starting Temperature	-20 °C (-4 °F)
LEED-EB MR Credit	31 picograms Hg per mean lumen hour
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2900
Mean Lumens	2660
Nominal Initial Lumens per Watt	103
Color Temperature	3500 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.5

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	425 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor	1.7

DIMENSIONS

Maximum Overall Length (MOL)	45.8000 in(1163.3 mm)
Nominal Length	45.200 in(1148.1 mm)
Bulb Diameter (DIA)	0.625 in(15.9 mm)
Bulb Diameter (DIA) (MAX)	0.625 in(15.9 mm)
Max Base Face to Base Face (A)	45.240 in(1149.1 mm)
Face to End of Opposing Pin (B) (MIN)	45.420 in(1153.7 mm)
Face to End of Opposing Pin (B) (MAX)	45.520 in(1156.2 mm)

PRODUCT INFORMATION

Product Code	46705
Description	F28W/T5/835/ECO
Standard Package	Case
Standard Package GTIN	10043168467053
Standard Package Quantity	40
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	40
UPC	043168467056

GE Lighting

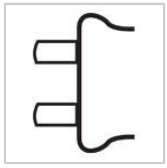
46705 - F28W/T5/835/ECO

GE Ecolux® Starcoat® T5

• Passes TCLP, which can lower disposal costs.

a product of ecomagination

High Color Rendering



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken

- Wear safety glasses and gloves when handling lamp.
- Do not use excessive force when installing lamp.

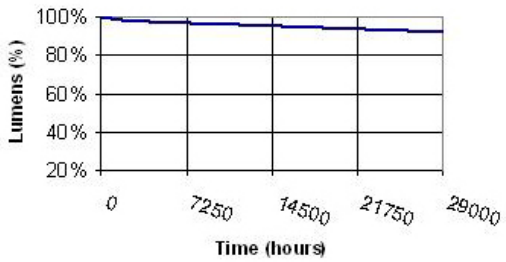
Warning

• Risk of Electric Shock

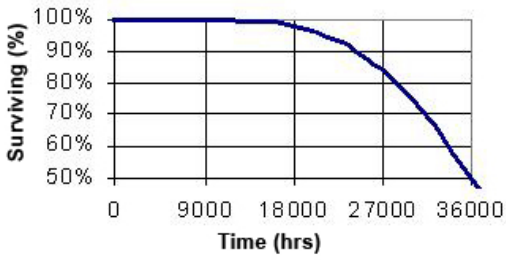
- Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Lumen Maintenance



Lamp Mortality



GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	28
Voltage	167
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	30000.0 @ 3.0/36000.0 @ 12.0 h
Bulb Material	Soda lime
Starting Temperature	-20 °C (-4 °F)
LEED-EB MR Credit	31 picograms Hg per mean lumen hour
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2900
Mean Lumens	2660
Nominal Initial Lumens per Watt	103
Color Temperature	3500 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.5

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	425 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor	1.7

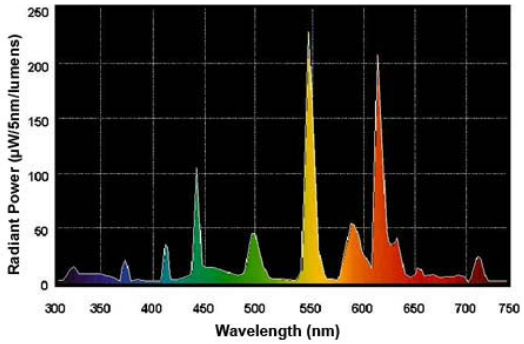
DIMENSIONS

Maximum Overall Length (MOL)	45.8000 in(1163.3 mm)
Nominal Length	45.200 in(1148.1 mm)
Bulb Diameter (DIA)	0.625 in(15.9 mm)
Bulb Diameter (DIA) (MAX)	0.625 in(15.9 mm)
Max Base Face to Base Face (A)	45.240 in(1149.1 mm)
Face to End of Opposing Pin (B) (MIN)	45.420 in(1153.7 mm)
Face to End of Opposing Pin (B) (MAX)	45.520 in(1156.2 mm)

PRODUCT INFORMATION

Product Code	46705
Description	F28W/T5/835/ECO
Standard Package	Case
Standard Package GTIN	10043168467053
Standard Package Quantity	40
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	40
UPC	043168467056

Spectral Power Distribution

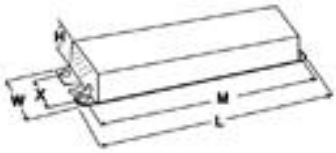


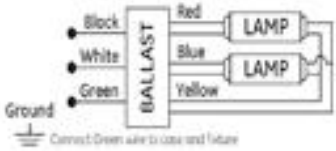
GE Lighting

99655 - GE228MVPS-A

GE LFL UltraStart® Electronic Program / Rapid Start Ballast

- High Efficiency T5 ballast with Continuous Cathode Cutout Technology
- Lower Maintenance Costs with Parallel Lamp Operation
- Fast Starting Time <700ms
- Multi-Voltage technology means a single ballast handles voltage from 108V to 305V
- Auto-Restart withstands temporary losses in power without the need to cycle power
- UltraCool™ Operation 90C case rating
- Anti-Striation Control for better light quality, with no striations.





GENERAL CHARACTERISTICS

Application	2 or 1 - F14-F35HE 120 to 277 UltraStart PRS Normal Light .95 BF A Can
Category	Linear Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Parallel
Line Voltage Regulation (+/-)	10 %
Case Temperature	90 °C(194 °F)
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Auto-restart/End of Life Protection (EOL)/Thermally protected/Universal voltage

PRODUCT INFORMATION

Product Code	99655
Description	GE228MVPS-A
Standard Package	Case
Standard Package GTIN	10043168996553
Standard Package Quantity	10
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168996556

DIMENSIONS

Case dimensions	
Length (L)	9.5 in(241.30 mm)
Width (W)	1.7 in(43.18 mm)
Height (H)	1.2 in(30.48 mm)
Mounting dimensions	
Mount Length (M)	8.9 in(226.06 mm)
Mount Slots (MS)	0.2 in(6.35 mm)
Weight	1.49 lb
Exit Type	Side
Remote Mounting Distance to Lamp	8 ft
Remote Mounting Wire Gauge	18 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Left/Right	25.0 (635mm)
Blue	2	Left/Right	34.0 (864mm)
Green	1	Left/Right	3.5 (89mm)
Red	2	Left/Right	34.0 (864mm)
White	1	Left/Right	25.0 (635mm)
Yellow	2	Left/Right	45 (1143mm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	50 Hz/60 Hz

SAFETY & PERFORMANCE

- CSA
- FCC - CLASS A Non-Consumer
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type CC
- UL Type HL
- RoHs Compliant
- Meets ANSI Standard C82.11-Cons 2002
- Meets ANSI Standard C62.41-1991
- High Temperature Rated: Suitable for high temperature applications
- 70C max case temp 5 yr warranty or 90C max case temp 3 yr warranty

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
F35T5/WM	1	120	44	0.36 A	1.08	2.45	99	1 1/2	9	5.0 / -15
F35T5/WM	1	277	43	0.17 A	1.08	2.51	92	1 1/2	8	5.0 / -15
F35T5/WM	2	120	70	0.59 A	0.94	1.34	99	1.6	8	5.0 / -15
F35T5/WM	2	277	69	0.26 A	0.94	1.36	96	1.6	9	5.0 / -15
F35T5/HE	1	120	46	0.39 A	1.11	2.41	99	1.6	8	5.0 / -15
F35T5/HE	1	277	46	0.18 A	1.11	2.41	93	1.6	8	5.0 / -15

F35T5/HE	2	120	74	0.62 A	0.95	1.28	99	1.7	9	5.0 / -15
F35T5/HE	2	277	73	0.27 A	0.95	1.30	97	1.7	8 1/2	5.0 / -15
F28T5/WM	1	120	36	0.3 A	1.08	3.00	99	1 1/2	10	5.0 / -15
F28T5/WM	2	120	57	0.48 A	0.95	1.67	99	1.6	9	5.0 / -15
F28T5/WM	1	277	36	0.15 A	1.08	3.00	90	1 1/2	10	5.0 / -15
F28T5/WM	2	277	56	0.21 A	0.95	1.70	95	1.6	9	5.0 / -15
F28T5/HL	1	120	37	0.31 A	1.09	2.95	99	1 1/2	10	5.0 / -15
F28T5/HL	2	120	60	0.5 A	0.96	1.60	99	1.6	8	5.0 / -15
F28T5/HL	1	277	37	0.15 A	1.09	2.95	91	1 1/2	10	5.0 / -15
F28T5/HL	2	277	59	0.23 A	0.96	1.63	96	1.6	9.3	5.0 / -15
F28T5/HE	1	120	37	0.31 A	1.09	2.95	99	1 1/2	10	5.0 / -15
F28T5/HE	1	277	37	0.15 A	1.09	2.95	91	1 1/2	10	5.0 / -15
F28T5/HE	2	277	59	0.23 A	0.96	1.63	96	1.6	9.3	5.0 / -15
F28T5/HE	2	120	60	0.5 A	0.96	1.60	99	1.6	8	5.0 / -15
F21T5/WM	2	120	45	0.38 A	1.01	2.24	99	1 1/2	9	5.0 / -15
F21T5/WM	1	120	29	0.24 A	1.15	3.97	99	1 1/2	10	5.0 / -15
F21T5/WM	1	277	29	0.12 A	1.15	3.97	85	1 1/2	9	5.0 / -15
F21T5/WM	2	277	45	0.18 A	1.01	2.24	93	1 1/2	8	5.0 / -15
F21T5/HE	1	120	31	0.26 A	1.16	3.74	99	1 1/2	9	5.0 / -15
F21T5/HE	2	120	48	0.4 A	1.01	2.10	99	1 1/2	9	5.0 / -15
F21T5/HE	2	277	48	0.18 A	1.01	2.10	94	1 1/2	9	5.0 / -15
F21T5/HE	1	277	31	0.13 A	1.16	3.74	86	1 1/2	10	5.0 / -15
F14T5/WM	1	120	22	0.18 A	1.15	5.23	99	1 1/2	9	5.0 / -15
F14T5/WM	2	120	32	0.27 A	0.99	NaN	99	1 1/2	9	5.0 / -15
F14T5/WM	1	277	22	0.1 A	1.15	5.23	NaN	1 1/2	9	5.0 / -15
F14T5/WM	2	277	32	0.13 A	0.99	NaN	87	1 1/2	9	5.0 / -15
F14T5/HE	1	120	23	0.19 A	1.20	5.22	99	1 1/2	9	5.0 / -15
F14T5/HE	1	277	23	0.11 A	1.20	5.22	78	1 1/2	10	5.0 / -15
F14T5/HE	2	120	34	0.29 A	1.03	3.03	99	1 1/2	9	5.0 / -15
F14T5/HE	2	277	34	0.14 A	1.03	3.03	89	1 1/2	10	5.0 / -15

WARRANTY INFORMATION

GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

ITH637

HID Metal Halide

PAR38MH 70W Stage III Theatrical Fixture Track Head

Catalog #:	Type:
Notes:	

Product Specifications

Lamp:
PAR38MH 70W

Socket:
E26 Medium Base

Features:
- Light weight, strong construction
- Clean style
- Adjustable for precision aiming
- One or two circuit track capability
- Compatible with Intense Lighting's Professional Series track
- Electronic ballast

Track Compatibility:
Single/two circuit positive contact is present to "down" position at factory, but may be raised to the higher position to install onto the second circuit.

Electronic Ballast:
High Power Factor.
Input:
.27A @ 70W
Open Circuit Voltage 300V max.
Sound Rated A
Max. case temp +80°C
Ignition Voltage 4.0KV max.
THD < 5%
PF > 98%
Outdoor Type 1

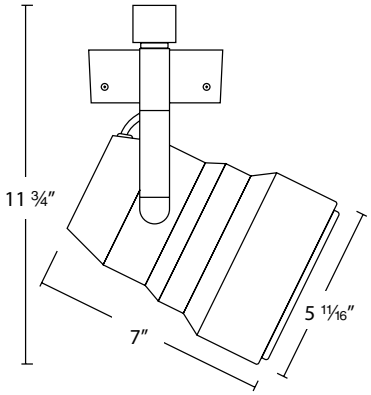
Professional Series Option:
Track fixture is compatible with Intense Two Circuit / Two Neutral Professional Track series. Track adapter is factory installed on fixture. Must specify –27 for 277V.

Two Circuit / Two Neutral 120V. The independent neutrals guarantee that the two circuits are completely isolated. Independent neutrals also offer twice the power handling capacity of ordinary common neutral track.

Two Circuit / Two Neutral 277V
The Intense Professional Series 2-cct/2-neutral 277V track system is well suited for larger retail and institutional applications where a number of metal halide or fluorescent fixtures are used. The 277V system offers twice the capacity of ordinary 120V track allowing for substantially longer runs with more fixtures between feed points. This translates into enhanced aesthetics and reduced installation costs.

Listing:
NRTL listed for dry locations

Dimensions



Ordering Matrix

ITH637

Series	Finish	Options
	W white	**-PS** 120V pro series
	B black	**-PS-27** 277V pro series
	SN satin nickel	

*Note: Specifications and dimensions subject to change without notice.

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INTENSE LIGHTING
Where Creativity and Performance Meet

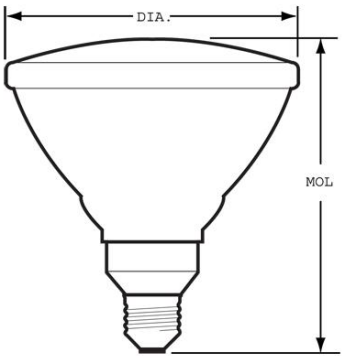
45677 - CMH70PAR38FL/ECO

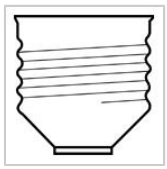
GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide PAR38

• Passes TCLP, which can lower disposal costs.

Photo
Not Available

RoHs Compliant





GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	PAR38
Base	Medium Screw (E26)
Wattage	70
Rated Life	10000 hrs
Bulb Material	Hard glass
Lamp Enclosure Type (LET)	Open or enclosed fixtures
LEED-EB MR Credit	167 picograms Hg per mean lumen hour
Additional Info	TCLP compliant/UV control

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	4800
Nominal Initial Lumens per Watt	68
Beam Spread	25 °
Center Beam Candlepower (CBCP)	14000
Color Temperature	3000 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Burn Position	Universal burning position
Open Circuit Voltage (peak lead ballast)	280 V
Open Circuit Voltage (RMS lag ballast)	198 V
Warm Up Time to 90% (MAX)	2 min
Hot Restart Time to 90% (MIN)	10 min
Hot Restart Time to 90% (MAX)	15 min

DIMENSIONS

Maximum Overall Length (MOL)	5.31 cm
Nominal Length	5.31 cm
Bulb Diameter (DIA)	4.75 cm
Bulb Diameter (DIA) (MAX)	4.75 cm

PRODUCT INFORMATION

Product Code	45677
Description	CMH70PAR38FL/ECO
ANSI Code	M143/M98
Standard Package	Case
Standard Package GTIN	10043168456774
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168456777

CAUTIONS & WARNINGS

R- WARNING: This lamp can cause serious skin burn and eye inflammation from shortwave ultraviolet radiation if outer envelope of the lamp is broken or punctured, and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available. Visit the FDA website for more information: http://www.fda.gov/cdrh/radhealth/products/urburns.html

Caution

• Lamp may shatter and cause injury if broken
  - Do not use lamp if outer glass is scratched or broken.
• Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.

Warning

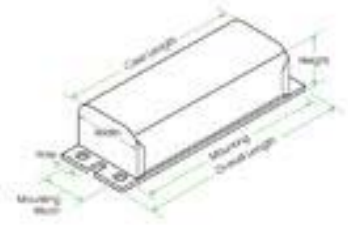
• Lamp emits UV radiation which may cause eye/skin irritation.
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.
• Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.

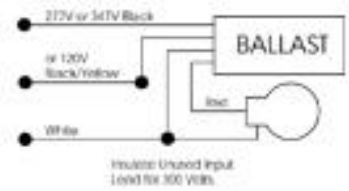
GE Lighting

86578 - 11210506CTC000C

GE HID Magnetic F-Can Ballast

- For applications requiring quieter or cooler operation than provided by standard coil & coil ballasts.
- Excellent sound-deadening and heat transfer qualities.





GENERAL CHARACTERISTICS

Application	1- 70w M98 120/277 Enclosed & Potted
Category	High Intensity Discharge
Ballast Type	Magnetic - F-Can
Type	Standard
Line Voltage Regulation (+/-)	5 %
Ballast Factor	Normal
Circuit Type	HX-HPF
Sound Rating	B (25-30 decibels)
Insulation Class	90C
Distance to Lamp	20 ft
Additional Info	Thermally protected

PRODUCT INFORMATION

Product Code	86578
Description	11210506CTC000C
Standard Package	Master
Standard Package GTIN	30043168865785
Standard Package Quantity	4
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	4
UPC	043168865784

DIMENSIONS

Case dimensions	
Length (L)	11.8 in(298.45 mm)
Width (W)	3.2 in(80.96 mm)
Height (H)	2.6 in(66.68 mm)
Mounting dimensions	
Mount Length (M)	11.1 in(282.97 mm)
Mount Width (X or F)	2.0 in(50.80 mm)
Mount Slots (MS)	0.2 in(5.95 mm)
Weight	11 lb
Exit Type	Side
Remote Mounting Distance to Lamp	20 ft
Remote Mounting Wire Gauge	18 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1		12 in (NaNmm)
Black/Yellow	1		12 in (NaNmm)
Red	1		12 in (NaNmm)
White	1		12 in (NaNmm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	60 Hz

SAFETY & PERFORMANCE

- cUL Listed
- UL Listed

SPECIFICATIONS BY LAMP & LINE VOLTAGE

Lamp	# of Lamps	Specifications by Line Voltage	System Wattage	Nominal Current	Ballast Factor	Ballast Efficiency	Max.Input Current	Starting Current	Open Circuit Voltage	Drop Out Voltage	Power factor	Min.starting temperature	Fuse rating	UL bench top rise
M98	1	120	90.0	0.78A	1	0.778	2A	0.6A	250V	66V	0.9	-22.0°F	6	
M98	1	277	90.0	0.35A	1	0.778	0.9A	0.27A	250V	152V	0.9	-22.0°F	3	

CAUTIONS & WARNINGS

Warning

- Risk of Electric Shock
  - Properly ground ballast and fixture.
  - Turn power off before servicing--see instructions.

NOTES

- Anchor bracket / Tab provided for splice box (SB-4 Not included)

WARRANTY INFORMATION

GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

LITECONTROL

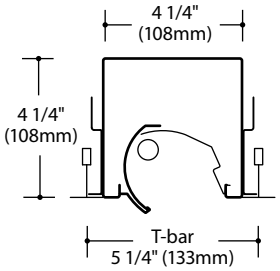
Fixture Type:
Project name:


R-WWD version shown here

Mod² Recessed Wall/Wash

LG-WWD-4400

Exposed Grid Ceiling
Recessed Wall Wash Direct



Product Description

The LG-WWD-4400 is a recessed fixture for grid ceilings with an optical system designed to provide uniform wall wash lighting. As part of the Mod² family from Litecontrol, the fixture has a low-profile housing (nominally 4" x 4") and uses T5 or T5HO lamping. The WWD-4400 can be row-configured for continuous run installations along a wall, and has an optional regressed lens that completely shields the lamp from view if desired.

Ordering Guide

Product, Lamping, & Length						Options					
LG -	**WWD -**	**44**	1	4	T5 -	--	CWM -	IND -	LP/ELB -	F -	120
Mounting	Distribution	Series	Lamp Count*	Nominal Length (ft)	Lamp Type	Diffuser	Finish	Position	Ballast	Other options	Volts
LG Recessed (exposed grid ceiling)	**WWD** Wall Wash Direct	**44**	**1 →** **2 →** see **notes**	**2 , 3, 4** **6, 8**	T5 T5HO (not available in T8)	**--** **SGL**	**CWM** (Matte White) is standard	**IND** **INT** **EOR/LH** **EOR/RH**	**LP/ELB is** std. **DA/MK7** **DL/ECO** **DO/HEL** see **Ballast Options**	**F** **CCEA** see **Other options**	**120** **277**

notes:
*Lamp Count = total number of lamps in the fixture

For Ordering guide information in shaded areas, choose selection by reading ACROSS the shaded areas for correct specifications.

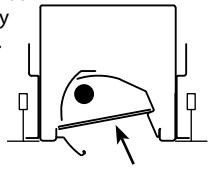
LG-WWD-4414T5-CWM-IND-LP/ELB-F-120 is a typical catalog number for a 1-lamp, 4-foot long T5 fixture, Matte White finish, individual fixture with an electronic ballast, optional fuse, 120 volts.

Cross-section lamping


1-T5, T5HO

Diffuser

SGL Soft Glow Lens. Extruded, frosted acrylic lens regressed at an angle above the ceiling to soften view of lamp from directly below while minimizing visibility from normal viewing angles.


Soft Glow Lens

Position

IND Individual fixture.
INT Intermediate fixture in a row.
EOR/LH Left hand end-of-row fixture in a row.
EOR/RH Right hand end-of-row fixture in a row.

Ballast

Specify in place of **LP/ELB**, contact factory for availability/compatibility with lamping:
DA/MK7 Advance Mark VII dimming ballast.
DL/ECO Lutron ECO-10 dimming ballast.
DO/HEL Osram Sylvania dimming ballast.

Other Options

F Fuse. Slow or fast blow, determined by Litecontrol.
CCEA City of Chicago Environmental Air Modification.

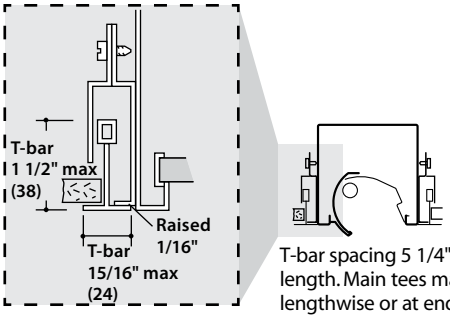
Questions to Ask

1. Row information, including desired fixture length?
2. Diffuser type? **3.** Other options? **4.** 1 20 or 277 volt?

revised 12/3/2009

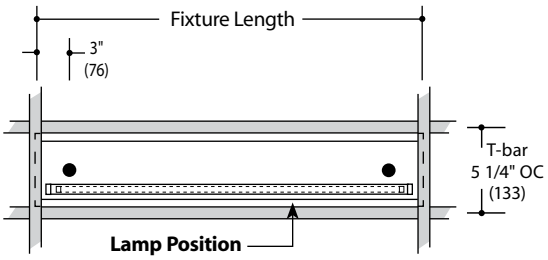
Click on
Quick Find 44wwd
litecontrol.com

Planning for installation



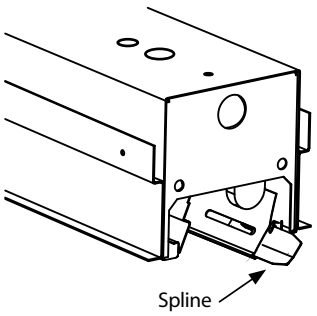
T-bar spacing 5 1/4" OC x fixture length. Main tees may be located lengthwise or at ends.

Individual Fixtures (IND)



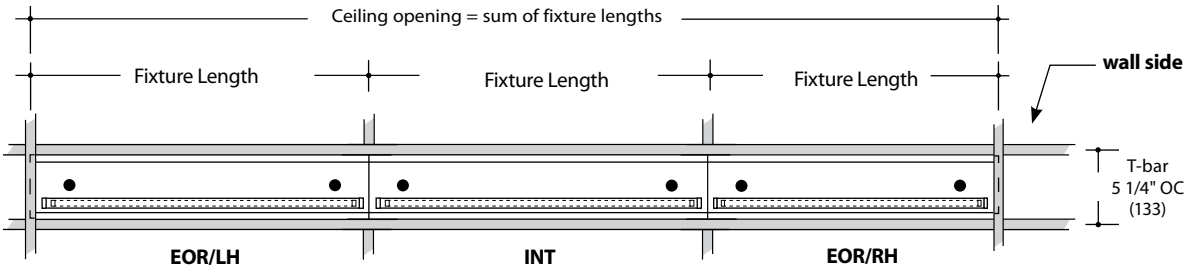
Fixture Lengths: 24", 36", 48", 72", and 96"
● 7/8" diameter knockout, electrical feed

Spline Detail



Row fixtures

End of Row Left Hand (EOR/LH) **Intermediate (INT)** **End of Row Right Hand (EOR/RH)**



Row is comprised of fixtures of standard lengths:
End of Row fixtures (EOR/LH & EOR/RH) are used at ends, Intermediate fixtures (INT) are used between other fixtures. Continuous opening in ceiling is framed by main tees parallel to row, spaced 5 1/4" OC and at end of row, spacing equal to the sum of the fixture lengths.

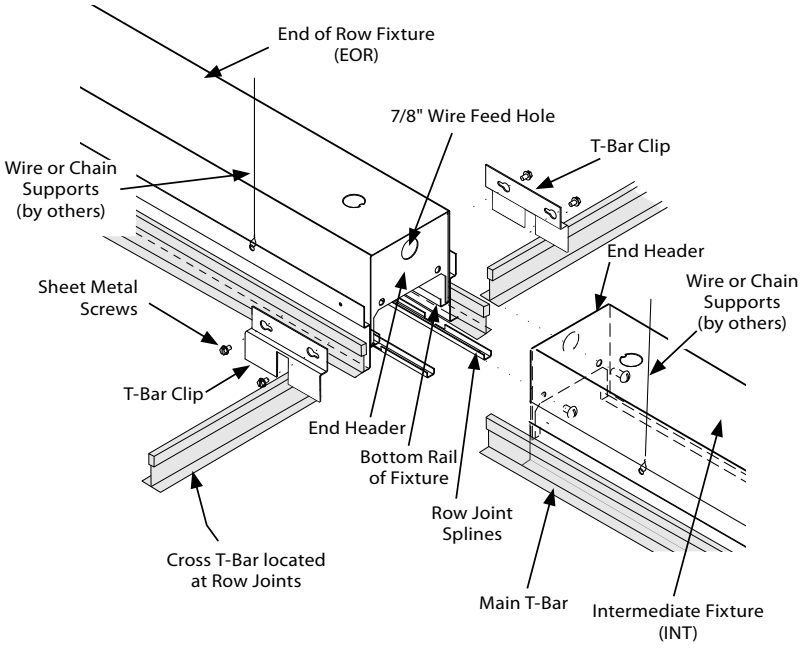
LITECONTROL
employee owned | customer driven
100 Hawks Avenue Hanson, MA 02341
781 294 0100 f: 781 293 2849 litecontrol.com

Specifications

HOUSING. Die-formed and welded steel, with 3/8" regression at housing bottom for rigidity and appearance. Continuous mounting rail along sides, with bottom flange regressed 1/16", is used as a lateral spacing aid between main T-bars, allows clearance for T-bar supporting wires, and accepts mounting of side clips. Furnished with 6" long, steel splines for insertion at each side of housing at junction of fixtures in rows for precise alignment. End headers have clearance holes for easy row installation.
REFLECTOR. Formed semi-specular high reflectance aluminum primary optic. Formed steel wall-side reflector painted gray. Painted, extruded aluminum room-side reflector shield extends below the ceiling and includes a pre-installed alignment spline that is slid between adjoining fixtures in the field.
END CAPS. Straddle T-bars and attach to ends of individual fixtures and ends of rows.
BALLAST. Low-profile Electronic Ballast (**LP/ELB**), high power factor, thermally protected Class P, Sound Rated A, less than 10% THD, manufactured by a UL-listed manufacturer, as available, determined by Litecontrol. Ballasts with a voltage range of 120 to 277 will be used when fixture configuration and ballast availability allow. The minimum number of ballasts will be used.
LAMPING. Available in one-lamp T5 or T5HO in cross-section.
BALLAST DISCONNECT. Fixture supplied with a ballast disconnect device to enable compliance with the NEC.
MOUNTING. For installation in exposed inverted T-bar grid ceilings (NEMA type G,1 1/2" high T-bar) only. Side T-bar clips and T-bar end caps provided; field installed by contractor. Knockouts in housing top for wiring. Holes provided in mounting rail for S-hooks of chain supports or guy wires.
CERTIFICATION. Fixture and electrical components shall be UL and/or CUL Listed and shall bear the I.B.E.W., A.F. of L. label. This fixture is Cradle to Cradle Certified[CM] Silver by MBDC.
Note: Litecontrol reserves the right to change specifications without notice for product development and improvement.

General notes for specifiers and contractors

1. Fixtures may be mounted in exposed grid ceilings, either as individual units, or in rows, for continuous light.
2. Suffixes for individual fixtures (IND), and row fixtures (INT, EOR/LH, EOR/RH) should be shown on electrical and reflected ceiling plans, together with fixture type designations and lengths. Example: B-EOR/LH-2', B-INT-6', B-IND-4'. These will be shown on order processing and carton labeling, and will assist with on-the-job installation.
3. Electrical and ceiling contractors should understand that this system is not a standard troffer construction (due to continuous light feature), so coordination between the two trades is essential.
4. All main tees and cross tees must be rigidly attached to each other (i.e. with angles and pop rivets, by others), so main tees will not twist or pivot under fixture weight. Additional supporting means may be necessary and required by local codes, to provide adequate support of ceiling grid in fixture areas. Knockouts are located in housing top for wiring. Access openings and cover plates are not provided.
5. Electrical contractor must attach T-bar clips, supplied by Litecontrol, after the fixtures have been installed.



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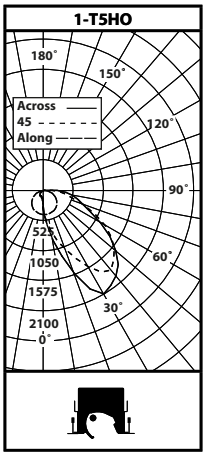
Photometric data

1-T5HO



CANDLEPOWER SUMMARY					
ANGLE	0	45	90	135	180
90	3	3	6	138	223
85	2	2	25	271	379
80	6	9	61	377	503
75	32	23	103	489	607
70	36	47	147	722	718
65	52	64	182	970	890
60	60	86	219	1220	1132
55	84	111	249	1425	1388
50	95	130	278	1581	1619
45	104	121	306	1702	1812
40	119	120	332	1802	1932
35	120	115	353	1729	2011
30	109	120	374	1520	2068
25	113	128	386	1300	1883
20	122	142	394	1089	1537
15	128	150	407	916	1180
10	141	181	414	724	884
5	230	300	420	563	617
0	418	418	418	418	418

LG-WWD-4414T5HO 68.7% Efficiency
Litecontrol Certified Test Report #66016000

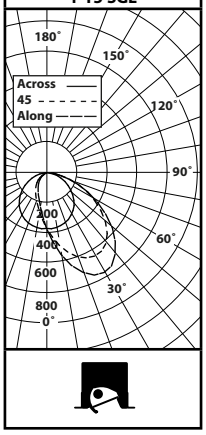
RCC	80				70				50			30			10			0
RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	82	82	82	82	80	80	80	80	76	76	76	73	73	73	70	70	70	69
1	73	69	66	63	71	68	65	62	65	62	60	62	60	58	60	58	56	55
2	66	59	54	49	64	58	53	49	55	51	48	53	50	46	51	48	45	44
3	59	51	45	40	57	50	44	39	48	43	39	46	42	38	44	40	37	36
4	54	44	38	33	52	44	37	32	42	36	32	40	35	31	38	34	31	29
5	49	39	32	27	47	38	32	27	37	31	27	35	30	26	34	30	26	24
6	45	35	28	23	43	34	28	23	33	27	23	31	26	23	30	26	22	21
7	41	31	24	20	40	30	24	20	29	24	20	28	23	19	27	23	19	18
8	38	28	22	17	37	27	21	17	27	21	17	26	21	17	25	20	17	15
9	35	25	19	15	34	25	19	15	24	19	15	23	18	15	23	18	15	13
10	33	23	17	13	32	23	17	13	22	17	13	21	17	13	21	16	13	12

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY			
ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	0	0	0
90-0°	3093	69	100
180-0°	3093	69	100

LUMINANCE SUMMARY (cd/m²)			
ANGLE	0°	45°	90°
45°	1464	1704	4309
55°	1458	1927	4323
65°	1225	1508	4288
75°	1231	885	3963
85°	228	228	2856

1-T5 SGL



CANDLEPOWER SUMMARY					
ANGLE	0	45	90	135	180
90	1	1	1	30	41
85	1	1	16	49	59
80	1	1	45	95	86
75	0	3	74	158	147
70	5	11	104	226	222
65	9	17	135	295	304
60	17	37	166	372	391
55	29	55	197	444	482
50	45	74	228	513	572
45	63	91	257	572	649
40	78	109	285	615	711
35	95	127	306	637	757
30	113	147	326	641	767
25	134	169	342	625	752
20	158	196	354	593	704
15	187	225	364	546	637
10	232	266	370	491	552
5	292	312	374	428	456
0	369	369	369	369	369

LG-WWD-4414T5-SGL 49.3% Efficiency
Litecontrol Certified Test Report #68316600

RCC	80				70				50			30			10			0
RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	59	59	59	59	57	57	57	57	55	55	55	52	52	52	50	50	50	49
1	53	51	49	47	52	50	48	46	48	46	45	46	45	43	44	43	42	41
2	49	44	41	38	47	44	40	38	42	39	37	40	38	36	39	37	35	34
3	44	39	35	32	43	38	34	31	37	33	31	35	33	30	34	32	30	29
4	40	34	30	27	39	34	30	26	33	29	26	31	28	26	30	28	25	24
5	37	31	26	23	36	30	26	23	29	25	22	28	25	22	27	24	22	21
6	34	28	23	20	33	27	23	20	26	22	20	25	22	19	25	22	19	18
7	32	25	21	17	31	24	20	17	24	20	17	23	20	17	22	19	17	16
8	29	23	18	15	29	22	18	15	22	18	15	21	18	15	20	17	15	14
9	27	21	17	14	27	20	16	14	20	16	14	19	16	14	19	16	14	13
10	26	19	15	12	25	19	15	12	18	15	12	18	15	12	17	14	12	11

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY			
ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	0	0	0
90-0°	1286	49	100
180-0°	1286	49	100

LUMINANCE SUMMARY (cd/m²)			
ANGLE	0°	45°	90°
45°	1141	1648	4653
55°	647	1228	4397
65°	273	515	4089
75°	0	148	3660
85°	147	147	2350

LITECONTROL
employee owned | customer driven

100 Hawks Avenue Hanson, MA 02341
781 294 0100 f: 781 293 2849 litecontrol.com

GE Lighting

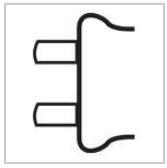
46706 - F28W/T5/841/ECO

GE Ecolux® Starcoat® T5

• Passes TCLP, which can lower disposal costs.

a product of ecomagination

High Color Rendering



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken

- Wear safety glasses and gloves when handling lamp.
- Do not use excessive force when installing lamp.

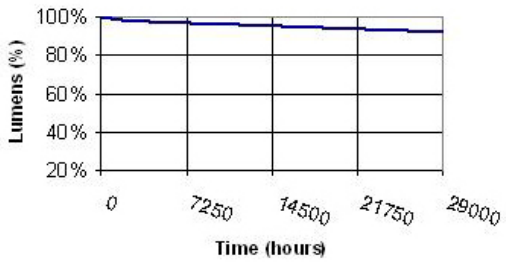
Warning

• Risk of Electric Shock

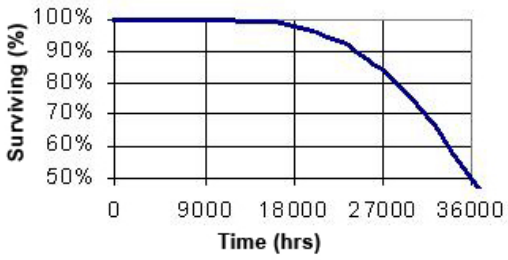
- Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Lumen Maintenance



Lamp Mortality



GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	28
Voltage	167
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	30000.0 @ 3.0/36000.0 @ 12.0 h
Bulb Material	Soda lime
Starting Temperature	-20 °C (-4 °F)
LEED-EB MR Credit	31 picograms Hg per mean lumen hour
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2900
Mean Lumens	2660
Nominal Initial Lumens per Watt	103
Color Temperature	4100 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.3

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	425 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor	1.7

DIMENSIONS

Maximum Overall Length (MOL)	45.8000 in(1163.3 mm)
Nominal Length	45.200 in(1148.1 mm)
Bulb Diameter (DIA)	0.625 in(15.9 mm)
Bulb Diameter (DIA) (MAX)	0.625 in(15.9 mm)
Max Base Face to Base Face (A)	45.240 in(1149.1 mm)
Face to End of Opposing Pin (B) (MIN)	45.420 in(1153.7 mm)
Face to End of Opposing Pin (B) (MAX)	45.520 in(1156.2 mm)

PRODUCT INFORMATION

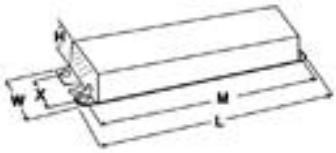
Product Code	46706
Description	F28W/T5/841/ECO
Standard Package	Case
Standard Package GTIN	10043168467060
Standard Package Quantity	40
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	40
UPC	043168467063

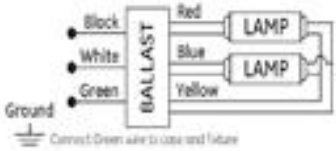
GE Lighting

99655 - GE228MVPS-A

GE LFL UltraStart® Electronic Program / Rapid Start Ballast

- High Efficiency T5 ballast with Continuous Cathode Cutout Technology
- Lower Maintenance Costs with Parallel Lamp Operation
- Fast Starting Time <700ms
- Multi-Voltage technology means a single ballast handles voltage from 108V to 305V
- Auto-Restart withstands temporary losses in power without the need to cycle power
- UltraCool™ Operation 90C case rating
- Anti-Striation Control for better light quality, with no striations.





GENERAL CHARACTERISTICS

Application	2 or 1 - F14-F35HE 120 to 277 UltraStart PRS Normal Light .95 BF A Can
Category	Linear Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Parallel
Line Voltage Regulation (+/-)	10 %
Case Temperature	90 °C(194 °F)
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Auto-restart/End of Life Protection (EOL)/Thermally protected/Universal voltage

PRODUCT INFORMATION

Product Code	99655
Description	GE228MVPS-A
Standard Package	Case
Standard Package GTIN	10043168996553
Standard Package Quantity	10
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168996556

DIMENSIONS

Case dimensions	
Length (L)	9.5 in(241.30 mm)
Width (W)	1.7 in(43.18 mm)
Height (H)	1.2 in(30.48 mm)
Mounting dimensions	
Mount Length (M)	8.9 in(226.06 mm)
Mount Slots (MS)	0.2 in(6.35 mm)
Weight	1.49 lb
Exit Type	Side
Remote Mounting Distance to Lamp	8 ft
Remote Mounting Wire Gauge	18 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Black	1	Left/Right	25.0 (635mm)
Blue	2	Left/Right	34.0 (864mm)
Green	1	Left/Right	3.5 (89mm)
Red	2	Left/Right	34.0 (864mm)
White	1	Left/Right	25.0 (635mm)
Yellow	2	Left/Right	45 (1143mm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	50 Hz/60 Hz

SAFETY & PERFORMANCE

- CSA
- FCC - CLASS A Non-Consumer
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type CC
- UL Type HL
- RoHs Compliant
- Meets ANSI Standard C82.11-Cons 2002
- Meets ANSI Standard C62.41-1991
- High Temperature Rated: Suitable for high temperature applications
- 70C max case temp 5 yr warranty or 90C max case temp 3 yr warranty

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
F35T5/WM	1	120	44	0.36 A	1.08	2.45	99	1 1/2	9	5.0 / -15
F35T5/WM	1	277	43	0.17 A	1.08	2.51	92	1 1/2	8	5.0 / -15
F35T5/WM	2	120	70	0.59 A	0.94	1.34	99	1.6	8	5.0 / -15
F35T5/WM	2	277	69	0.26 A	0.94	1.36	96	1.6	9	5.0 / -15
F35T5/HE	1	120	46	0.39 A	1.11	2.41	99	1.6	8	5.0 / -15
F35T5/HE	1	277	46	0.18 A	1.11	2.41	93	1.6	8	5.0 / -15

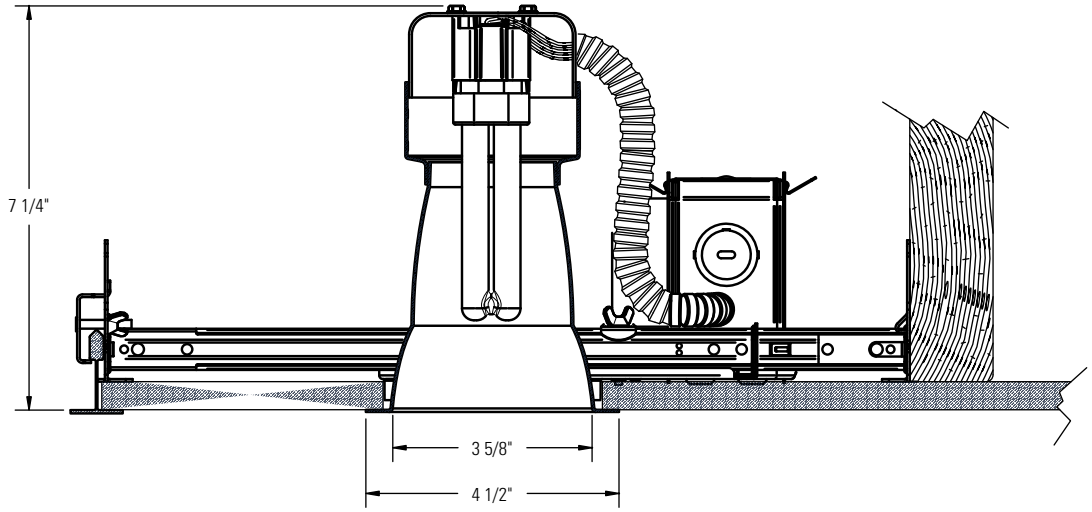
F35T5/HE	2	120	74	0.62 A	0.95	1.28	99	1.7	9	5.0 / -15
F35T5/HE	2	277	73	0.27 A	0.95	1.30	97	1.7	8 1/2	5.0 / -15
F28T5/WM	1	120	36	0.3 A	1.08	3.00	99	1 1/2	10	5.0 / -15
F28T5/WM	2	120	57	0.48 A	0.95	1.67	99	1.6	9	5.0 / -15
F28T5/WM	1	277	36	0.15 A	1.08	3.00	90	1 1/2	10	5.0 / -15
F28T5/WM	2	277	56	0.21 A	0.95	1.70	95	1.6	9	5.0 / -15
F28T5/HL	1	120	37	0.31 A	1.09	2.95	99	1 1/2	10	5.0 / -15
F28T5/HL	2	120	60	0.5 A	0.96	1.60	99	1.6	8	5.0 / -15
F28T5/HL	1	277	37	0.15 A	1.09	2.95	91	1 1/2	10	5.0 / -15
F28T5/HL	2	277	59	0.23 A	0.96	1.63	96	1.6	9.3	5.0 / -15
F28T5/HE	1	120	37	0.31 A	1.09	2.95	99	1 1/2	10	5.0 / -15
F28T5/HE	1	277	37	0.15 A	1.09	2.95	91	1 1/2	10	5.0 / -15
F28T5/HE	2	277	59	0.23 A	0.96	1.63	96	1.6	9.3	5.0 / -15
F28T5/HE	2	120	60	0.5 A	0.96	1.60	99	1.6	8	5.0 / -15
F21T5/WM	2	120	45	0.38 A	1.01	2.24	99	1 1/2	9	5.0 / -15
F21T5/WM	1	120	29	0.24 A	1.15	3.97	99	1 1/2	10	5.0 / -15
F21T5/WM	1	277	29	0.12 A	1.15	3.97	85	1 1/2	9	5.0 / -15
F21T5/WM	2	277	45	0.18 A	1.01	2.24	93	1 1/2	8	5.0 / -15
F21T5/HE	1	120	31	0.26 A	1.16	3.74	99	1 1/2	9	5.0 / -15
F21T5/HE	2	120	48	0.4 A	1.01	2.10	99	1 1/2	9	5.0 / -15
F21T5/HE	2	277	48	0.18 A	1.01	2.10	94	1 1/2	9	5.0 / -15
F21T5/HE	1	277	31	0.13 A	1.16	3.74	86	1 1/2	10	5.0 / -15
F14T5/WM	1	120	22	0.18 A	1.15	5.23	99	1 1/2	9	5.0 / -15
F14T5/WM	2	120	32	0.27 A	0.99	NaN	99	1 1/2	9	5.0 / -15
F14T5/WM	1	277	22	0.1 A	1.15	5.23	NaN	1 1/2	9	5.0 / -15
F14T5/WM	2	277	32	0.13 A	0.99	NaN	87	1 1/2	9	5.0 / -15
F14T5/HE	1	120	23	0.19 A	1.20	5.22	99	1 1/2	9	5.0 / -15
F14T5/HE	1	277	23	0.11 A	1.20	5.22	78	1 1/2	10	5.0 / -15
F14T5/HE	2	120	34	0.29 A	1.03	3.03	99	1 1/2	9	5.0 / -15
F14T5/HE	2	277	34	0.14 A	1.03	3.03	89	1 1/2	10	5.0 / -15

WARRANTY INFORMATION

GE Lighting warrants to the purchaser that each ballast will be free from defects in material or workmanship for period as defined in the attached documents from the date of manufacture when properly installed and under normal conditions of use.

3 ¾" Aperture Vertical Open, Compact Fluorescent, Performance Series, Reflector Trim

UNIFRAME



Complete Fixture consists of Frame-In Kit and Reflector Trim. Select each separately.

Uniframe™ Compact Fluorescent Performance Series Reflector Trims		**Compatible Frame-In Kits** (See Individual Frame-In Kit Specification Sheets)		
Catalog No.	Description	Catalog No.	Installation Type	Lamping
2001CL	3 3/4" Vertical Open Downlight – Specular Clear	**2001F13U**	Uniframe™ Non-IC 120/277v	13w Quad/Triple
2001CD	3 3/4" Vertical Open Downlight – Clear Diffuse	**2001F18U**	Uniframe™ Non-IC 120v/277v	18w Triple
2001WH	3 3/4" Vertical Open Downlight – Matte White	**2001F13ICU/N**	Performance IC 120v/277v	13w Quad/Triple
		2001F18ICU/N	Performance IC 120v/277v	18w Triple

Features

1. **Reflector:** Formed aluminum. Matte White flange.
2. **Finishes:** CL = Specular Clear (Iridescent Free coating)
   CD = Clear Diffuse
   WH = Matte White Paint
4. **Performance Data:** 65˚ Cutoff angle.
   See attached photometric reports for distribution and efficiency data.
   Go to www.lightolier.com for .IES files.

Labels

cULus Listed. Suitable for Damp Locations. I.B.E.W.

Job Information **Type:**

Job Name:

Cat. No.:

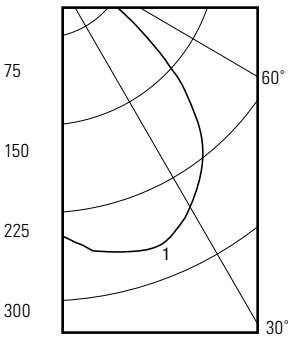
Lamp(s):

Notes:

Lightolier a Genlyte company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

LIGHTOLIER®

18W TRIPLE TUBE LAMP, LUMEN RATING = 1200 LMS, ELECTRONIC BALLAST, CL FINISH TRIM



SC = 1.5

CERTIFIED TEST REPORT NO. 3038FR
COMPUTED BY LSI PROGRAM
TEST-LITE

CANDLEPOWER SUMMARY

Angle	0° CP
0	239
5	246
10	260
15	266
20	271
25	267
30	255
35	238
40	215
45	180
50	130
55	59
60	19
65	1
70	0
75	0
80	0
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens
0-10	23.94
10-20	75.59
20-30	122.65
30-40	148.09
40-50	136.28
50-60	58.12
60-70	4.48
70-80	.0
80-90	0
90-100	0
100-110	0
110-120	0
120-130	0
130-140	0
140-150	0
150-160	0
160-170	0
170-180	0

ZONAL LUMENS AND PERCENTAGES

Zone	Lumens	%Lamp	%Fixt
0-30	222.19	18.5	39
0-40	370.28	30.9	65.1
0-60	564.67	47.1	99.2
0-90	569.15	47.4	100
90-120	0	0	0
90-130	0	0	0
90-150	0	0	0
90-180	0	0	0
0-180	569.15	47.4	100

** Efficiency = 47.4%**

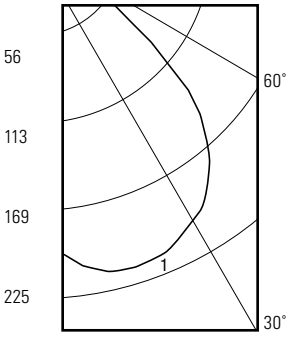
COEFFICIENTS OF UTILIZATION

Ceiling	80%				70%		50%		30%		
Wall	70	50	30	10	50	10	50	10	50	10	0
RCR	Zonal Cavity Method - Effective Floor Reflectance = 20%										
0	56	56	56	56	55	55	53	53	50	50	47
1	53	52	50	49	50	48	49	47	47	45	43
2	50	47	44	42	46	42	44	41	43	40	38
3	46	42	39	37	42	37	40	36	39	35	34
4	43	38	35	32	38	32	37	32	36	31	30
5	40	35	31	29	34	28	33	28	32	28	27
6	37	32	28	25	31	25	30	25	30	25	24
7	35	29	25	23	29	23	28	23	27	22	21
8	32	27	23	21	26	21	26	20	25	20	19
9	30	24	21	19	24	19	24	18	23	18	18
10	28	23	19	17	22	17	22	17	22	17	16

Room Cavity Ratio

Determined In Accordance With Current IES Published Procedures
Luminaire Input Watts = 22.0

13W TRIPLE TUBE LAMP, LUMEN RATING = 900 LMS, ELECTRONIC BALLAST, CL FINISH TRIM



SC = 1.5

CERTIFIED TEST REPORT NO. 3040FR
COMPUTED BY LSI PROGRAM
TEST-LITE

CANDLEPOWER SUMMARY

Angle	0° CP
0	190
5	195
10	207
15	212
20	213
25	209
30	202
35	191
40	175
45	151
50	108
55	53
60	18
65	3
70	1
75	0
80	0
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens
0-10	19.02
10-20	60.03
20-30	96.41
30-40	119.11
40-50	113.45
50-60	50.56
60-70	5.48
70-80	.13
80-90	0
90-100	0
100-110	0
110-120	0
120-130	0
130-140	0
140-150	0
150-160	0
160-170	0
170-180	0

ZONAL LUMENS AND PERCENTAGES

Zone	Lumens	%Lamp	%Fixt
0-30	175.46	19.5	37.8
0-40	294.57	32.7	63.5
0-60	458.58	51	98.8
0-90	464.18	51.6	100
90-120	0	0	0
90-130	0	0	0
90-150	0	0	0
90-180	0	0	0
0-180	464.18	51.6	100

** Efficiency = 51.6%**

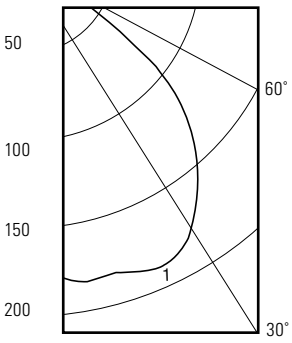
COEFFICIENTS OF UTILIZATION

Ceiling	80%				70%		50%		30%		
Wall	70	50	30	10	50	10	50	10	50	10	0
RCR	Zonal Cavity Method - Effective Floor Reflectance = 20%										
0	61	61	61	61	60	60	57	57	55	55	52
1	58	56	54	53	55	52	53	50	51	49	47
2	54	51	48	46	50	45	48	44	46	43	41
3	50	46	42	40	45	39	44	39	42	38	37
4	46	41	38	35	41	35	40	34	38	34	32
5	43	38	34	31	37	31	36	30	35	30	29
6	40	34	30	27	34	27	33	27	32	27	26
7	37	31	27	24	31	24	30	24	29	24	23
8	35	29	25	22	28	22	28	22	27	22	21
9	33	26	22	20	26	20	25	20	25	20	19
10	31	24	21	18	24	18	24	18	23	18	17

Room Cavity Ratio

Determined In Accordance With Current IES Published Procedures
Luminaire Input Watts = 17.0

13W QUAD TUBE LAMP, LUMEN RATING = 900 LMS, ELECTRONIC BALLAST, CL FINISH TRIM



SC = 1.4

CERTIFIED TEST REPORT NO. 3039FR
COMPUTED BY LSI PROGRAM
TEST-LITE

CANDLEPOWER SUMMARY

Angle	0° CP
5	174
10	179
15	183
20	182
25	187
30	187
35	179
40	164
45	146
50	126
55	97
60	48
65	17
70	2
75	0
80	0
85	0
0	0

ZONAL LUMEN SUMMARY

Zone	Lumens
0-10	17.21
10-20	52.09
20-30	85.75
30-40	102.22
40-50	95.83
50-60	45.94
60-70	4.74
70-80	0
80-90	0
90-100	0
100-110	0
110-120	0
120-130	0
130-140	0
140-150	0
150-160	0
160-170	0
170-180	0

ZONAL LUMENS AND PERCENTAGES

Zone	Lumens	%Lamp	%Fixt
0-30	55.05	17.2	38.4
0-40	257.28	28.6	63.7
0-60	399.05	44.3	98.8
0-90	403.78	44.9	100
90-120	0	0	0
90-130	0	0	0
90-150	0	0	0
90-180	0	0	0
0-180	403.78	44.9	100

** Efficiency = 44.9%**

COEFFICIENTS OF UTILIZATION

Ceiling	80%				70%		50%		30%		
Wall	70	50	30	10	50	10	50	10	50	10	0
RCR	Zonal Cavity Method - Effective Floor Reflectance = 20%										
0	53	53	53	53	52	52	50	50	48	48	45
1	50	49	47	46	48	45	46	44	44	43	41
2	47	44	42	40	43	39	42	38	40	38	36
3	44	40	37	35	39	34	38	34	37	33	32
4	40	36	33	30	35	30	34	30	33	29	28
5	37	33	29	27	32	27	31	26	30	26	25
6	35	30	26	24	29	24	29	24	28	23	22
7	32	27	24	21	27	21	26	21	26	21	20
8	30	25	22	19	25	19	24	19	24	19	18
9	28	23	20	17	23	17	22	17	22	17	16
10	27	21	18	16	21	16	21	16	20	16	15

Room Cavity Ratio

Determined In Accordance With Current IES Published Procedures
Luminaire Input Watts = 16.0

Job Information **Type:**

Lightolier a Genlyte company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

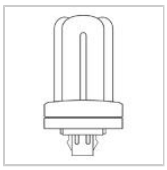
LIGHTOLIER®

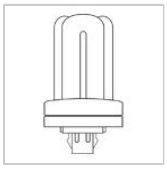
GE Lighting

97622 - F13TBX/841/A/ECO

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering
Energy Savings





CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken

- Remove and install by grasping only plastic portion of the lamp.

GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24q-1
Wattage	13
Voltage	120/91
Rated Life	17000 hrs
Cathode Resistance	10.5 Ohm
LEED-EB MR Credit	312 picograms Hg per mean lumen hour
Rated Life (rapid start) @ Time	20000.0 @ 12.0 h
Additional Info	Dimmable with appropriate dimming ballast./End of Life Protection (EOL)/TCLP compliant
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	900
Mean Lumens	755
Nominal Initial Lumens per Watt	69
Color Temperature	4100 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.25 A
Open Circuit Voltage (after preheating)	190 V
Open Circuit Voltage Across Starter	198 V
Lamp Current	0.175 A
Preheat Voltage	4.25 V
Current Crest Factor	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	4.3000 in(109.2 mm)
Nominal Length	4.200 in(106.7 mm)
Base Face to Top of Lamp	3.700 in(94.0 mm)

PRODUCT INFORMATION

Product Code	97622
Description	F13TBX/841/A/ECO
Standard Package	Case
Standard Package GTIN	10043168976227
Standard Package Quantity	10
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168976220

NOTES

• 4-Pin lamp minimum starting temperature is a function of the ballast. Most ballasts are rated with a minimum starting temperature of 50 degrees F (10 C). Ballasts are also available that provide reliable starting to 0 degrees F (-18C) and -20 F (-29C).

• Amalgam product experience stable brightness over a wider temperature range and in various operating positions.

• Based on 60Hz reference circuit.

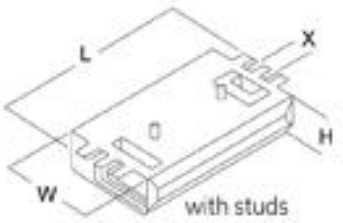
• Fluorescent lamp lumens decline during life

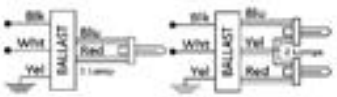
GE Lighting

71430 - GEC213-MVPS-3W

GE CFL Multi-Volt ProLine™ Electronic Program / Rapid Start Ballast

- Multi-Voltage technology means a single ballast handles voltage from 108V to 305V
- Programmed starting for extended lamp life
- End-of-Lamp-Life Protection
- Color Coded Poke-In Connectors simplifies wiring
- 3-Way Ballast Kit (-3W) includes mounting plate, lead wires, extraction tool and mounting hardware for side exit, bottom exit or bottom exit with studs mounting





GENERAL CHARACTERISTICS

Application	2 or 1- CFQ13W/G24q 120-277V Proline PS 3-Way Kit
Category	Compact Fluorescent
Ballast Type	Electronic - Program / Rapid Start
Starting Method	Programmed start
Lamp Wiring	Series
Line Voltage Regulation (+/-)	10 %
Case Temperature	70 °C(158 °F)
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Enclosure Type	Metal
Additional Info	Auto-restart/Thermally protected/Universal voltage

PRODUCT INFORMATION

Product Code	71430
Description	GEC213-MVPS-3W
Standard Package	Master
Standard Package GTIN	10043168714300
Standard Package Quantity	10
Sales Unit	Individual Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168714303

DIMENSIONS

Case dimensions	
Length (L)	5.0 in(127.00 mm)
Width (W)	2.4 in(60.96 mm)
Height (H)	1.0 in(25.40 mm)
Mounting dimensions	
Mount Length (M)	4.6 in(117.60 mm)
Weight	0.57 lb
Exit Type	Poke-in
Remote Mounting Distance to Lamp	20 ft
Remote Mounting Wire Gauge	18 AWG

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	50 Hz/60 Hz

SAFETY & PERFORMANCE

- CSA
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type CC
- UL Type HL
- FCC Part 18 Class B at 120 volts

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
CFTR18W/4P	1	120	20	0.17 A	1.00	5.00	99	1 1/2	12	-20.0 / -29
CFTR18W/4P	1	277	20	0.07 A	1.00	5.00	97	1 1/2	12	-20.0 / -29
CFTR13W/4P	1	120	16	0.16 A	1.00	NaN	96	1 1/2	10	-20.0 / -29
CFTR13W/4P	1	277	16	0.06 A	1.00	NaN	96	1 1/2	10	-20.0 / -29
CFTR13W/4P	2	120	29	0.25 A	1.00	3.45	99	1 1/2	10	-20.0 / -29
CFTR13W/4P	2	277	29	0.11 A	1.00	3.45	99	1 1/2	10	-20.0 / -29
CFS16W/4P	1	120	17	0.14 A	1.00	5.88	96	1 1/2	12	-20.0 / -29
CFS16W/4P	1	277	17	0.06 A	1.00	5.88	96	1 1/2	12	-20.0 / -29
CFS10W/4P	1	120	13	0.11 A	1.05	8.08	96	1 1/2	14	-20.0 / -29
CFS10W/4P	1	277	13	0.05 A	1.05	8.08	96	1 1/2	14	-20.0 / -29
CFS10W/4P	2	120	23	0.19 A	0.95	4.13	97	1 1/2	11	-20.0 / -29
CFS10W/4P	2	277	23	0.09 A	0.95	4.13	97	1 1/2	11	-20.0 / -29
CFQ18W/4P	1	120	20	0.17 A	1.00	5.00	99	1 1/2	12	-20.0 / -29
CFQ18W/4P	1	277	20	0.07 A	1.00	5.00	97	1 1/2	12	-20.0 / -29
CFQ13W/4P	1	120	16	0.16 A	1.00	NaN	96	1 1/2	10	-20.0 / -29
CFQ13W/4P	1	277	16	0.06 A	1.00	NaN	96	1 1/2	10	-20.0 / -29
CFQ13W/4P	2	120	29	0.25 A	1.00	3.45	99	1 1/2	10	-20.0 / -29
CFQ13W/4P	2	277	29	0.11 A	1.00	3.45	99	1 1/2	10	-20.0 / -29

CAUTIONS & WARNINGS

Shine™

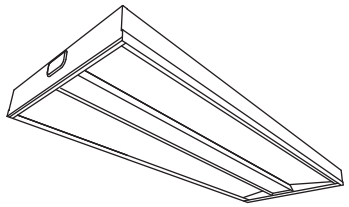
LEDALITE

Recessed

2'x4'

2 T8

airwave™ RESPONSE®



Project Name

Spec Type

Notes

Order Guide

Some combinations of product options may not be available. Consult factory for assistance with your specification.

3324			T232	–		–		–		–	

Product Series & Size

Shine 2'x4'

Version

D1 Standard T-Grid
A1 Air Return on Standard T-Grid

See details on next page

Configuration

ST Standalone
CR Continuous Row
SMS Standalone Master/Satellite
CMS Continuous Row Master/Satellite

Lamping

2 T8 (32W)

Housing

S Standard (22ga.)
N New York (20ga.)
C Chicago Plenum

Wiring

1 1 cct
2 2 cct
5 1 cct w/ Battery Pack
7 1 cct Dimming

Consult website for complete list of standard wiring options

Voltage

1 120V
2 277V
3 347V

Ballast

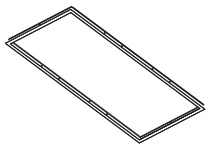
E Standard Ballast

Consult website for ballast manufacturer information

Upgrades & Accessories

Please indicate with check mark.

- ☐ Lamps Included
- ☐ Lamps Included & Installed
- ☐ Job Pack
- ☐ Flex Whip
- ☐ Drywall Kit



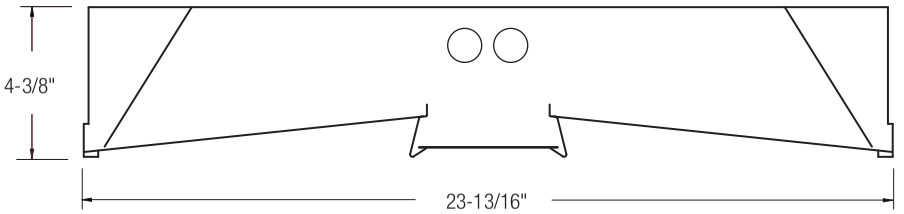
Can be mounted to wood frame or with hanger wire

Wood Frame

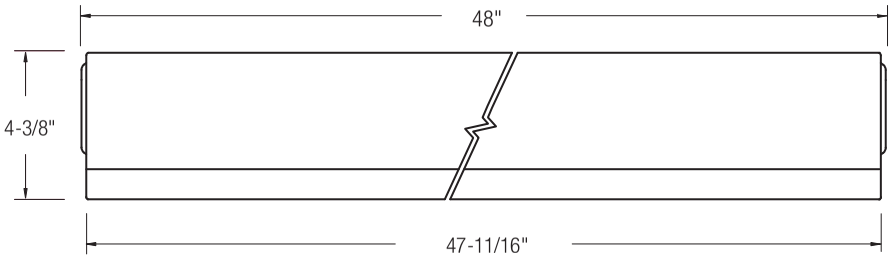
Hanger Wire

- ☐ Response Daylight
  For details visit www.ledalite.com/response

Cross Section



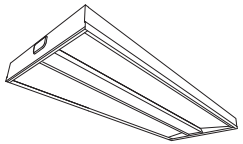
Side View



Phone: 604.888.6811 Fax: 800.665.5332 Web: www.ledalite.com

Shine™

Recessed
2'x4'
2 T8



Photometry

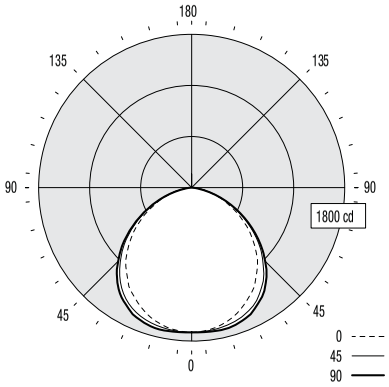
Report Summary

Report # 9901682
Filename 3324D1T232.ies
Efficiency 81.5%

Spacing Criteria 1.24 @ 0˚ along
1.35 @ 90˚ across

Candela Distribution

Vertical Angle	Horizontal Angle 0	22.5	45	67.5	90	Zonal Lumens
0	1700	1700	1700	1700	1700	
5	1689	1695	1696	1702	1704	165
15	1624	1645	1666	1698	1704	471
25	1495	1547	1593	1637	1641	731
35	1312	1384	1432	1491	1489	890
45	1073	1151	1179	1257	1222	911
55	791	848	872	931	897	779
65	485	541	543	573	548	539
75	232	258	240	258	241	268
85	44	51	37	42	34	56
90	0	0	0	0	0	



Coefficients of Utilization (%)

Ceiling:	80				70			50			0
Wall:	70	50	30	10	70	50	30	50	30	10	0
0 RCR	97	97	97	97	94	94	94	90	90	90	81
1	89	85	82	79	87	83	80	80	77	75	69
2	81	74	69	65	79	73	68	70	66	62	58
3	74	66	59	54	72	64	58	62	57	52	49
4	68	58	51	46	66	57	50	55	49	45	42
5	62	52	45	39	61	51	44	49	43	39	36
6	57	47	39	34	56	46	39	44	38	34	32
7	53	42	35	30	52	42	35	40	34	30	28
8	49	39	32	27	48	38	31	37	31	27	25
9	46	35	29	24	45	35	28	34	28	24	22
10	43	33	26	22	42	32	26	31	26	22	20

Based on a floor reflectance of 0.2

Avg. Luminance (cd/m²)

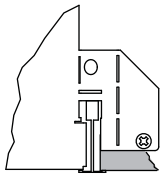
Vertical Angle	Horizontal Angle 0	45	90
55	1982	2185	2247
65	1649	1846	1863
75	1288	1333	1338
85	726	610	561

IES files for this and other photometric options can be downloaded online at www.ledalite.com

Additional Information

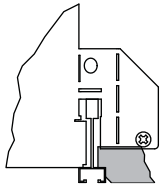
Mounting

Integrates with most common T-bar ceiling types.



Flat T-Grid

Option D1 works with 9/16" and 15/16" flat T-grid ceilings.

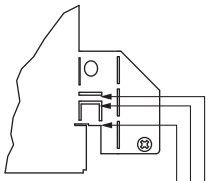


Slot T-Grid

D1 can also be used with slot T-grid ceilings, but it will not sit flush with the bottom of the T-bar.

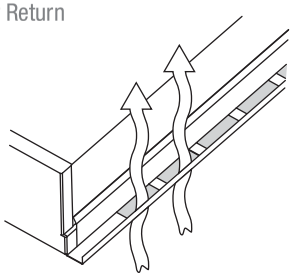
Ceiling Types

Integrated mounting tabs can be field-adjusted to various T-bar ceiling heights for fastening directly to the T-bar grid and/or tied-off to the building structure.



1" T-bar height
1-1/2" T-bar height
1-11/16" T-bar height

Air Return



The air return version features slotted vents along the sides of the fixture. As a result, the installation method of the air return version is different to the standard version, and the fixture cannot be installed in continuous rows.

Specifications

Due to continuing product improvements, Ledalite reserves the right to change specifications without notice.

Housing
Die-formed, post-painted, 22 gauge cold-rolled steel (New York City version is 20 gauge). Wire entrances are positioned on the side of the housing to allow easy wiring access for the installer. Multiple wire entrances are available on top or side to allow continuous row mounting of fixtures. Maintenance can be performed from below the ceiling without tools. No hardware is visible.

Weight
Maximum 40 lbs.

Optical System
Optical system consists of highly reflective painted interior reflectors and three flat acrylic lenses with 95% transmittance.

Mounting
Fixture is compatible with most ceiling types. Option D1 works with 9/16" and 15/16" standard T-grid ceiling systems. D1 can be used with slot T-grid ceiling systems but fixture will be slightly regressed above the T-bar. Integrated tabs are provided for different T-grid heights. Optional drywall kit is available for non-accessible ceilings.

Ballast
Electronic. Supplied with pre-installed ballast disconnects as per national electric codes.

Wiring
Fixtures are factory pre-wired and tested for all circuits and emergency battery packs; all leads pulled to a side access with cover plate. Optional armored cable flex whips are supplied in 6' lengths for 1x4, 2x2 and 2x4 fixtures. Armored cable flex connectors are supplied in 9' lengths for optional master/satellite configurations.

Air Return
Air return option available in 2'x2' and 2'x4' sizes. Perforated air return side rails are finished in black.

Approvals
Certified to UL & CSA Standards. City of Chicago Approved CCEA (housing option C). Designed to comply with NYC code requirements (Housing Option N).

Finish
Housing and Frame: Post-painted, high quality powder coat. Available in white.

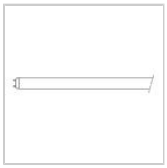
GE Lighting

15904 - F32T8/SP41/ECO/C

GE Ecolux® Starcoat® T8

• Passes TCLP, which can lower disposal costs.

High Color Rendering
Meets Federal Minimum Efficiency Standards



CAUTIONS & WARNINGS

Caution

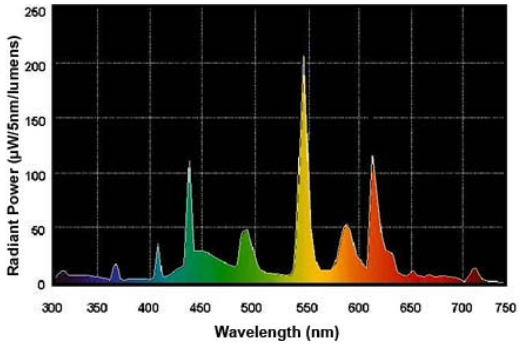
• Lamp may shatter and cause injury if broken
- Wear safety glasses and gloves when handling lamp.
- Do not use excessive force when installing lamp.

Warning

• Risk of Electric Shock
- Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Spectral Power Distribution



GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - Straight Linear
Bulb	T8
Base	Medium Bi-Pin (G13)
Wattage	32
Voltage	137
Rated Life	20000 hrs
Rated Life (instant start) @ Time	24000 h @ 12 h
	20000 h @ 3 h
Rated Life (rapid start) @ Time	24000.0 @ 12.0 h
Bulb Material	Soda lime
Starting Temperature	10 °C (50 °F)
LEED-EB MR Credit	74 picograms Hg per mean lumen hour
Additional Info	TCLP compliant
Primary Application	Standard

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2800
Mean Lumens	2660
Nominal Initial Lumens per Watt	87
Color Temperature	4100 K
Color Rendering Index (CRI)	78

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	315 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor	1.7

DIMENSIONS

Maximum Overall Length (MOL)	47.7800 in(1213.6 mm)
Minimum Overall Length	47.6700 in(1210.8 mm)
Nominal Length	48.000 in(1219.2 mm)
Bulb Diameter (DIA)	1.000 in(25.4 mm)
Bulb Diameter (DIA) (MIN)	0.940 in(23.9 mm)
Bulb Diameter (DIA) (MAX)	1.000 in(25.4 mm)
Max Base Face to Base Face (A)	47.220 in(1199.4 mm)
Face to End of Opposing Pin (B) (MIN)	47.400 in(1204.0 mm)
Face to End of Opposing Pin (B) (MAX)	47.500 in(1206.5 mm)
End of Base Pin to End of Opposite Pin End (C)	47.670 in(1210.8 mm)

PRODUCT INFORMATION

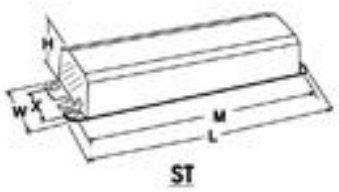
Product Code	15904
Description	F32T8/SP41/ECO/C
ANSI Code	1005-2
Standard Package	Case
Standard Package GTIN	10043168159040
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168159043

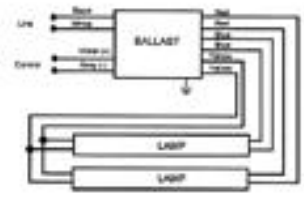
GE Lighting

80355 - B232SR120V5

GE LFL Electronic Dimming Ballast

- T8 fluorescent dimming ballasts help you save as much as 30% on energy bills.
- Greater control of workspace lighiting, ability to create a mood, energy savings
- Designed to ensure optimum lamp performancewith lamp current crest factor below the 1.7 ANSI standard
- Start lamps according to ANSI recommendations throughout the entire dimming range.





GENERAL CHARACTERISTICS

Application	2 - F32T8 DIM 100 to 5% RS 120
Category	Linear Fluorescent
Ballast Type	Electronic - Dimming
Dimming Type	Continuous
Starting Method	Rapid start
Lamp Wiring	Series
Line Voltage Regulation (+/-)	10 %
Ambient Temperature (MAX)	105 °F(41 °C)
Case Temperature	70 °C(158 °F)
Ballast Factor	Normal
Power Factor Correction	Active
Sound Rating	A (20-24 decibels)
Additional Info	Auto-restart/Thermally protected

PRODUCT INFORMATION

Product Code	80355
Description	B232SR120V5
Standard Package	Case
Standard Package GTIN	
Standard Package Quantity	10
Sales Unit	Standard Pack
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168803557

DIMENSIONS

Case dimensions	
Length (L)	9.5 in(241.30 mm)
Width (W)	2.4 in(60.45 mm)
Height (H)	1.6 in(39.37 mm)
Mounting dimensions	
Mount Length (M)	8.9 in(225.81 mm)
Mount Width (X or F)	1.7 in(42.93 mm)
Mount Slots (MS)	0.3 in(7.92 mm)
Weight	2.3 lb
Exit Type	Side
Remote Mounting Distance to Lamp	12 ft
Remote Mounting Wire Gauge	18 AWG

Lead lengths	Qty	Exit	Length (± 1 in.)
Blue	1	Right	33.0 (838mm)
Gray	1	Right	33.0 (838mm)
Violet	1	Right	33.0 (838mm)
White	1	Left	25.0 (635mm)
Yellow	1	Right	51.0 (1295mm)
Red	1	Right	33.0 (838mm)
Black	1	Left	25 in (NaNmm)

ELECTRICAL CHARACTERISTICS

Supply Current Frequency	60 Hz

SAFETY & PERFORMANCE

- CSA
- FCC - CLASS A Non-Consumer
- UL Class P
- UL Listed
- UL Type 1 Outdoor
- UL Type HL

SPECIFICATIONS BY LAMP & WATTAGE

Lamp	# of Lamps	Line Volts	System Watts	Nom. Line Current	System Ballast Factor	Ballast Efficacy Factor	Power Factor% (>=)	Crest Factor (<=)	THD% (<=)	Min. Starting Temp (°F/°C)
F32T8	2	120	13	0.12 A	0.05	0.38	90	1.7	10	50.0 / 10
F32T8	2	120	62	0.52 A	0.88	1.42	99	1.6	10	50.0 / 10

CAUTIONS & WARNINGS

Warning

- Risk of Electric Shock
  - Properly ground ballast and fixture.
  - Turn power off before servicing--see instructions.

WARRANTY INFORMATION

LP8 Peanut Lighting Control Panels

Simple and effective interior and exterior lighting control

Controls up to eight single-pole lighting circuits

Easy user interface with on-screen help

Compatible with AS-100 Automatic Control Switches for local override control

System clock provides time scheduled or astronomic control

PROJECT

LOCATION/TYPE

Product Overview

Description

WattStopper's LP8 Peanut Lighting Control Panels provide simple, effective zone-based control of exterior and interior lighting in small applications. Panels control up to eight channels or zones of lighting. Zones respond to control signals from the system clock (or other signalling device) to turn lighting on and off. LP8 Panels ship pre-assembled in easy-to-install compact packages available for surface and flush mounting. They consist of relays, a system clock, panel intelligence, power supply, tub and cover. The standard enclosure is NEMA 1-rated.

Operation

For exterior applications, the system clock provides astronomic control (based on sunrise and sunset), or an optional EM Photocell can be added for light-level control. For interior applications, AS-100 Automatic Control Switches or low voltage switches can automate after-hours lighting shutoff while providing manual override control.

System Clock

The LP8 system clock provides automation and features a seven-day format with holiday scheduling. Set-up and programming is simple with an easy-to-navigate keypad, backlit LCD and user-friendly help menus. Preprogrammed control scenarios include: scheduled-on/off and manual-on/scheduled-off. Manual-on/sweep-off is available with an AS-100 switch. Astronomic or photocell on/off, and astronomic or photocell with schedule on/off available by adding an EM Photocell.

Applications

LP8 Panels save energy by turning lights off when not needed, while providing a secure illuminated space when occupants are present. They are ideal for areas with less than eight loads and a small amount of zones in both interior (i.e., small offices or retail facilities and elevator lobbies) and exterior (i.e., small parking lots, courtyards and driveways) applications. LP8 Panels integrate with a wide range of control devices, such as switches and occupancy sensors to create a flexible lighting shutoff strategy.

Features

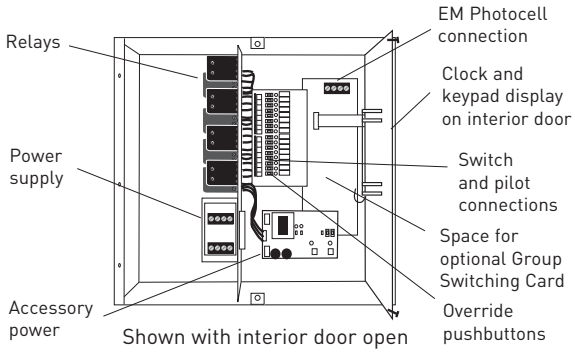
- Preprogrammed control scenarios; seven-day format with holiday scheduling, astronomic control and automatic daylight savings
- Time retained during power outage; nonvolatile program memory
- Eight universal switch inputs for low voltage switches, occupancy sensors, photocells or other devices to directly control each relay
- Pushbuttons for manual override of each relay
- Uses individually replaceable HDR5P Mechanically Latching Relay with integral manual override
- Optional group of eight switch inputs for pushbutton grouping of relays (Smartwiring™)
- LED for visual indication of relay status
- Accepts most types of switch inputs
- Separate high voltage and low voltage sections for user protection

Specifications

- Multiple power supplies available: 115/277 VAC, 220-240 VAC, 115/347 VAC; 50/60 Hz
- Relay: Mechanically latching
  Integral manual override
  Individually replaceable
  Ratings: 20 Amp tungsten @ 120 VAC
  30 Amp ballast @ 277 VAC
  20 Amp ballast @ 347 VAC
  30 Amp resistive @ 347 VAC
  1.5 hp @ 120 VAC
- Accessory power 800 mA at 24 VDC/VAC/VACR
- Eight universal switch inputs; compatible with 3-wire momentary or maintained, 2-wire momentary or maintained, or 24 VDC input
- Eight universal group switch inputs that allow pushbutton grouping of relays (optional)
- Ambient temperature 32-139°F (0-60°C); 5-95% RH noncondensing
- Dimensions: 15.08" x 16.5" x 4.62" (383.0mm x 419.1mm x 117.3mm) L x W x D
- UL and CUL listed; one-year warranty

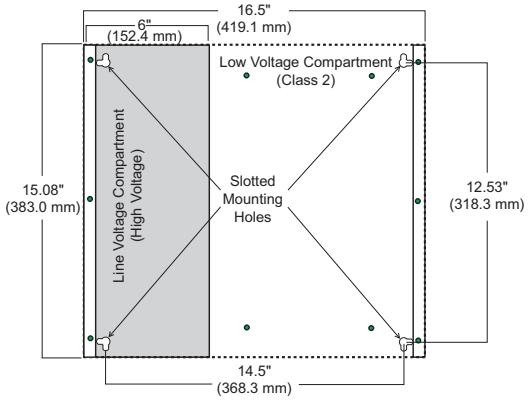
Wiring & Installation

LP8 Panel Layout



Shown with interior door open

LP8 Dimensions

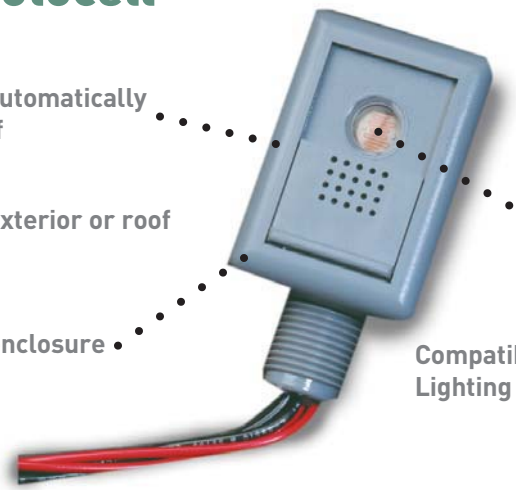


Ordering Information

Catalog No.	Description	Door Mounting	# Relays	Group Switching Card	Voltage
☐ LP8S-8-115	LP8 Peanut Lighting Control Panel	Surface	8 Relays	none	115/277 VAC
☐ LP8S-8-G-115	LP8 Peanut Lighting Control Panel	Surface	8 Relays	included	115/277 VAC
☐ LP8F-8-115	LP8 Peanut Lighting Control Panel	Flush	8 Relays	none	115/277 VAC
☐ LP8F-8-G-115	LP8 Peanut Lighting Control Panel	Flush	8 Relays	included	115/277 VAC
☐ LP8S-4-115	LP8 Peanut Lighting Control Panel	Surface	4 Relays	none	115/277 VAC
☐ LP8F-4-115	LP8 Peanut Lighting Control Panel	Flush	4 Relays	none	115/277 VAC
☐ LP8S-8-347	LP8 Peanut Lighting Control Panel	Surface	8 Relays	none	115/347 VAC
☐ LP8S-8-G-347	LP8 Peanut Lighting Control Panel	Surface	8 Relays	included	115/347 VAC
☐ LP8F-8-347	LP8 Peanut Lighting Control Panel	Flush	8 Relays	none	115/347 VAC
☐ LP8F-8-G-347	LP8 Peanut Lighting Control Panel	Flush	8 Relays	included	115/347 VAC
☐ LP8S-8-240	LP8 Peanut Lighting Control Panel	Surface	8 Relays	none	240 VAC
☐ LP8S-8-G-240	LP8 Peanut Lighting Control Panel	Surface	8 Relays	included	240 VAC
☐ LP8F-8-240	LP8 Peanut Lighting Control Panel	Flush	8 Relays	none	240 VAC
☐ LP8F-8-G-240	LP8 Peanut Lighting Control Panel	Flush	8 Relays	included	240 VAC
Optional system enhancements:					
☐ EM-24A2	Exterior Photocell, low voltage				24VAC
☐ AS-100-W	Automatic Control Switch, White				120/277 VAC, 50/60 Hz
☐ AS-100-A	Automatic Control Switch, Light Almond				120/277 VAC, 50/60 Hz
☐ AS-100-I	Automatic Control Switch, Ivory				120/277 VAC, 50/60 Hz

Pub. No. 15106 rev 11/2009

EM Exterior Photocell



Low voltage photocell automatically turns lighting on and off

Simple to install

Mounts on building exterior or roof

Adjustable aperture window for varying on setpoint

Rain-tight gray plastic enclosure

Compatible with all Watt Stopper Lighting Control panels and power packs

PROJECT

LOCATION/TYPE

Product Overview

Description

The low voltage EM Exterior Photocell controls exterior lighting in conjunction with Watt Stopper/ Legrand lighting control panels and power packs by signalling a change in light levels to the panel.

Operation

Typically mounted so the light level window faces the northern sky, the EM Exterior Photocell provides an on signal when the ambient light level drops below a preset 'dark' setpoint, and an off signal as the ambient light level rises above the preset 'light' setpoint. The setpoints can be changed for specific applications by opening and closing the EM Photocell's aperture window. Normally a lighting control panel or a power pack supplies power to the EM Photocell. The photocell's relay contact red wires are connected to the panel or to a low voltage controlled load.

Installation Flexibility

The EM Exterior Photocell is available in two models to provide multiple installation options. Model EM-24A2 is compatible with LP8 Peanut, LP24 Peanut Plus and Lighting Integrator Lighting Control Panels. Model EM-24D2 works with Watt Stopper/Legrand B347D-P, BZ-50 and BZ-150 power packs.

Applications

The EM Exterior Photocell provides dusk to dawn lighting control for most exterior lighting control applications such as parking lots, landscape lighting and signage.

Features

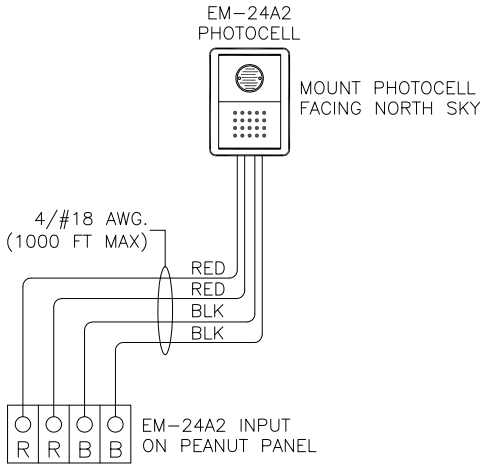
- One set of normally open, isolated relay contacts; closed when sensed light level is below dark setpoint, open when light level is above light setpoint
- Eight-second time delay and built-in setpoint deadband prevent cycling
- 1/2" threaded male conduit base for easy mounting on conduit fittings or junction boxes.

Specifications

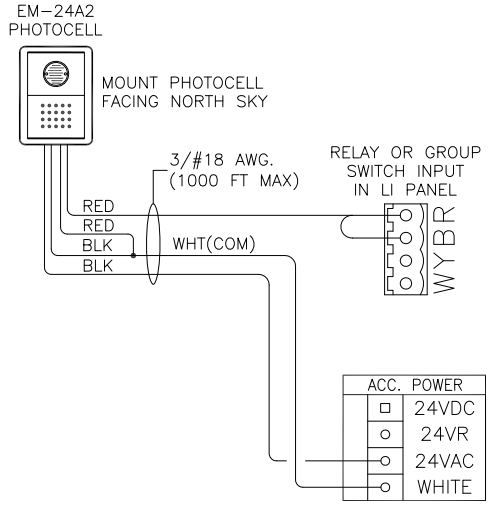
- 1-15 footcandle range (10.8 -161.5 lux)
- Isolated relay contacts 1 amp @ 30 VAC/VDC
- Power input: 24 VAC, 1 VA or 24 VDC, 1 VA
- Operating Temperature: -25 to 125°F (-31.67 to 51.67°C) ambient
- Dimensions: 2.65"x 1.88"x 1.5" (66.68mm x 47.63mm x 38.1mm) H x W x D
- One-year warranty

Wiring

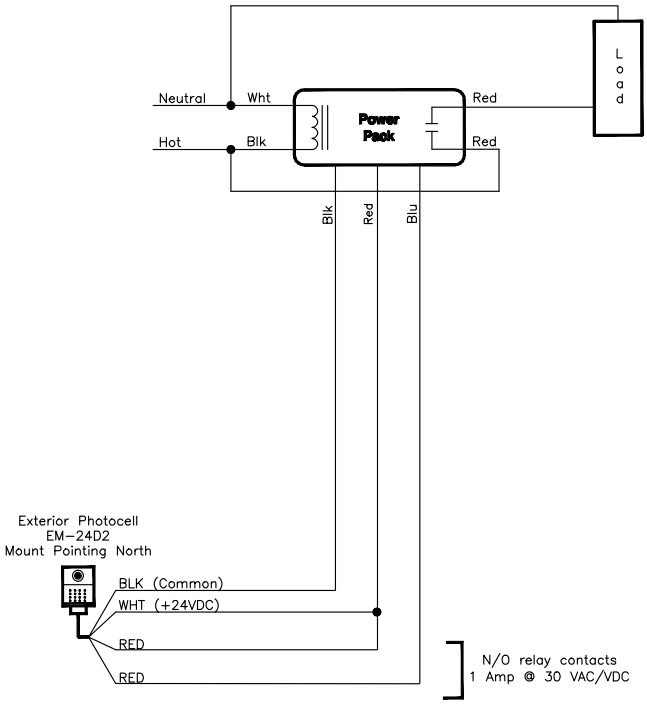
EM24A2 with LP Peanut Lighting Control Panel



EM24A2 with Lighting Integrator Control Panel



EM-24D2 with a Power Pack



Ordering Information

Catalog No.	Description	Voltage
☐ EM-24A2	EM Exterior Photocell for Use with Panels	24 VAC
☐ EM-24D2	EM Exterior Photocell for Use with Power Packs	24 VDC

Pub. No. 8406

DT-200 Series Dual Technology Ceiling/Wall Sensors

Combines passive infrared (PIR) and ultrasonic technologies

Auto set automatically selects optimal settings for each space

Walk-through mode increases savings potential

Built-in light level sensor

Accepts low-voltage switch input for manual-on operation

Automatic or manual-on operation when used with a BZ-150 Power Pack

PROJECT

LOCATION/TYPE

Product Overview

Description

WattStopper's DT-200 Series Dual Technology Ceiling Sensors combine PIR and ultrasonic technologies into one unit to achieve precise coverage in detecting occupancy.

Operation

Low voltage DT-200 Series Sensors utilize a WattStopper power pack to turn lights on when both PIR and ultrasonic technologies detect occupancy. They can also work with a low voltage switch for manual-on operation. PIR technology senses motion via a change in infrared energy within the controlled area, whereas ultrasonic uses 40 kHz high frequency ultrasound. Once on, detection by either technology holds lights on. When no occupancy is detected for the length of the time delay, lights turns off. DT-200 Series Sensors can also be set to trigger lights on when either technology or both detect occupancy, or to require both technologies to hold lighting on.

Auto set

The DT-200 requires no adjustment at installation. Auto set continuously monitors the controlled space to identify usage patterns. Based on these patterns, units automatically adjust time delay and sensitivity settings for optimal performance and energy efficiency. Sensors assign short delays (as low as five minutes) for times when the space is usually vacant, and longer delays (up to 30 minutes) for busier times.

Application

DT-200 Series Sensors have the flexibility to work in a variety of applications. Mounted at ten feet, the sensors can cover up to 2000 square feet of walking motion and 1000 square feet of desktop motion. The sensors are designed to control lighting in difficult applications where one technology alone could encounter false triggers. The DT-200 works well in classrooms, warehouses, large offices, open office spaces and computer rooms.

Features

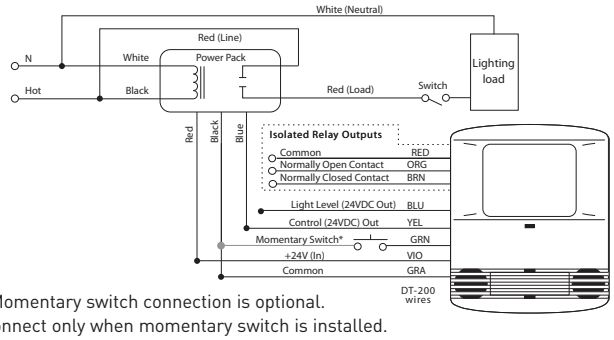
- Advanced control logic based on RISC microcontroller provides:
  - Detection Signature Processing to eliminate false triggers and provides immunity to RFI and EMI
  - Walk-through Mode turns lights off three minutes after the area is initially occupied – ideal for brief visits, such as mail delivery
  - Available with built-in light level sensor featuring simple, one-step setup
- Sensors work with low-voltage momentary switches to provide manual control
- LEDs indicate occupancy detection
- Eight occupancy logic options provide the ability to customize control to meet application needs
- Available with isolated relay for integration with BAS or HVAC
- Swivel mounting bracket for convenient corner mounting to wall or ceiling
- Qualifies for ARRA-funded public works projects

Specifications

- 24 VDC/VAC and halfwave rectified AC
- 40 kHz frequency ultrasonic transmission
- Time delays: Auto set, fixed (5, 10, 15, 20 or 30 minutes), Walk-through/Test Modes
- Sensitivity adjustment: Auto set; reduced sensitivity (PIR); variable with trim pot (ultrasonic)
- Built-in light level sensor: 2 to 200 footcandles (21 to 2,152 lux)
- Low voltage, momentary switch input for manual operation
- DT-200 contains an isolated relay with N/O and N/C outputs; rated for 1 Amp at 24 VDC/VAC
- 2000 ft² of walking motion mounted at 10 ft; 1000 ft² of desktop motion
- Max. DT-200s per power pack: B=2, BZ=3
  Max. DT-205s per power pack: B=3, BZ=4
- Dimensions: 4.4" x 3.4" x 2" (110.3mm x 85.9mm x 49.6mm) L x W x D
- UL and cUL listed
- Five year warranty

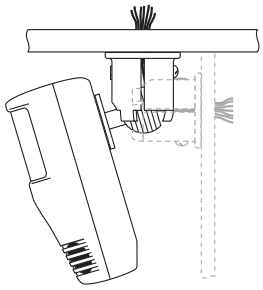
Wiring & Mounting

Wiring Diagram



*Momentary switch connection is optional.
Connect only when momentary switch is installed.

Mounting



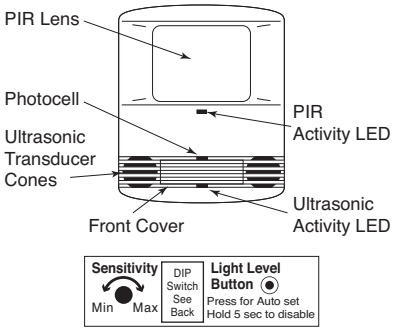
A swivel mounting bracket attached to the sensor allows the sensor to be angled for wall or ceiling mounting.

Grooves on the bracket help to achieve desired angle for coverage.

Mount to mud ring.

Controls & Settings

Product Controls



DIP Switch Settings

◀ = Factory Setting
● = ON
– = OFF

Occupancy Logic	Switch# 1	2	3
Standard	–	–	– ◀
Option 1	●	–	–
Option 2	–	●	–
Option 3	●	●	–
Option 4	–	–	●
Option 5	●	–	●
Option 6	–	●	●
Option 7	●	●	●

Time Delay	4	5	6
5 sec/SmartSet	–	–	–
5 minutes	–	–	●
10 min.	–	●	–
10 minutes	–	●	●
15 min.	●	–	–
15 minutes	●	–	●
20 minutes	●	●	– ◀
30 min.	●	●	●

= walk-through mode

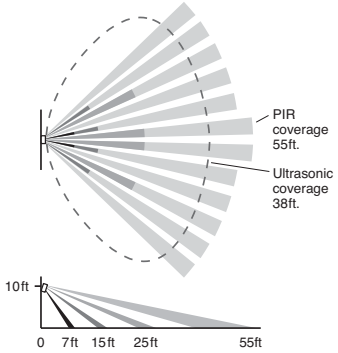
Occupancy Logic	Trigger	Initial Occupancy	Maintain Occupancy	Re-trigger (seconds duration)
Standard	Both	Either	Either(5)
Option 1	Either	Either	Either(5)
Option 2	PIR	Either	Either(5)
Option 3	Both	Both	Both(5)
Option 4	PIR	PIR	PIR(5)
Option 5	Ultra	Ultra	Ultra(5)
Option 6	Man.	Either	Either(30)
Option 7	Man.	Both	Both(30)

LEDs	7
Disabled	–
Enabled	● ◀

PIR Sensitivity	8
Minimum	–
Max./SmartSet	● ◀

Coverage

Coverage Pattern



Coverages shown are maximum and represent half-step walking motion. Under ideal conditions with no barriers or obstacles, coverage for half-step walking motion can reach up to 2000 ft², while coverage for typical desktop activity can reach up to 1000 ft².

Ordering Information

Catalog No.	Voltage	Current	Coverage	Features
☐ DT-200	24 VDC	43 mA	2000 ft² (185.8 m²)	light level, isolated relay
☐ DT-205	24 VDC	35 mA	2000 ft² (185.8 m²)	

Sensors are white and use WattStopper power packs. Current consumption can be slightly higher when only one sensor per power pack is used.

LMSW-105 Digital 5-Button Scene Switch

Low voltage switch for control of four preset scenes and raise/lower control of scenes or loads

Component of Digital Lighting Management integrated control system

Plugs to other components using Cat 5e cables with RJ45 connectors eliminating wiring errors

Plug n' Go automatic configuration and Push n' Learn for personalization

Customizable buttons with LED status indicators

Active Dim feature enables temporary adjustment of any selected load

PROJECT

LOCATION/TYPE

Product Overview

Description

The LMSW-105 Digital Scene Switch is a low voltage device that sets and recalls preset lighting scenes and raises and lowers lighting levels. It is part of a Digital Lighting Management (DLM) system and controls loads connected to DLM room controllers by accessing four of the 16 scenes available in a DLM local network.

Operation

The LMSW-105 operates on Class 2 power supplied to a DLM local network by one or more room controllers. Plug n' Go automatic configuration assigns presets 1, 2, 3 and 4 to the scene buttons on the switch upon system startup. When multiple switches are installed, default operation is for multi-way control; each switch controls the same scenes. Scene buttons may be reconfigured to control different scenes or control loads instead of scenes. Users activate a scene by tapping one of the scene buttons. They may raise or lower light levels, and turn lights on or off, with the paddle. In Active Dim mode, users can temporarily adjust the level of any dimmable load or scene on the local network by selecting a load or scene button and then pressing and holding the paddle on the LMSW-105.

Personalizing Scene Switches

Plug 'n Go assigns all loads to each LMSW-105 upon system startup. Load assignments may be changed using Push n' Learn. Preset scene levels are stored by the room controllers, and default levels are established by Plug n' Go. Scene 1 is 100%, scene 2 is 75%, scene 3 is 50% and scene 4 is 25%. Preset levels can be easily changed by adjusting lighting to the desired level, typically using LMDM-101 dimming switches assigned to control each load, or channel, and pressing and holding a scene button on the LMSW-105 to memorize the new levels. Each scene switch may be personalized in the field with custom-engraved buttons. The integral IR transceiver allows both wireless configuration and system operation.

Applications

The LMSW-105's sleek low profile appearance is ideally suited for use in conference and board rooms, classrooms, training centers, and other applications where preset scene-based dimming control is desired. The LMSW-105 Scene Switch works with LMDM-101 Digital Dimming Wall Switches to create a flexible and elegant small dimming system. Digital Lighting Managment's Active Dim feature gives designers the option of reducing wall clutter by facilitating scene setting without the need for individual dimming switches for each load.

Features

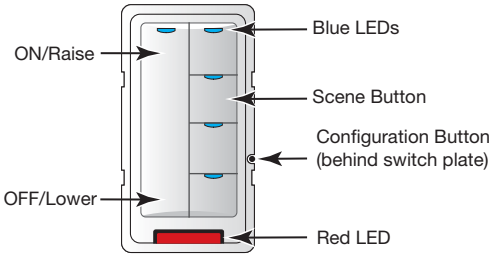
- Hidden configuration button for easy access to Push n' Learn mode
- Used with DLM dimming room controller
- Master raise/lower paddle and all-on/all-off control
- Infrared (IR) transceiver for wireless configuration and control
- Sleek single gang device fits decorator wall plates
- May be used for multi-way control applications
- LED status indicators
- Five color options and custom engraving options; standard buttons may be replaced in the field
- RoHS compliant
- Qualifies for ARRA-funded public works projects

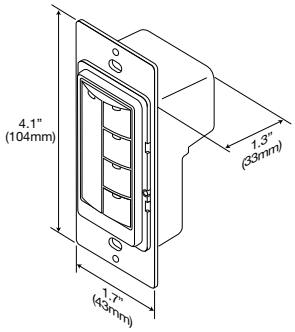
Specifications

- Input voltage: 24VDC from DLM local network
- Current consumption: 5mA
- DLM local network connection: 2 RJ45 ports
- Control button with LED status indicator
- Hidden configuration button for access to Push n'Learn mode
- Infrared (IR) transceiver
- Operating conditions: for indoor use only; 32-131°F (0-55°C); 5-95% RH, non-condensing
- UL and cUL listed
- FCC part 15 compliant
- Five year warranty

Controls & Dimensions

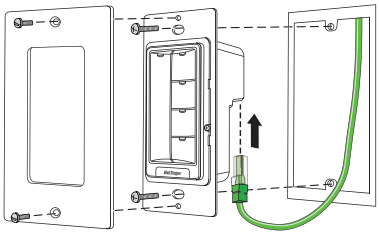
Switch Controls and Dimensions





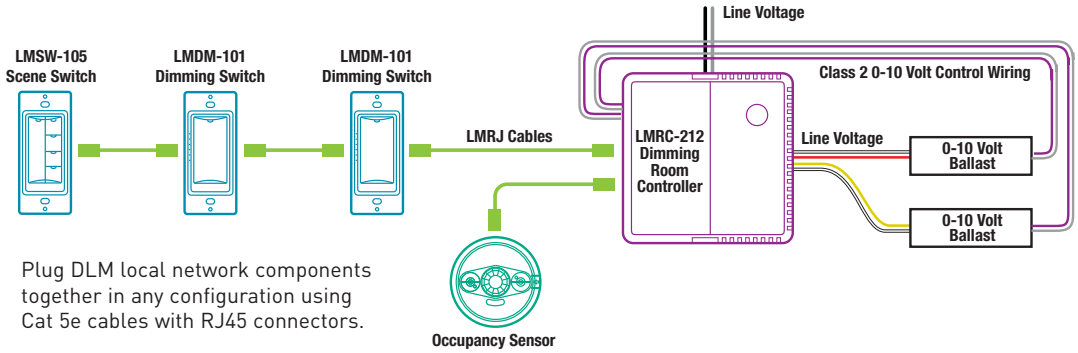
Mounting & Connecting

Mounting



LMSW-105 Scene Switches fit in standard single gang boxes.

Sample Connection Diagram with 0-10 Volt Dimming



Plug DLM local network components together in any configuration using Cat 5e cables with RJ45 connectors.

Ordering Information

Catalog No.	Color	Description
☐ LMSW-105-W	White	Digital 5-Button Scene Switch
☐ LMSW-105-W-U	White	Digital 5-Button Scene Switch, ARRA-compliant
☐ LMSW-105-LA	Light Almond	Digital 5-Button Scene Switch
☐ LMSW-105-I	Ivory	Digital 5-Button Scene Switch
☐ LMSW-105-I-U	Ivory	Digital 5-Button Scene Switch, ARRA-compliant
☐ LMSW-105-G	Grey	Digital 5-Button Scene Switch
☐ LMSW-105-B	Black	Digital 5-Button Scene Switch

Switches do not include face plates. Order decorator style plate separately.

DT-300 Series Dual Technology Ceiling Sensors

PROJECT

LOCATION/TYPE

Product Overview

Description

The DT-300 Series Dual Technology Ceiling Sensors combine the benefits of passive infrared (PIR) and ultrasonic technologies to detect occupancy. Sensors have a flat, unobtrusive appearance and provide 360 degrees of coverage.

Operation

Low voltage DT-300 Series sensors utilize a WattStopper power pack to turn lights on when both PIR and ultrasonic technologies detect occupancy. They can also work with a low voltage switch for manual-on operation. PIR technology senses motion via a change in infrared energy within the controlled area, whereas ultrasonic uses 40KHz high frequency ultrasound. Once lights are on, detection by either technology holds them on. When no occupancy is detected for the length of the time delay, lights turns off. DT-300 Series Sensors can also be set to trigger lights on when either technology or both detect occupancy, or to require both technologies to hold lighting on.

Auto Set

The DT-300 requires no adjustment at installation. Auto set continuously monitors the controlled space to identify usage patterns. Based on these patterns, the unit automatically adjusts time delay and sensitivity settings for optimal performance and energy efficiency. Sensors assigns short delays (as low as five minutes) for times when the space is usually vacant, and longer delays (up to 30 minutes) for busier times.

Application

DT-300 Series Dual Technology Sensors have the flexibility to work in a variety of applications, where one technology alone could cause false triggers. Ideal applications include classrooms, open office spaces, large offices and computer rooms. The DT-300 Series mounting system makes them easy to install in ceiling tiles or to junction boxes, providing the flexibility to be used in a wide range of spaces.

Features

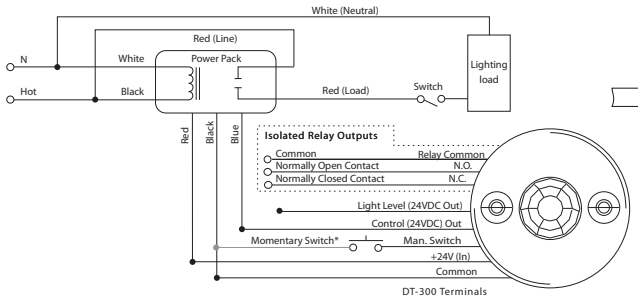
- Advanced control logic based on RISC microcontroller provides:
  - Detection Signature Processing eliminates false triggers and provides immunity to RFI and EMI
  - Walk-through mode turns lights off three minutes after the area is initially occupied – ideal for brief visits such as mail delivery
  - Available with built-in light level sensor featuring simple, one-step setup
- Sensors work with low-voltage momentary switches to provide manual control
- Patented ultrasonic diffusion technology spreads coverage to a wider area
- LEDs indicate occupancy detection
- Uses plug terminal wiring system for quick and easy installation
- Eight occupancy logic options provide the ability to customize control to meet application needs
- Available with isolated relay for integration with BAS or HVAC
- Qualifies for ARRA-funded public works projects

Specifications

- 24 VDC/VAC
- Ultrasonic frequency: 40kHz
- Time delays: Auto set, fixed (5, 10, 15, 20, or 30 minutes), Walk-through/Test Modes
- Sensitivity adjustment: Auto set; reduced sensitivity (PIR); variable with trim pot (ultrasonic)
- Built-in light level sensor: 10 to 300 footcandles (107.6 to 3,229.2 lux)
- Low-voltage, momentary switch input for manual on or off operation
- DT-300 contains an isolated relay with N/O and N/C outputs; rated for 1 Amp @ 30 VDC/VAC
- Multi-level Fresnel lens provides 360° coverage
- Mounting options: ceiling tile; 4" octagonal J-box, 1.5" deep
- Max DT-300s per power pack: B=2 , BZ=3
  Max DT-305s per power pack: B=3, BZ=4
- Dimensions: 4.50" diameter x 1.02" deep (114.3mm x 25.9mm)
- UL and cUL listed
- Five year warranty

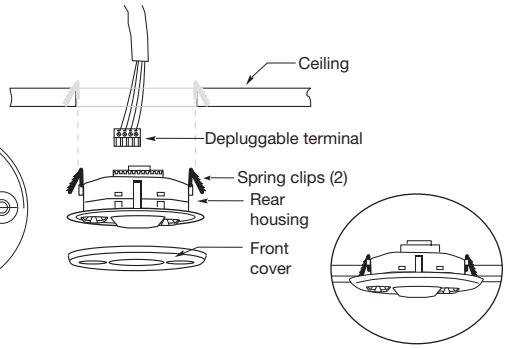
Wiring & Mounting

Wiring Diagram



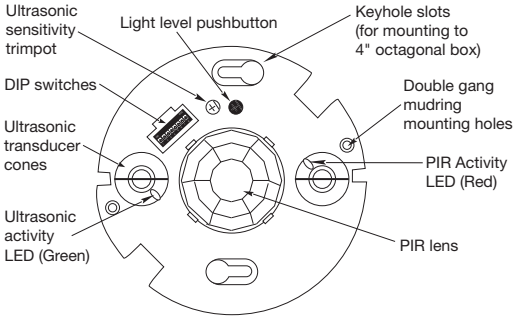
*Momentary switch connection is optional.
Connect only when momentary switch is installed.

Ceiling Mounting



Controls & Settings

Product Controls



DIP Switch Settings

◂ = Factory Setting
● = ON
– = OFF

Occupancy	Logic	Switch# 1	2	3
	Standard	–	–	– ◂
	Option 1	●	–	–
	Option 2	–	●	–
	Option 3	●	●	–
	Option 4	–	–	●
	Option 5	●	–	●
	Option 6	–	●	●
	Option 7	●	●	●

Time Delay	4	5	6
5 sec/SmartSet	–	–	–
5 minutes	–	–	●
10 min.	–	●	–
10 minutes	–	●	●
15 min.	●	–	–
15 minutes	●	–	●
20 minutes	●	●	– ◂
30 min.	●	●	●

= walk-through mode

Occupancy Logic	Trigger	Initial Occupancy	Maintain Occupancy	Re-trigger (seconds duration)
	Standard	Both	Either	Either(5)
	Option 1	Either	Either	Either(5)
	Option 2	PIR	Either	Either(5)
	Option 3	Both	Both	Both(5)
	Option 4	PIR	PIR	PIR(5)
	Option 5	Ultra	Ultra	Ultra(5)
	Option 6	Man.	Either	Either(30)
	Option 7	Man.	Both	Both(30)

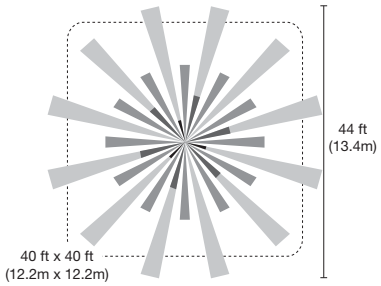
LEDs	7
Disabled	–
Enabled	● ◂

PIR Sensitivity	8
Minimum	–
Max./SmartSet	● ◂

The technology control (occupancy logic) options are adjustable by user. The standard setting recommended for most applications requires both technologies to trigger on, either to hold on.

Coverage

Coverage Pattern



Coverage shown is maximum and represents half-step walking motion. Under ideal conditions, coverage for half-step walking motion can reach up to 1000 ft².

Ordering Information

Catalog No.	Voltage	Current	Coverage	Features
☐ DT-300 ☐ DT-300-U	24 VDC/VAC	43 mA	up to 1000 ft² (92.9 m²)	Isolated relay, light level
☐ DT-305 ☐ DT-305-U	24 VDC/VAC	35 mA	up to 1000 ft² (92.9 m²)	

Sensors are white and use WattStopper power packs. Current consumption can be slightly higher when only one sensor per power pack is used.

10

Type PRL2a

Contents

Type PRL2a

Product Description

- 480Y/277 Vac maximum (125 Vdc)
- Three-phase four-wire, three-phase three-wire, single-phase three-wire, single-phase two-wire
- 400A maximum mains
- 100A maximum branch breakers
- Bolt-on branch breakers
- Each branch connector is capable of up to a total of 140A maximum by breaker ampere rating
- Factory assembled
- Refer to **Page 357** for additional information

Application Description

- Lighting branch panelboard
- Fully rated or series rated
- Interrupting ratings up to 200 kA symmetrical
- Suitable for use as Service Entrance Equipment, when specified on the order
- See **Pages 357** through **373** for additional information

Standards and Certifications

- UL 67, UL 50
- Federal Specification W-P-115c
- Refer to **Page 357** for additional information

UL Listed

Product Selection

Type PRL2a

PRL2a

Ampere Rating	Interrupting Rating (kA Symmetrical) 240 Vac	480Y/277 Vac	125/250 Vdc	Breaker Type
Main Lug Only				
100	—	—	—	—
225	—	—	—	—
400	—	—	—	—
Main Breaker				
100	65	14	14	GHB
100	18	14	10	EHD
100	65	35	10	FD, FDE
100	100	65	22	HFD, HFDE
100	200	100	22	FDC
225	65	—	—	ED
225	65	35	10	FD, FDE
225	100	65	22	HFD, HFDE
225	200	100	22	FDC
250	65	35	10	JD
250	100	65	22	HJD
250	200	100	22	JDC
400	65	35	10	KD
400	100	65	22	HKD
400	100	65	—	LHH
400	200	100	22	KDC

PRL2a Branch Circuit Breakers

Ampere Rating	Interrupting Rating (kA Symmetrical) 240 Vac ①	480Y/277 Vac	125/250 Vdc	Breaker Type
15–20	65	14	—	GHQ ②
15–20	65	14	14	GHB ②
25–60	65	14	14	GHB ②
70–100	65	14	14	GHB ②
15–30	65	25	—	HGHB ②
15–20	65	14	—	GHQRSP ③
15–30	65	14	—	GHBS ②③
15–60	—	14	—	GHBGFEP ②④
15–20	—	14	—	GHBHID ②⑤
Provision	—	—	—	—

Notes

① Interrupting ratings in this column are applicable to 120 Vac for single-pole breakers.
② Must be used on 480Y/277V grounded wye systems only.
③ Remote controllable breaker.
④ GFP for 30 mA equipment protection. Requires two-pole spaces. 277 Vac only.
⑤ HID (High Intensity Discharge) rated breaker.

Box Sizing and Selection

Approximate Dimensions in Inches (mm)

Assembled Circuit Breaker Panelboards and Lighting Controls

Box size and box and trim catalog numbers for all standard panelboard types are found on **Page 391**.

Instructions

1. Using description of the required panelboard, select the rating and type of main required.
2. Count the total number of branch circuit poles, including provisions, required in the panelboard. Do not count main breaker poles. Convert two- or three-pole branch breaker to single-poles, i.e., three-pole breaker, count as three poles. Determine sub-feed breaker or through-feed lug requirements.
3. Select the main ampere rating section from table on **Page 391**.
4. Select panelboard type from first column, main breaker frame, if applicable, from second column, and sub-feed breaker frame, if applicable, from the third column.
5. From Step #2, determine the number of branch circuits in Column 4.
6. Read box size, box and trim catalog numbers across columns to the right. Specify surface or flush mounting on the order.

Cabinets

Fronts are code-gauge steel, ANSI-61 light gray painted finish.

Boxes are code-gauge galvanized steel without knockouts. Standard depth is 5-3/4 inches (146.1 mm). Standard width is 20 inches (508.0 mm). An optional 28-inch (711.2 mm) wide box is available.

Top and Bottom Gutters

5-1/2 inches (139.7 mm) minimum.

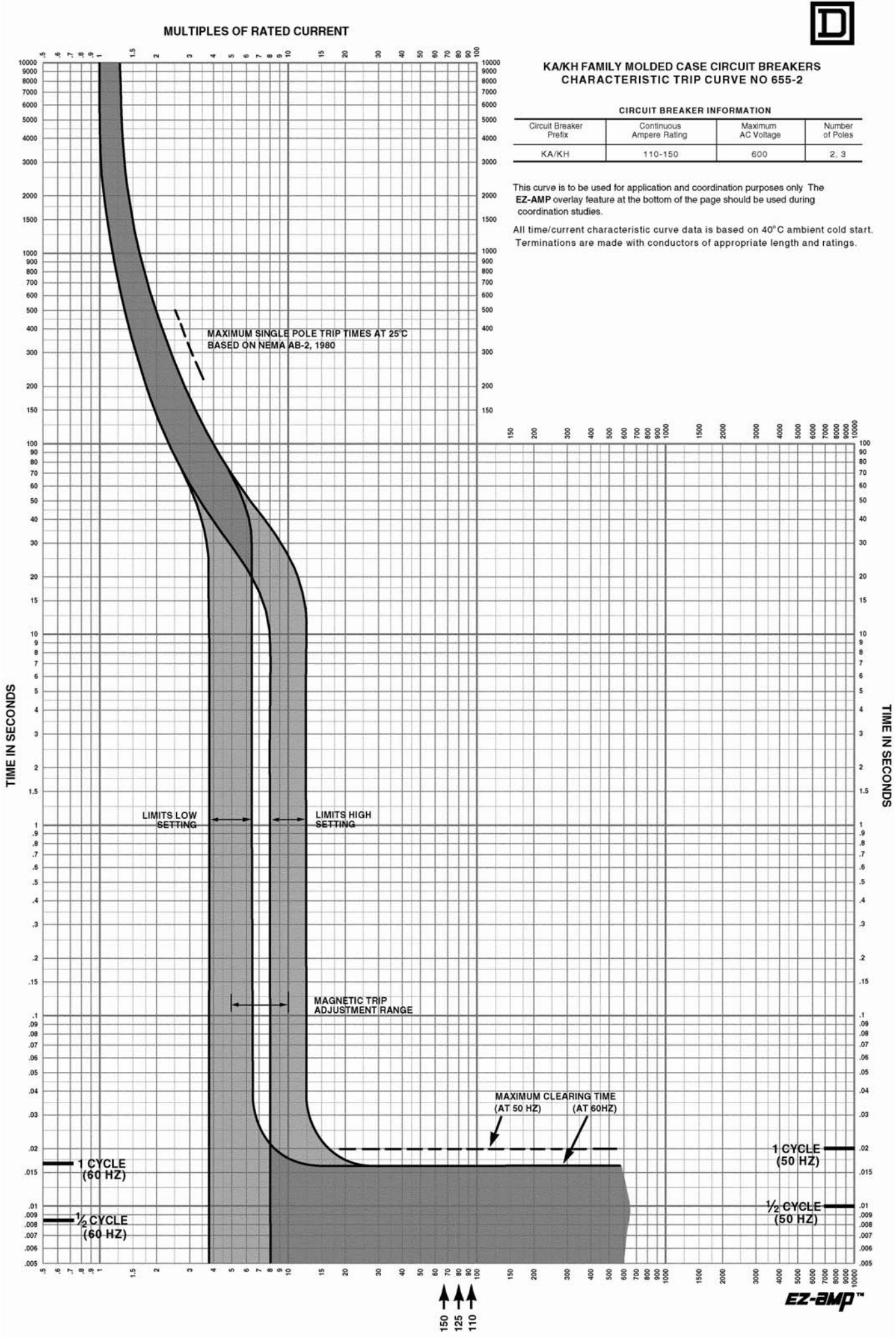
Approximate Dimensions in Inches (mm)

PRL2a Panelboard Sizing

Panelboard Types	Main Breaker Types and Mounting Position (H) = Horizontal (V) = Vertical	Sub-Feed Breaker Types and Mounting Position (H) = Horizontal (V) = Vertical	Maximum No. of Branch Circuits Including Provisions	Box Dimensions ① Height	Width	Depth	YS Box Catalog Number	LT Trim Catalog Number	EZ Box Catalog Number	EZ Trim Catalog Number
100A										
Main breaker	BAB, QBHW (H)	—	15	36.00 (914.4)	20.00 (508.0)	5.75 (146.1)	**YS2036**	**LT2036S or F**	**EZB2036R**	**EZT2036S or F**
		—	27	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
		—	39	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
		—	42	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
Main lugs or main breaker	EHD FD, HFD, FDE HFDE (V)	—	18	36.00 (914.4)	20.00 (508.0)	5.75 (146.1)	**YS2036**	**LT2036S or F**	**EZB2036R**	**EZT2036S or F**
		—	30	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
		—	42	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
Main lugs or main breaker with 100A through-feed lugs or sub-feed breaker	EHD FD, FDE HFD, HFDE (V)	EHD FD HFD (V)	18	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
			30	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
			42	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
225A										
Main lugs or main breaker	EDB, EDS, ED, EDH, FD, HFD FDE, HFDE (V)	—	18	36.00 (914.4)	20.00 (508.0)	5.75 (146.1)	**YS2036**	**LT2036S or F**	**EZB2036R**	**EZT2036S or F**
		—	30	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
		—	42	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
	JD, HJD JDC (V)	—	18	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
		—	30	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
		—	42	72.00 (1828.8)	20.00 (508.0)	5.75 (146.1)	**YS2072**	**LT2072S or F**	**EZB2072R**	**EZT2072S or F**
Main lugs or main breaker with 225A through-feed lugs or sub-feed breaker	EHD, FD, HFD, EDB, EDS, ED, EDH FDE, HFDE (V)	EHD, FD, HFD, EDB, EDS, ED, EDH (V)	18	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
			30	48.00 (1219.2)	20.00 (508.0)	5.75 (146.1)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
			42	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
	JD, HJD JDC (V)	EHD, FD, HFD, EDB, EDS, ED, EDH (V)	18	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
			30	72.00 (1828.8)	20.00 (508.0)	5.75 (146.1)	**YS2072**	**LT2072S or F**	**EZB2072R**	**EZT2072S or F**
			42	72.00 (1828.8)	20.00 (508.0)	5.75 (146.1)	**YS2072**	**LT2072S or F**	**EZB2072R**	**EZT2072S or F**
400A										
Main lugs or main breaker	DK, KD, HKD, KDC, LHH (V)	—	18	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
		—	30	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
		—	42	72.00 (1828.8)	20.00 (508.0)	5.75 (146.1)	**YS2072**	**LT2072S or F**	**EZB2072R**	**EZT2072S or F**
Main lugs or main breaker with 225A through-feed lugs or sub-feed breaker	DK, KD, HKD, KDC, LHH (V)	EHD, FD, HFD, EDB, EDS, ED, EDH (V)	18	60.00 (1524.0)	20.00 (508.0)	5.75 (146.1)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
			30	72.00 (1828.8)	20.00 (508.0)	5.75 (146.1)	**YS2072**	**LT2072S or F**	**EZB2072R**	**EZT2072S or F**
			42	72.00 (1828.8)	20.00 (508.0)	5.75 (146.1)	**YS2072**	**LT2072S or F**	**EZB2072R**	**EZT2072S or F**
Main lugs or main breaker with 400A through-feed lugs or sub-feed breaker	DK, KD, HKD, KDC, LHH (V)	JD, HJD, JDC, DK, KD, HKD, KDC (V)	18	72.00 (1828.8)	20.00 (508.0)	5.75 (146.1)	**YS2072**	**LT2072S or F**	**EZB2072R**	**EZT2072S or F**
			30	90.00 (2286.0)	20.00 (508.0)	5.75 (146.1)	**YS2090**	**LT2090S or F**	**EZB2090R**	**EZT2090S or F**
			42	90.00 (2286.0)	20.00 (508.0)	5.75 (146.1)	**YS2090**	**LT2090S or F**	**EZB2090R**	**EZT2090S or F**

Note

① Smaller panelboard box sizes are available if required. Contact Eaton for application information.


MULTIPLES OF RATED CURRENT
KA/KH FAMILY MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO 655-2
CIRCUIT BREAKER INFORMATION
Circuit Breaker Prefix
Continuous Ampere Rating
Maximum AC Voltage
Number of Poles
KA/KH
110-150
600
2, 3
This curve is to be used for application and coordination purposes only The EZ-AMP overlay feature at the bottom of the page should be used during coordination studies.
All time/current characteristic curve data is based on 40°C ambient cold start.
Terminations are made with conductors of appropriate length and ratings.
MAXIMUM SINGLE POLE TRIP TIMES AT 25°C
BASED ON NEMA AB-2, 1980
TIME IN SECONDS
LIMITS LOW SETTING
LIMITS HIGH SETTING
MAGNETIC TRIP ADJUSTMENT RANGE
MAXIMUM CLEARING TIME
(AT 50 HZ)
(AT 60HZ)
1 CYCLE (60 HZ)
½ CYCLE (60 HZ)
1 CYCLE (50 HZ)
½ CYCLE (50 HZ)
150
125
110
EZ-AMP™
SQUARE D®
©1985 Square D Company
MULTIPLES OF RATED CURRENT
Curve No. 0655TC8502
Drawing No. B48095-655-02

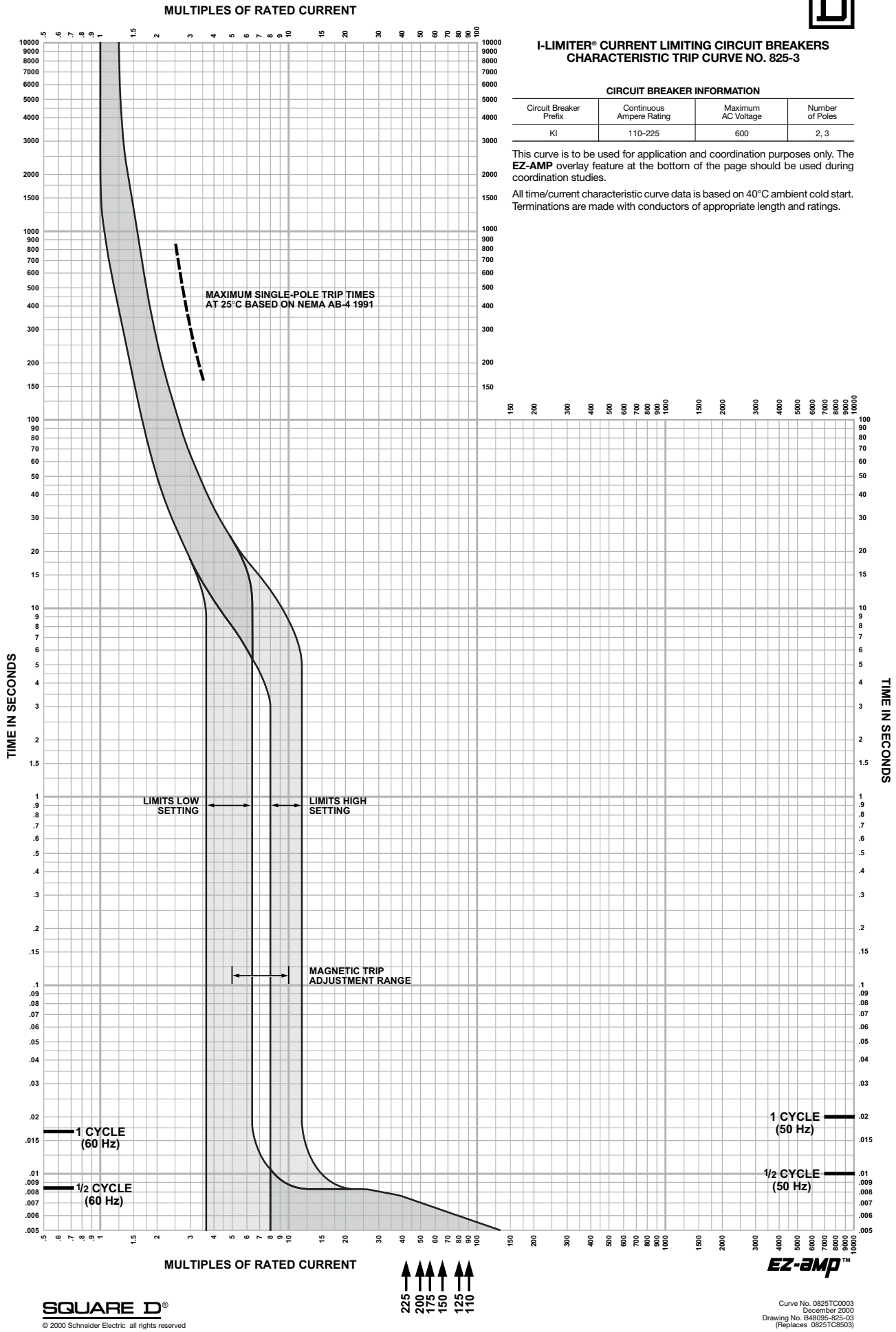
I-LIMITER® CURRENT LIMITING CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO. 825-3

CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
KI	110–225	600	2, 3

This curve is to be used for application and coordination purposes only. The **EZ-AMP** overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.



SQUARE D®

Curve No. 0825TC0003
December 2000
Drawing No. B48095-825-03
(Replaces 0825TC8503)

MULTIPLES OF RATED CURRENT

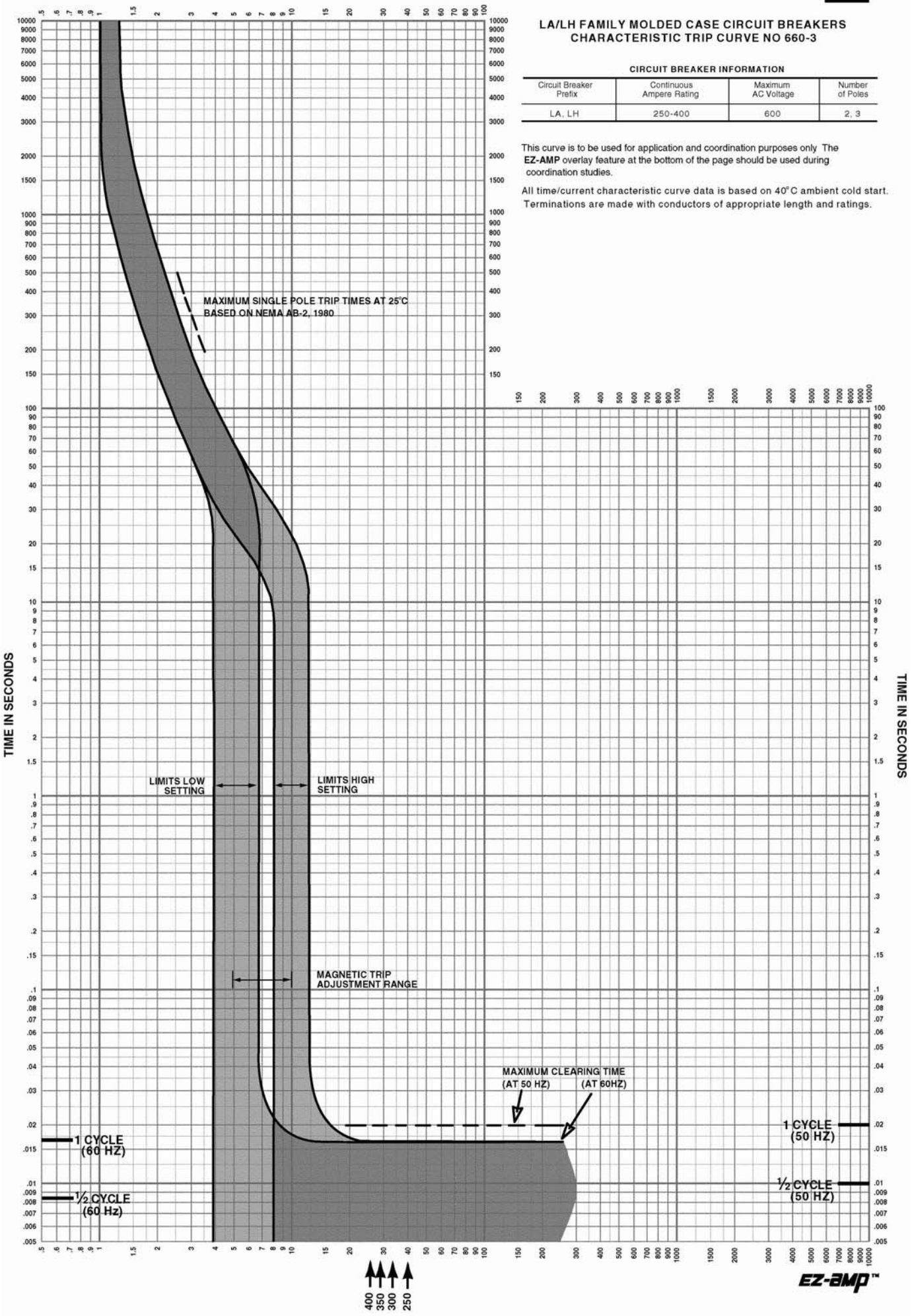
LA/LH FAMILY MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO 660-3

CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
LA, LH	250-400	600	2, 3

This curve is to be used for application and coordination purposes only The **EZ-AMP** overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.



TIME IN SECONDS

TIME IN SECONDS

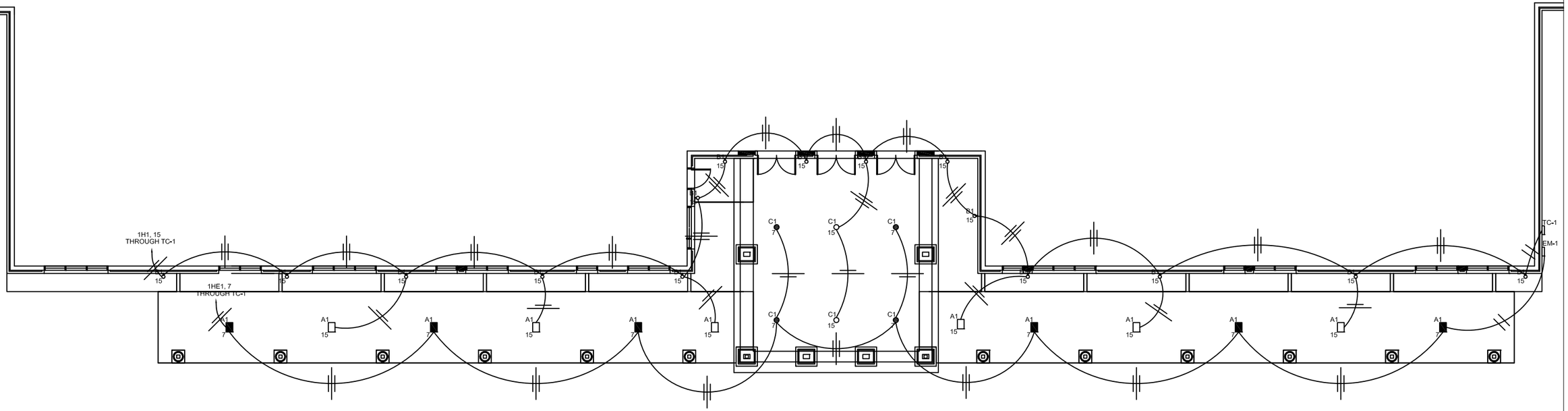
EZ-AMP™

MULTIPLES OF RATED CURRENT

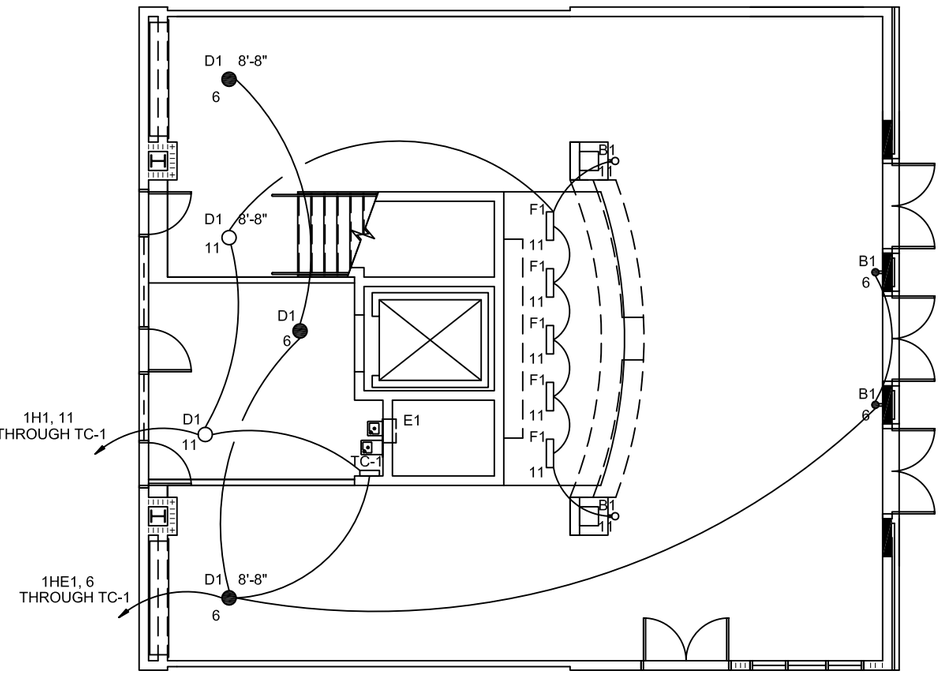
SQUARE D®

Curve No. 0660TC8503
Drawing No. B48095-660-03

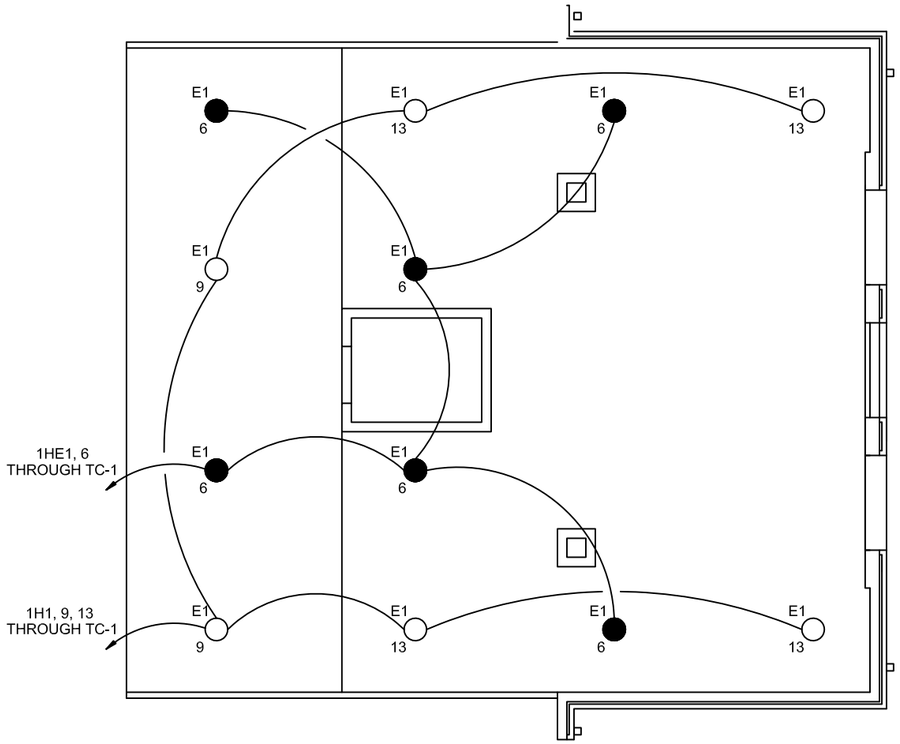
Appendix B: Lighting Layouts and Electrical Details



LEAH MATERN	COVERED ENTRANCE LIGHTING PLAN	SCALE 1/16" = 1'
APRIL 7, 2011	CRYSTAL LAKE ELEMENTARY SCHOOL	AE 482 AE SENIOR THESIS

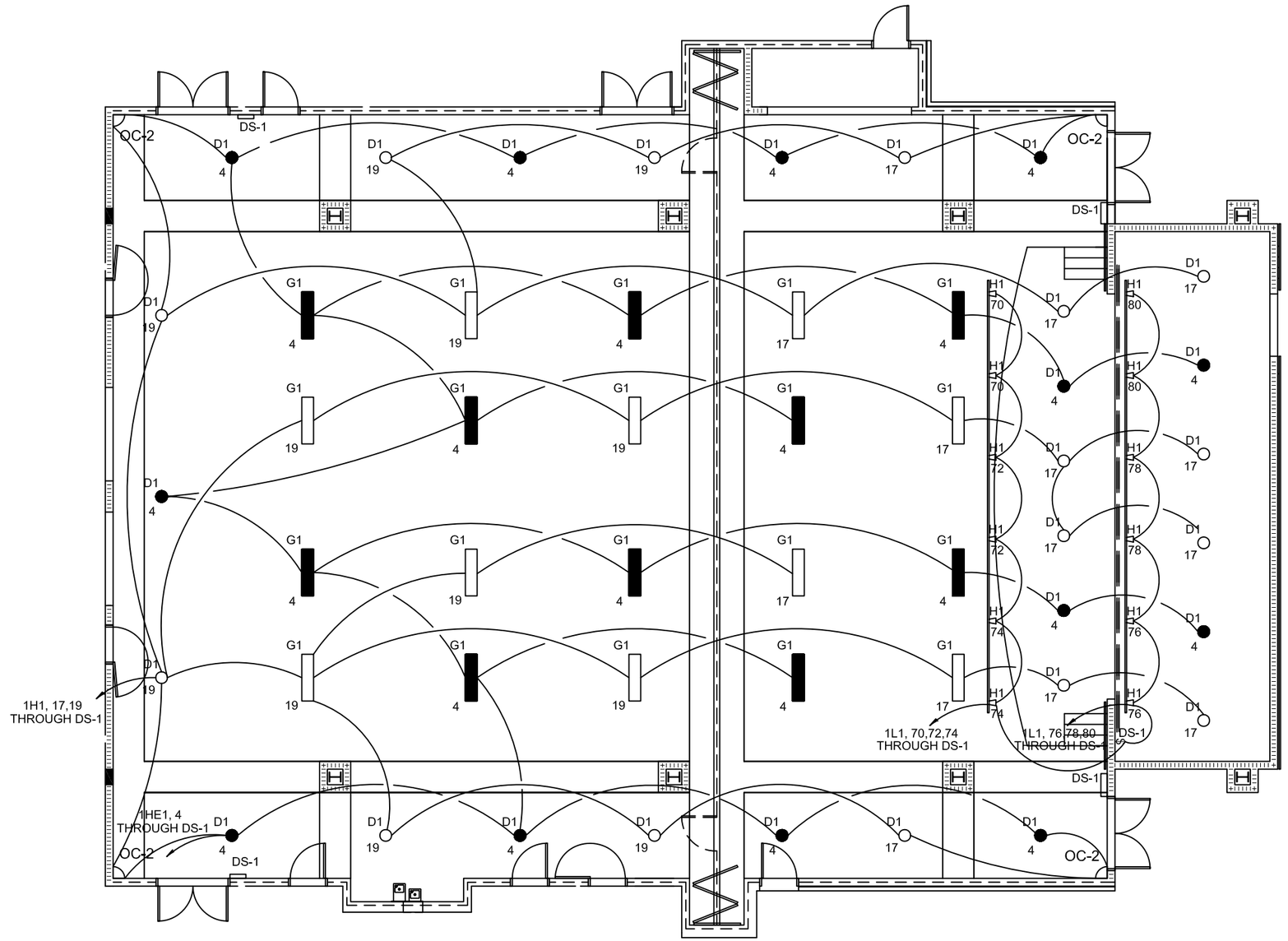


LOBBY FIRST FLOOR

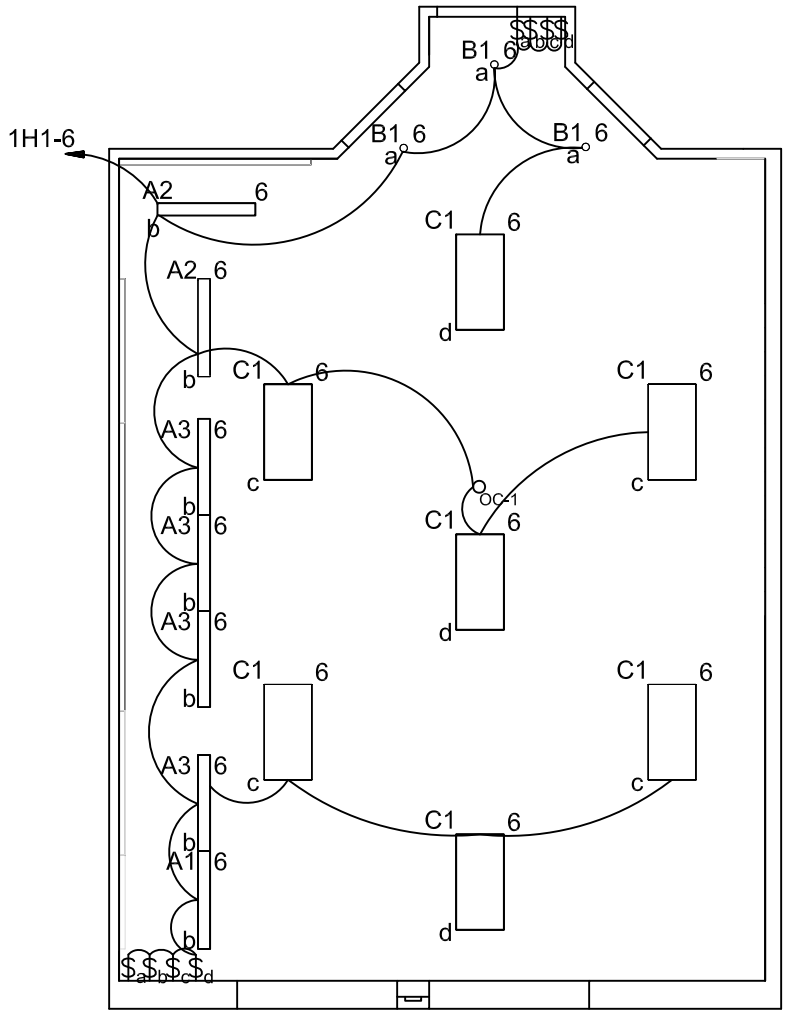


LOBBY SECOND FLOOR

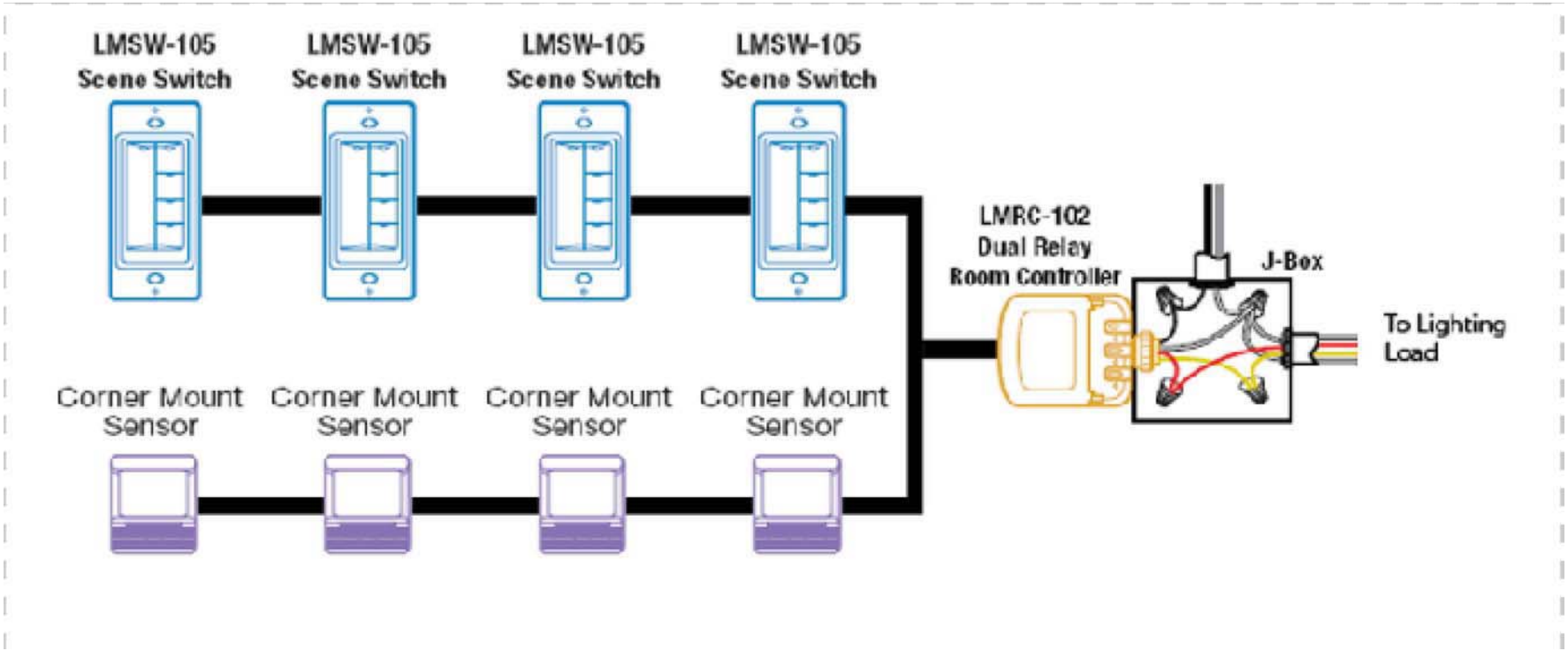
LEAH MATERN	LOBBY LIGHTING PLAN	SCALE 3/32" = 1'
APRIL 7, 2011	CRYSTAL LAKE ELEMENTARY SCHOOL	AE 482 AE SENIOR THESIS



LEAH MATERN	MULTIPURPOSE ROOM LIGHTING PLAN	SCALE 3/32" = 1'
APRIL 7, 2011	CRYSTAL LAKE ELEMENTARY SCHOOL	AE 482 AE SENIOR THESIS

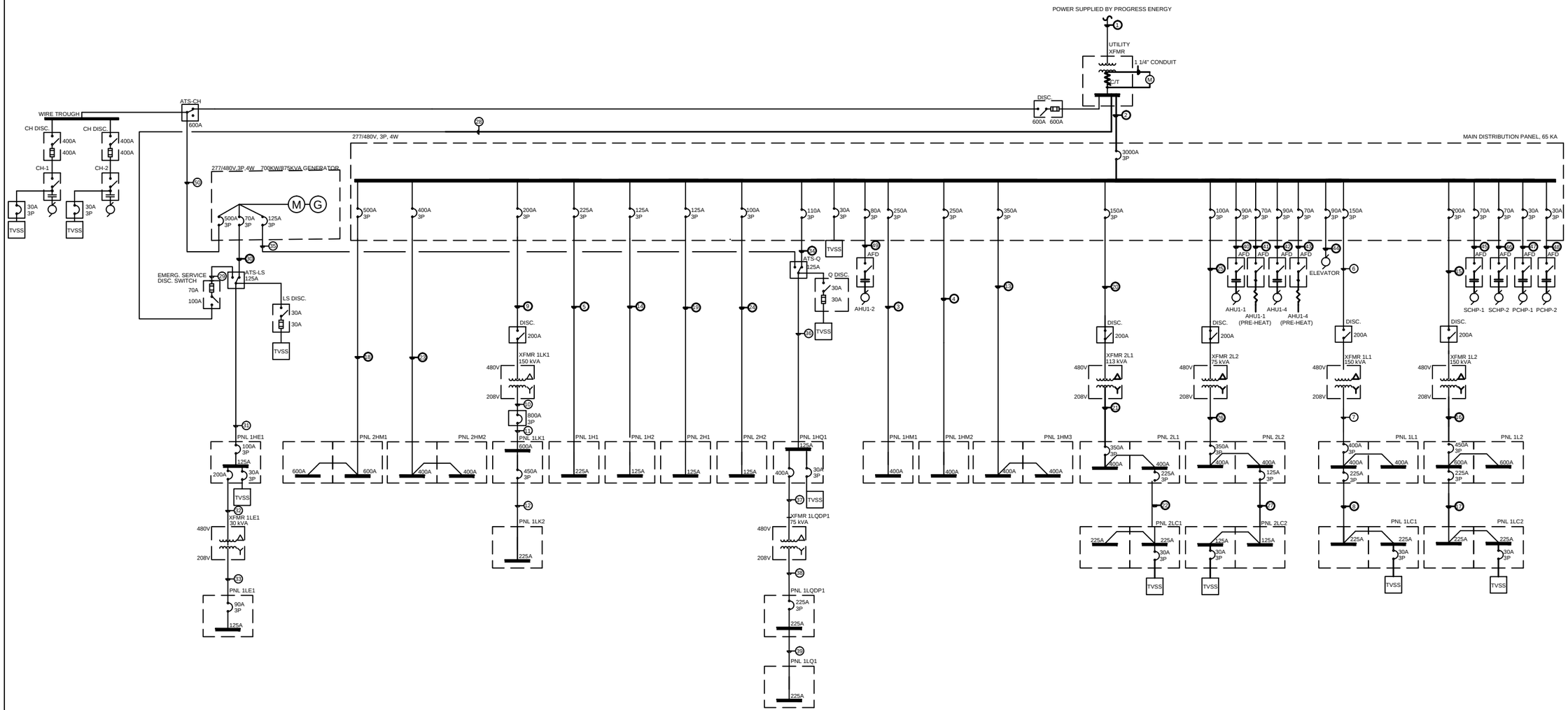


LEAH MATERN	PRIMARY CLASSROOM LIGHTING PLAN	SCALEI 1/8" = 1'
APRIL 7, 2011	CRYSTAL LAKE ELEMENTARY SCHOOL	AE 482 AE SENIOR THESIS



LEAH MATERN	MULTIPURPOSE ROOM WIRING DIAGRAM	NTS
APRIL 7, 2011	CRYSTAL LAKE ELEMENTARY SCHOOL	AE 482 AE SENIOR THESIS

Appendix C: Emergency System Redesign



CRYSTAL LAKE ELEMENTARY SCHOOL

SEMINOLE COUNTY SCHOOL BOARD
LAKE MARY, FL

DATE: 04/07/2011

DRAWN BY:
LEAH MATERN

AE 482-SENIOR THESIS

Single Line Diagram

E502

FEEDER SCHEDULE

				CONDUIT		CONDUCTORS (PER SET)									SIZE OF	FRAME OR	
			NO. OF	(PER SET)		PHASE CONDUCTORS			NEUTRAL CONDUCTORS			GROUND CONDUCTORS			OVERCURRENT	SWITCH	
TAG	FROM	TO	SETS	SIZE	TYPE	No.	SIZE	TYPE	No.	SIZE	TYPE	No.	SIZE	TYPE	PROTECTION	SIZE	REMARKS
1	UTILITY	POWER CO. XFRM	2	4"	PVC												BY UTILITY
2	POWER CO. XFMR	MDP	8	3.5"	PVC	3	#500MCM	CU THWN	1	#500MCM	CU THWN	1	#3/0	CU THWN	3000	3000A/3P	
3	MDP	1HM1	1	2.5"	RMC	3	#250MCM	CU THWN	1	#250MCM	CU THWN	1	#4	CU THWN	250	250A/3P	
4	MDP	1HM2	1	2.5"	RMC	3	#250MCM	CU THWN	1	#250MCM	CU THWN	1	#4	CU THWN	250	250A/3P	
5	MDP	1H1	1	2.0"	RMC	3	#3/0	CU THWN	1	#3/0	CU THWN	1	#4	CU THWN	225	225A/3P	
6	MDP	XFMF 1L1	1	2.5"	RMC	3	#3/0	CU THWN	0			1	#6	CU THWN	175	225A/3P	
7	XFMR 1L1	PNL1L1	2	3.00"	RMC	3	#3/0	CU THWN	1	#3/0	CU THWN	1	#4	CU THWN	400	400A/3P	
8	PNL 1L1	PNL1LC1	1	2.5"	RMC	3	#3/0	CU THWN	1	#4/0	CU THWN	1	#6	CU THWN	175	225A/3P	
9	MDP	XFMR 1LK1	1	2"	PVC	3	#3/0	CU THWN	0			1	#6	CU THWN	450	600A/3P	
10	XFMR 1LK1	ENCLOSED C.B.	2	2.5"	RMC	3	$4/0	CU THWN	1	#4/0	CU THWN	1	#1/0	CU THWN	450	600A/3P	
11	ENCLOSED C.B.	PNL 1LK1	2	2.5"	RMC	3	$4/0	CU THWN	1	#4/0	CU THWN	1	#1/0	CU THWN	450	600A/3P	
12	PNL 1LK1	PNL 1LK2	1	2"	RMC	3	#1/0	CU THWN	1	#1/0	CU THWN	1	#6	CU THWN	150	150A/3P	
13	MDP	PNL 1HM3	1	3.5"	PVC	3	#500MCM	CU THWN	1	#500MCM	CU THWN	1	#3	CU THWN	350	400A/3P	
14	MDP	PNL 1H2	1	2"	PVC	3	#1/0	CU THWN	1	#1/0	CU THWN	1	#6	CU THWN	125	125A/3P	
15	MDP	XFMR 1L2	1	2"	PVC	3	#3/0	CU THWN	0			1	#6	CU THWN	200	225A/3P	
16	XFMR 1L2	PNL 1L2	2	2.5"	RMC	3	#4/0	CU THWN	1	#4/0	CU THWN	1	#1/0	CU THWN	450	600A/3P	
17	PNL 1L2	PNL 1LC2	1	2.5"	RMC	3	#3/0	CU THWN	1	#4/0	CU THWN	1	#6	CU THWN	175	225A/3P	
18	MDP	2HM1	2	2.5"	RMC	3	#250MCM	CU THWN	1	#250MCM	CU THWN	1	#2	CU THWN	500	600A/3P	
19	MDP	2H1	1	2"	RMC	3	#1/0	CU THWN	1	#1/0	CU THWN	1	#6	CU THWN	125	125A/3P	
20	MDP	XFMR 2L1	1	1.5"	RMC	3	#1/0	CU THWN	0			1	#6	CU THWN	150	150A/3P	
21	XFMR 2L1	PNL 2L1	2	2"	RMC	3	#3/0	CU THWN	1	#3/0	CU THWN	1	#2	CU THWN	350	400A/3P	
22	PNL2L1	PNL 2LC1	1	2"	RMC	3	#1/0	CU THWN	1	#1/0	CU THWN	1	#6	CU THWN	125	125A/3P	
23	MDP	PNL 2HM2	2	2"	RMC	3	#3/0	CU THWN	1	#3/0	CU THWN	1	#3	CU THWN	400	400A/3P	
24	MDP	PNL 2H2	1	1.5"	RMC	3	#1	CU THWN	1	#1	CU THWN	1	#8	CU THWN	100	100A/3P	
25	MDP	XFMR 2L2	1	1.25"	RMC	3	#1	CU THWN	0			1	#8	CU THWN	100	100A/3P	
26	XFMR 2L2	PNL 2L2	1	3"	RMC	3	#250MCM	CU THWN	1	#250MCM	CU THWN	1	#2	CU THWN	225	225A/3P	
27	PNL 2L2	PNL 2LC2	1	2"	RMC	3	#1/0	CU THWN	1	#1/0	CU THWN	1	#6	CU THWN	125	150A/3P	
28	POWER CO. XFMR	EMERG. DISC.	1	1.25"	PVC	3	#4	CU THWN	1	#4	CU THWN	1	#10	CU THWN	60	100A/3P	
29	EMERG. DISC	ATS-LS	1	1.25"	PVC	3	#4	CU THWN	1	#4	CU THWN	1	#10	CU THWN	60	100A/3P	
30	GENERATOR	ATS-LS	1	1.25"	PVC	3	#4	CU THWN	1	#4	CU THWN	1	#10	CU THWN	60	100A/3P	
31	ATS-LS	PNL 1HE1	1	1.25"	RMC	3	#3	CU THWN	1	#3	CU THWN	1	#8	CU THWN	90	100A/3P	
32	PNL 1HE1	XFMR 1LE1	1	0.75"	RMC	3	#8	CU THWN	0			1	#10	CU THWN	40	100A/3P	
33	XFMR 1LE1	PNL 1LE1	1	1.25"	RMC	3	#2	CU THWN	1	#2	CU THWN	1	#8	CU THWN	90	100A/3P	
34	MDP	ATS-Q	1	1.5"	RMC	3	#2	CU THWN	1	#2	CU THWN	1	#6	CU THWN	110	125A/3P	
35	GENERATOR	ATS-Q	1	1.5"	PVC	3	#2	CU THWN	1	#2	CU THWN	1	#6	CU THWN	110	125A/3P	
36	ATS-Q	PNL 1HQ1	1	1.5"	RMC	3	#2	CU THWN	1	#2	CU THWN	1	#6	CU THWN	110	125A/3P	
37	PNL 1HQ1	XFMR 1LQDP1	1	1.25"	RMC	3	#1	CU THWN	0			1	#8	CU THWN	100	100A/3P	
38	XFMR 1LQDP1	PNL 1LQDP1	1	2.5"	RMC	3	#4/0	CU THWN	1	#4/0	CU THWN	1	#2	CU THWN	225	225A/3P	
39	PNL 1LQDP1	PNL 1LQ1	1	2.5"	RMC	3	#1/0	CU THWN	1	#1/0	CU THWN	1	#6	CU THWN	150	150A/3P	
40	MDP	AHU 1-1	1	0.75"	PVC	3	#6	CU THWN	0			1	#8	CU THWN	90	100A/3P	
41	MDP	AHU 1-1 (PRE-HEAT)	1	1"	PVC	3	#4	CU THWN	0			1	#8	CU THWN	70	100A/3P	
42	MDP	AHU 1-4	1	0.75"	PVC	3	#6	CU THWN	0			1	#8	CU THWN	90	100A/3P	
43	MDP	AHU 1-4 (PRE-HEAT)	1	1"	PVC	3	#4	CU THWN	0			1	#8	CU THWN	70	100A/3P	
44	MDP	ELEVATOR	1	1"	PVC	3	#4	CU THWN	0			1	#8	CU THWN	70	100A/3P	
45	MDP	SCHP-1	1	0.75"	PVC	3	#8	CU THWN	0			1	#8	CU THWN	70	100A/3P	
46	MDP	SCHP-2	1	0.75"	PVC	3	#8	CU THWN	0			1	#8	CU THWN	70	100A/3P	
47	MDP	PCHP-1	1	0.75"	PVC	3	#12	CU THWN	0			1	#12	CU THWN	30	100A/3P	
48	MDP	PCHP-2	1	0.75"	PVC	3	#12	CU THWN	0			1	#12	CU THWN	30	100A/3P	
49	MDP	AHU 1-2	1	0.75"	PVC	3	#12	CU THWN	0			1	#12	CU THWN	30	100A/3P	

NOTES:
1. REFER TO RISER DIAGRAM FOR FEEDER TAGS
2. ADD OTHER PROJECT NOTES HERE

AL=ALUMINUM
CU=COPPER

Appendix D: Photovoltaic Design

SUNPOWER

E19 / 320 SOLAR PANEL

MAXIMUM EFFICIENCY AND PERFORMANCE

BENEFITS

Highest Efficiency
SunPower™ Solar Panels are the most efficient photovoltaic panels on the market today.

More Power
Our panels produce more power in the same amount of space—up to 50% more than conventional designs and 100% more than thin film solar panels.

Reduced Installation Cost
More power per panel means fewer panels per install. This saves both time and money.

Reliable and Robust Design
Proven materials, tempered front glass, and a sturdy anodized frame allow panel to operate reliably in multiple mounting configurations.

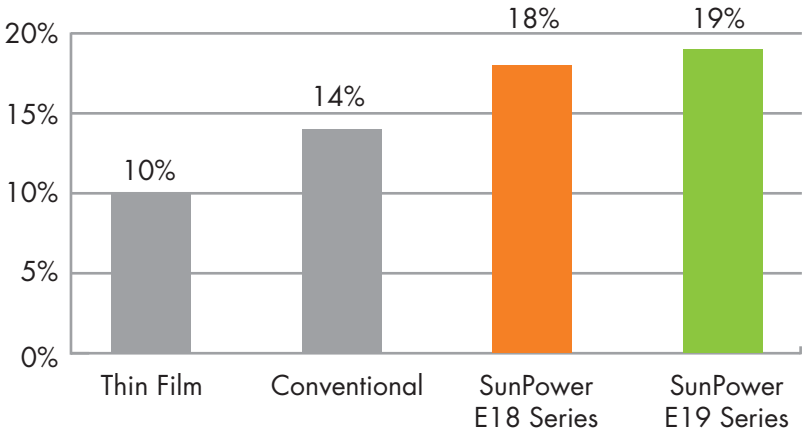
SPR-320E-WHT-D

E19 SERIES

The planet's most powerful solar panel.

The SunPower™ 320 Solar Panel provides today's highest efficiency and performance. Utilizing 96 back-contact solar cells, the SunPower 320 delivers a total panel conversion efficiency of 19.6%. The 320 panel's reduced voltage-temperature coefficient, anti-reflective glass and exceptional low-light performance attributes provide outstanding energy delivery per peak power watt.

SunPower's High Efficiency Advantage



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SUNPOWER™

E19 / 320 SOLAR PANEL

MAXIMUM EFFICIENCY AND PERFORMANCE

Electrical Data

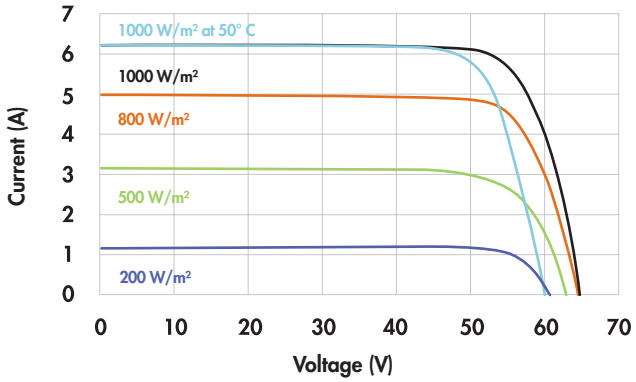
Measured at Standard Test Conditions (STC): irradiance of 1000W/m², AM 1.5, and cell temperature 25° C

Peak Power (+5/-3%)	P_{max}	320 W
Efficiency	η	19.6 %
Rated Voltage	V_{mpp}	54.7 V
Rated Current	I_{mpp}	5.86 A
Open Circuit Voltage	V_{oc}	64.8 V
Short Circuit Current	I_{sc}	6.24 A
Maximum System Voltage	UL	600 V
Temperature Coefficients	Power (P)	-0.38% / K
	Voltage (V_{oc})	-176.6mV / K
	Current (I_{sc})	3.5mA / K
NOCT		45° C +/-2° C
Series Fuse Rating		15 A

Mechanical Data

Solar Cells	96 SunPower all-back contact monocrystalline
Front Glass	High transmission tempered glass with anti-reflective (AR) coating
Junction Box	IP-65 rated with 3 bypass diodes Dimensions: 32 x 155 x 128 (mm)
Output Cables	1000mm length cables / MultiContact (MC4) connectors
Frame	Anodized aluminum alloy type 6063 (silver); stacking pins
Weight	41.0 lbs (18.6 kg)

I-V Curve



Current/voltage characteristics with dependence on irradiance and module temperature.

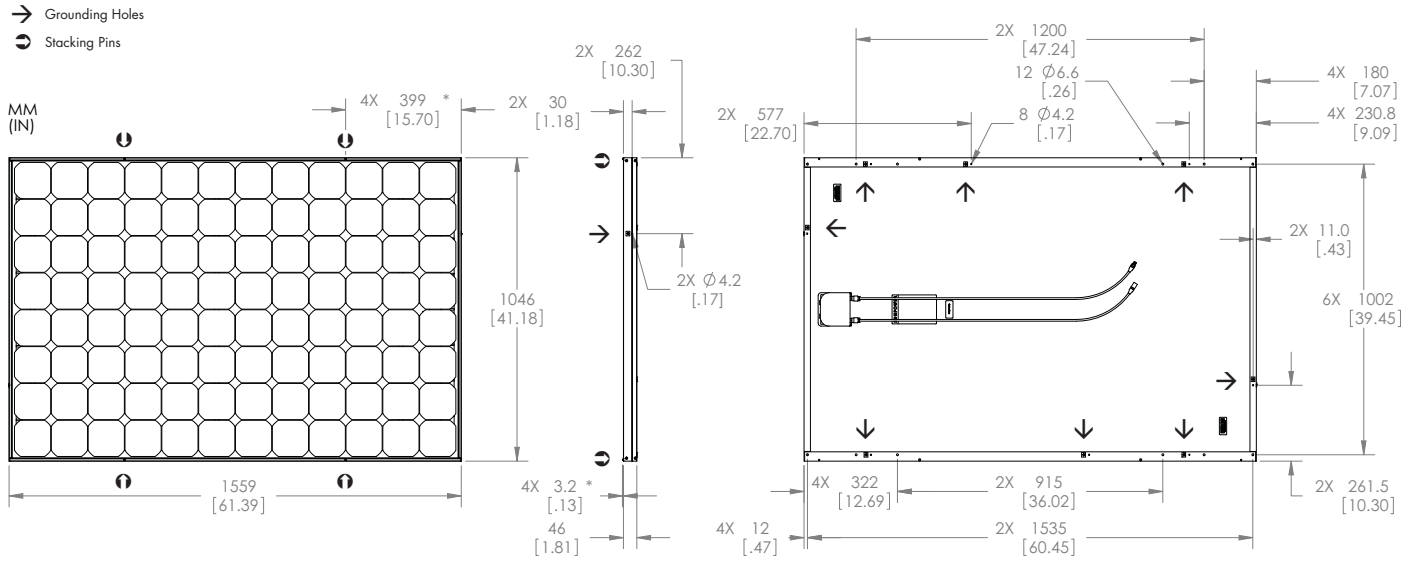
Tested Operating Conditions

Temperature	-40° F to +185° F (-40° C to + 85° C)
Max load	113psf 550 kg/m² (5400 Pa), front (e.g. snow) w / specified mounting configurations 50 psf 245 kg/m² (2400 Pa) front and back – e.g. wind
Impact Resistance	Hail 1 in (25 mm) at 51mph (23 m/s)

Warranties and Certifications

Warranties	25 year limited power warranty
	10 year limited product warranty
Certifications	Tested to UL 1703. Class C Fire Rating

Dimensions



CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Visit sunpowercorp.com for details

sunpowercorp.com

Document #001-64281 Rev** / LTR_EN

SOLECTRIA RENEWABLES

Grid-Tied PV Inverters

PVI 60KW PVI 82KW PVI 95KW

a breakthrough in price and quality

INTERTEK ETL LISTED C US

Best-in-class PVI 60KW, PVI 82KW and PVI 95KW inverters: exceptional quality and efficiency at an extraordinary price.

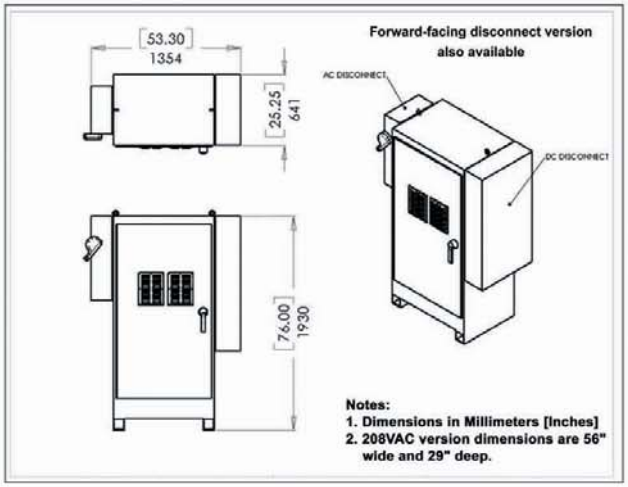
Product Information

PVI 60KW PVI 82KW PVI 95KW

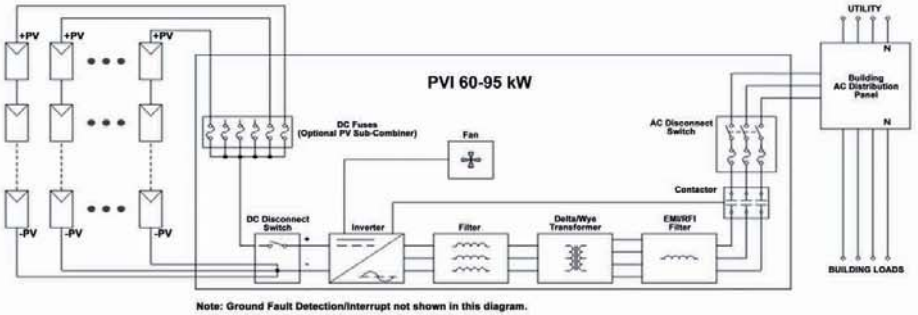
Grid-Tied PV Inverters

INTEGRATED INVERTER

DIMENSIONS



PVI 60-95KW 3-PHASE COMMERCIAL / INDUSTRIAL INVERTER BLOCK DIAGRAM



Note: Ground Fault Detection/Interrupt not shown in this diagram.

OVERVIEW: INTEGRATED PV INVERTER

The Solectria Renewables PVI 60KW, PVI 82KW and PVI 95KW are rugged, DSP-controlled, premium efficient PV inverters for grid-connected commercial, industrial and utility 3-phase PV systems. The core of the inverter, Solectria's proven DMGI 660 distributed generation inverter, uses state-of-the-art control techniques and devices including space vector PWM, a precision MPT algorithm, and low-loss IGBTs. With peak inverter power electronics efficiency over 98% (over 96.5% including the transformer and filters), fully integrated packaging, and heavy duty AC & DC disconnects,these inverters set a new industry standard for efficiency, ease of installation and use, reliability and installed cost. Made in USA.

APPLICATIONS

- 40-95kWAC, 60Hz, 208, 240, 480 or 600VAC, 3-phase, grid-tied commercial PV systems (50-120kWDC STC array).
- Multiple inverters can be used together in any combination for 150, 200, 500kW, MW or larger PV systems.
- Designed for mounting as desired, in full sun, driving rain and drifting snow: rooftop/ground or indoors.
- Can be used for other renewable and distributed generation applications such as wind power, hydro, geothermal, biomass, battery and smart grid as new technologies develop.

FEATURES & OPTIONS

- Fully integrated design includes transformer, filters, and heavy duty, visible blade AC & DC disconnects (with optional DC sub-combiner fuses).
- Smart user-navigable LCD display.
- Near zero nighttime standby losses.
- Industry-leading overall efficiency.
- Simple set-up and connections (connect DC from PV combiners and 3-phase AC connections).
- Precision DSP-controlled Maximum Power Tracking Algorithm.
- High-reliability design, based on 20 years of power electronics development, includes sealed power and signal electronics unit and high-efficiency magnetics.
- Optional fused DC sub-combiner (2-48 fuses, 8-250A).
- Optional positive grounded version.
- Optional fwd. facing disconnect orientation (AC, DC or both).
- Optional stainless steel enclosure & disconnects.
- Custom grid-interactive settings for utilities: KVAR support, ramp rates, remote control.

CONNECTIVITY

- RS232 and PC software for diagnostics and data capture.
- RS485 port and MODBUS RTU for data monitoring.
- Ethernet port for direct connection to the internet with optional Solrenview web-based monitoring or various third party services.

SAFETY FEATURES

- Electronic temperature protection.
- DC ground-fault detection and interrupt.
- Current limit protections.
- Standards-compliance: All inverters Listed to UL 1741, IEEE Std 1547, CSA 22.2 #107.1 and certified to IEEE 62.41 (NY SIR Surge Test Requirements) as well as FCC Part 15, class A. Units are alsolisted on CEC's eligible equipment list (208 & 480VAC).

SPECIFICATIONS

		PVI 60KW	PVI 82KW	PVI 95KW
Output				
Continuous AC Power (CEC)		60 kW	83 kW	95 kW
Power Factor		> 0.98		
Voltage (L-L), ±10%		208 / 240 / 480 / 600 VAC, 3-Ph		
Rated Current	(CEC) 208VAC	166A	228A	261A
	240VAC	147A	204A	230A
	(CEC) 480VAC	73A	100A	115A
	600VAC	60A	80A	92A
Current Distortion		< 3% THD, Nom Power		
Frequency, ±1 %		60 Hz		
Inverter Electronics Peak Efficiency		> 98% (50%-100% load)		
Overall Peak Efficiency [1]		> 96.5% (50%-100% load) @ 480 VAC		
CEC Efficiency		> 95.5% (50%-100% load) @ 480 VAC		
Audible Noise Level (1m), blower on		73dBa	74dBa	76dBa
Certification: UL1741, IEEE1547, IEEE C62.41.2, CSA 22.2#107.1, FCC Part 15, Class A				
Input				
Array Configuration:		Monopole, negative grounded (Positive ground option)		
Max V_{DC} [2]		600 VDC		
Maximum DC Current		190A	248A	287A
CEC Eligible DC Current		177A	241A	279A
MPT Voltage Range [3]		315-500 VDC (300 with low tap option)[3]		
CEC Full Power Voltage Range		346-480 VDC		
Protection [4]				
AC Grid-connection (Standards Compliance: See "Safety Features")		Over/Under Voltage, Over Current Over/Under Freq., DC Ground Fault (GFDI)		
AC Disconnect (Integral)		NEMA 3R, Integral		
DC Sub-Combiner w/Fuses (Optional [5])		8A-250A fuses available, 2-48 pole, NEMA 3R, TVSS		
DC Disconnect (Integral)		Break load rated, NEMA 3R		
Environmental				
Ambient Temperature		-25 to 50 deg C (full power)		
Cooling		Automatic Forced Convection		
Enclosure		Rain Proof (UL 1741)		
Electronics Enclosure		Sealed (IP62)		
General				
Weight lb (kg)		1526 (694)	1615 (734)	1748 (794)
Dimensions: inch [mm] [6] (Height w/o lifting eyes)	208,240VAC	76[1930] H x 56[1422] W x 29.3[744] D		
	480,600VAC	76[1930] H x 54[1372] W x 25.3[643] D		
Communications, Optional Data Acquisition		LCD, RS232, RS485, MODBUS RTU, Ethernet. Optional Solrenview web-based monitoring.		
Warranty		5 years standard (optional 10, 15, & 20 year warranties)		

[1] Fully Integrated Package: Includes premium efficient transformer, filters, brushless blower, AC & DC disconnects. (>95.5% peak efficiency for 208VAC versions).
[2] Max Open circuit voltage (V_{OC}) of PV array = 1.25 x V_{mp} rated (per NEC 690-7).
[3] 5% Low DC voltage tap option available for lower voltage PV arrays or hot climates.
[4] Complies with grid connection and safety standards ("Safety Features").
[5] Integrated into inverter package if selected.
[6] Fwd face disco width: AC only-68" (79"-208V), DC only-71" (73"-208V), both-82.5" (93.5"-208V)

proven history, sustainable future

Solectria Renewables designs and manufactures power electronics for renewable power generation systems. Feature-packed and highly integrated, the products lead the industry in installation ease and total value. At the heart of Solectria's products are its reliable and efficient core inverters, which have been proven over the past 20 years in the extremely harsh environment of truck, bus and military transportation applications. Solectria Renewables is run by the renowned MIT engineers who founded the Solectria brand in 1989. With a customer-focused team, high quality suppliers and a best practices manufacturing process, Solectria is committed to your success.

SOLECTRIA RENEWABLES

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Background: 118kW Spire Corporation installation at North Coast Seafoods includes a PVI 95KW inverter.
Left: 1.26MW Chico Electric/DC Power Systems installation at Sierra Nevada Brewery.
Right: 1.2MW Third Energy Development installation at Hyundai Heavy Industries in Hae Nam, South Korea.