2010

Marie Ostrowski

Lighting/Electrical

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Science Building-Phase 1

Buffalo State College-Buffalo, NY

Wednesday, April 7, 2010

Final Summary Report

Science Building - Phase 1 Addition

Buffalo State College

Owner: Buffalo State College
General Contractor: Savarino Companies
Construction Manager: Bovis Lend Lease
Architect: Cannon Design
Engineers: Cannon Design
Wind/Snow Consultant: Gradient Microclimate Engineering
Commissioning Agent: Horizon Engineering
Size: 96,000 ft^2
Stories: 3 above ground
Cost: $34,807,000

Architecture + Construction

- Phase 1 is an addition to the existing science building and joins via an atrium.
- Phase 2 includes the demolition and renovation of the existing building. The final complex will be upwards of 224,000 ft^2.
- Phase 1 construction period is October 2009 - March 2012, with completion of both phases set for 2015.

Structural

- One-way reinforced concrete slab supported by cast-in-place concrete beams and columns, two-way reinforced concrete systems for the slab-on-grade
- Steel framed systems for mechanical penthouse, atrium, and link to the existing structure
- Foundations for the building are primarily composed of an H pile system, while the atrium is supported by spread footings

Mechanical

- Laboratory spaces supplied 100% outside air via heat recovery AHUs
- One dedicated VAV supply terminal unit minimum per lab; connected back to its associated fume hoods and exhaust valves
- One central, mixed air VAV AHU serves atrium
- Heating by a 10” 40 PSI metered steam line connected to the campus system
- Cooling by electric centrifugal chiller in penthouse

Electrical

- 5kV service from campus substation routed to unit substation within the building.
- Double-ended 480Y/277 V 3φ 4W substation located in the basement and 208Y/120 V 3φ 4W switchboard in the penthouse
- Dedicated normal, emergency, standby, and optional branches
- Emergency branch served by a 750 kW diesel-driven generator in basement;
- Lighting primarily 277V

Buffalo, NY

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EXECUTIVE SUMMARY

The following report is a technical analysis of the existing design for the Buffalo State College New Science Building Phase 1 addition. It consists of a focus on lighting and electrical redesign of four spaces, as well as detailed studies for a motor controller center design and electrical distribution system analysis through SKM software. In addition to satisfying the AE requirements for the option depths, associated areas or breadths have been studied with regards to daylighting (MAE), mechanical systems, acoustical performance, and LED luminaire performance.

Specifically, daylighting and mechanical systems were both addressed in the analysis of an open loop switching system for the atrium corridor lighting. Initial studies indicate proper daylight and electric light integration can reduce energy consumption associated with atrium lighting without having dramatic effects on the thermal loads within the space. The acoustical study is also situated in the atrium, to ensure the large volume and hard surfaces within the space do not detract from its purpose and evaluate an alternative flooring material.

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INTRODUCTION

The Science Building Phase 1 construction project is the first phase in a two-phase addition and renovation project for the School of Natural and Social Sciences at Buffalo State College. The 96,000 ft^2 LEED Gold addition is designed to reflect in its exterior, the high-tech education and research that occur within its laboratories and classrooms. Once completed in 2015 the addition and renovation will become the 224,000 ft^2 Mathematics and Science Complex.

Design elements of the addition are a conscious testament to the scientific and collaborative developments housed within its walls. Everything in the architectural elements, from materials and colors to proportions, has a purpose and hints towards different theories or scientific concepts.

The layout of the building is largely influenced by circulation, a practical and figurative indication of biological systems. The addition joins the existing building at a central atrium from which smaller corridors branch out to join the west corridor looking out onto the neighboring athletic play fields. The west corridor acts as a curtain wall skin to the building, with a seemingly random assortment of metal and glass panels that calls upon the principles of the Fibonacci sequence, genetics, and optics. The circulation spaces connect students and visitors to a multitude of research/teaching labs and offices where the lessons fuel ongoing developments in science.

FIGURE 1 – WESTERN FAÇADE (COURTESY OF CANNON DESIGN)

GENERAL BUILDING DATA

Building Name: Buffalo State College Science Building – Phase 1

Location: Buffalo, NY

Building Occupant Name: Buffalo State College – Biology, Chemistry, Earth Science and Science Education Departments

Occupancy Type: Education

Size: approximately 96,000 sq. ft.

Number of Stories: 4 above grade (including penthouse)/5 total

Project Team:

Owner: Buffalo State College/State University Construction Fund
http://www.buffalostate.edu/facilities/

General Contractor: Savarino Companies

Construction Manager: Bovis Lend Lease
http://www.bovislendlease.com/

Architect: Cannon Design
http://www.cannondesign.com/

MEP Engineers: Cannon Design
http://www.cannondesign.com/

Wind/Snow Consultant: Gradient Microclimate Engineering
http://gradientwind.com/

Commissioning Agent: Horizon Engineering
http://www.horizon-engineering.com/

Dates of Construction: October 15, 2009 – March 31, 2012 (Phase 1 Projected Completion Date 11/2/2010)

Cost: $36,064,000 budget overall project cost

Project Delivery Method: Design-Bid-Build

ARCHITECTURE

Codes:

IBC 2006
NEC 2008

Building Code of NYS 2007
New York State Energy Conservation Construction Code
Plumbing Code of NYS
Mechanical Code of NYS
Fuel Gas Code of NYS
SUCF Directives
ASCE 7-02
AISC 301, 303.1, 303-05
ACI 318-02
ANSI C2 – National Electrical Safety Code
NFPA

Zoning: Buffalo State College as an educational institution does not fall under City of Buffalo R-2 zoning requirements.

Historical Requirements: Not Applicable

The Science Building at Buffalo State College houses labs, offices, and classrooms for the school's natural science departments. The building exterior conveys the interior scientific inquiry and development through the materials and design. A high-tech appearance is achieved through numerous design features that cleverly express themes associated with the various science departments including: optics, geology, genetics, biology, and math.

The Phase 1 building project is an addition to the existing science complex and joins to the existing building via an atrium. The linear plan is broken on the western side with a vertex in the middle and two curtain wall segments that are slightly angled.

A combination of genetics and mathematics is portrayed in the arrangement and proportions of the glass and metal panels on the western curtain wall. Brightly colored walls are visible behind the glass panels of the western corridor to mimic the refraction of a prism. Throughout the building, striations, platforms and the linear atrium space refer to geologic forms such as mesas and gorges for proportions. Building circulation takes a cue from biology and creates a main thoroughfare through the atrium space to connect the academic and residential areas of campus. Additionally, the science curriculum is fostered by an environment that supports collaboration. Throughout the building there are gathering spaces for students with writable surfaces. Optimum floor space and flexibility is enabled by the concrete structural system and central utility spine.

BUILDING ENCLOSURE

The walls of the building are a combination of concrete masonry unit assemblies and curtain wall, both using cold metal framing to hang exterior paneling. The western façade uses cold metal framing and a combination of aluminum composite metal wall panels and high performance, insulated glazing. The very top level, the mechanical penthouse, is a shell composed of non-insulated metal panels.

The atrium permits natural light through a series of thirteen sloped glazing assembly clerestories, with condensation resistance and a solar heat gain coefficient ≤ 0.40. Roof structure is predominantly concrete deck except for the steel roof deck on the penthouse. Roofing layers are similar on each roof type with either a tapered or flat insulation (R-20), membrane underlayment board, and light-colored EPDM (ethylene propylene diene terpolymer) roof membrane.

SUSTAINABILITY FEATURES

The building design is required to satisfy LEED Silver certification and sustainability features are largely attributed to controls for the mechanical and electrical systems. Mechanical system design incorporates variable speed drive motors for air handling pumps and fans to increase efficiency. The lighting systems incorporate automatic lighting controls with occupancy and daylight sensors, as well as dimming systems to extend lamp life of incandescent sources.

The project will satisfy numerous LEED points from the beginning of construction, with strategies such as Construction IAQ Management, to completion with initial building performance being tested by a commissioning agent.

CONSTRUCTION

The Phase 1 addition for the Buffalo State College (BSC) Science Building is scheduled for October 15, 2009 – March 12, 2012. Phase 2 renovations (which would bring total complex area up to 224,000 ft^2) are projected to finish in 2015.

Site work throughout demolition and construction is to uphold standards set forth in the NY Guidelines for Urban Erosion and Sediment Control. Construction methods include plans for temporary mechanical services to the existing building following demolition, which comply with the IAQ management plan. Of all waste generated throughout construction, 50% (by weight) is to be salvaged or recycled and documented with progress reports submitted regularly.

ELECTRICAL

Medium voltage service enters the building at 5kV and is routed to a unit substation within the building. The double-ended 4.16kV 480Y/277 V 3ϕ 4W substation is located in the basement, feeding a 2,000A 208V/120V 3ϕ 4W switchboard in the basement and a 3,000A 480Y/277 V 3ϕ 4W switchboard situated in the penthouse. The basement switchboard feeds the normal power in the basement and a 1,000A 208V 3ϕ 4W bus duct serving laboratory loads on normal power throughout the building and future phase. The penthouse switchboard serves most of the mechanical equipment.

The building is served by four separate, switched branches: Normal, Emergency, Standby, and Optional. The emergency branch of the distribution system is served by a 750 kW diesel-driven generator enclosed in a separate room in the basement.

LIGHTING

General lighting within the building is supplied by linear fluorescent luminaires using T8 or T5 lamps predominantly at 277V. Classrooms and labs utilize pendant, direct/indirect linear fluorescent luminaires to provide even luminance levels across task planes while minimizing shadows. This is important due to the measuring and reading tasks that occur within the space. Corridors in the atrium combine a recessed wall-mounted fixture (switched for emergency power) as well as a decorative, compact fluorescent pendant. The atrium combines daylighting by means of clerestories and skylights with supplementary electric light from pendant, wall-washing, metal halide fixtures that illuminate the acoustical ceiling panels at the top of the space.

MECHANICAL

Heating for the Science Building is provided by a 10" 40 PSI metered steam supply connected to the campus system and distributed by redundant variable flow pumps. AHU preheat coils are energized by low pressure 15 PSI steam.

General cooling is supplied by a high efficiency, water-cooled, electric centrifugal chiller in the penthouse. The penthouse also houses the refrigerant monitoring and exhaust system. Primary/secondary pumping connects the chiller to the AHUs and heat is rejected by two induced draft cooling towers in the penthouse. Data rooms are also served by a back-up DX system while the main telecom room is served by a 10 ton split-system a/c unit.

Three AHUs supply 100% outside air to the labs and provide partial redundancy since they are sized to approximately 50% peak airflow. One AHU is connected to emergency power to prevent excessive negative pressurization. Each lab area has one dedicated VAV terminal unit with a hot water reheat coil and low velocity supply diffusers. The atrium has one mixed air VAV AHU with enthalpy control and outside air flow measuring. An array of nine 3,500 cfm fans is also dedicated to air handling in the atrium.

STRUCTURAL

The majority of the Science Building is composed of a cast-in-place concrete system with steel framing in connecting areas such as the atrium, the northeastern entrance, links to the existing building, and the mechanical penthouse. The foundation consists mainly of an H pile and cap (4' thick typically) system supporting the interior spaces, spread footings for the atrium, and several strip footings along the exterior walls.

The basement structural slab is 10" thick and supported by 2' square grade beams on the west, exterior edge of the building. The first level is a 5" thick, one-way concrete slab spanning north to south, primarily supported by concrete beams B4 24x30. The second and third levels are 8-1/2" one-way concrete slab supported by B1 24x30 beams, which are tapered and cantilevered into the atrium and west, exterior edge of the building. The cantilevers on the western edge of the building support the corridors and the metal and glass panel curtain wall.

Steel framing in the atrium consists of HSS10x.625 columns with a 21'-0" span. HSS8-5/8x.250 columns support the northeastern entrance. Atrium and penthouse framing consists of wide flange beams, primarily W12x14 and W18x50 respectively.

FIRE PROTECTION

Most areas within the building are protected by a wet sprinkler system except for rooms housing extensive electrical, voice, or data equipment which have a partition that is rated at least three hours. The fire command center is located in room 127 and houses the Fire Alarm Control Unit (FACU), Emergency Voice/Alarm Communication (EVAC), Graphic Smoke Control Panel (GSCP), and annunciator panels for the generator and elevators. Alarms are ADA compliant combined speaker/strobe.

Atrium fire protection consists of 175° sidewall sprinklers in the skylight and 135° dry pendant sprinklers in between skylights on the ceiling, as well as a manual smoke exhaust operation controlled by the GSCP. Elevator shafts contain sidewall sprinkler heads.

TRANSPORTATION

There are three passenger elevators in the Science Building addition, one adjacent to the north stairwell and two in the southwest corridor. The electric traction elevators specified are based on Otis Gen2 Machine Room-Less Elevators and are rated for 2500 lbs. The elevators are connected to the fire protection system for automatic recall and are also operable on standby power. The elevator controllers and ATS are located in the basement areaway.

TELECOMMUNICATIONS

The telecom service entrance room is connected to campus utilities by interbuilding, exterior fiber optic cabling. Individual telecom rooms are connected by intrabuilding backbone systems with 24 strand 50 micron cabling in 4" electrical metallic tubing (EMT) conduit. Horizontal cabling throughout the building telecom distribution system is copper. Telephone service for the existing building and addition is being updated from a Centrex phone system to VoIP.

Data outlets are available above counters in the lab spaces and throughout other work spaces. Within the lab furniture, 2" conduit is stubbed up for data and terminated in a furniture doghouse. The labs and offices also have electronic card reader door systems for security. Wireless access points are available in the labs and throughout most of the corridors.

LIGHTING DEPTH

DIRECTOR'S OFFICE - SPECIAL PURPOSE SPACE

SPACE

The private office space in room 319A is occupied by the director of the Great Lakes Center and his administrative support. The Great Lakes Center (GLC) is an institute committed to research and education focused on the scientific understanding of the Great Lakes and holds a regional office at Buffalo State College. The layout of the approximately 350 ft^2 rectangular office space is specific to the director's day-to-day tasks and includes a table where he can hold small meetings. It is also directly connected to the secretary's office and the GLC research labs. Though all walls are interior, there is a window that looks into the daylit west corridor (transmittance of 0.75).

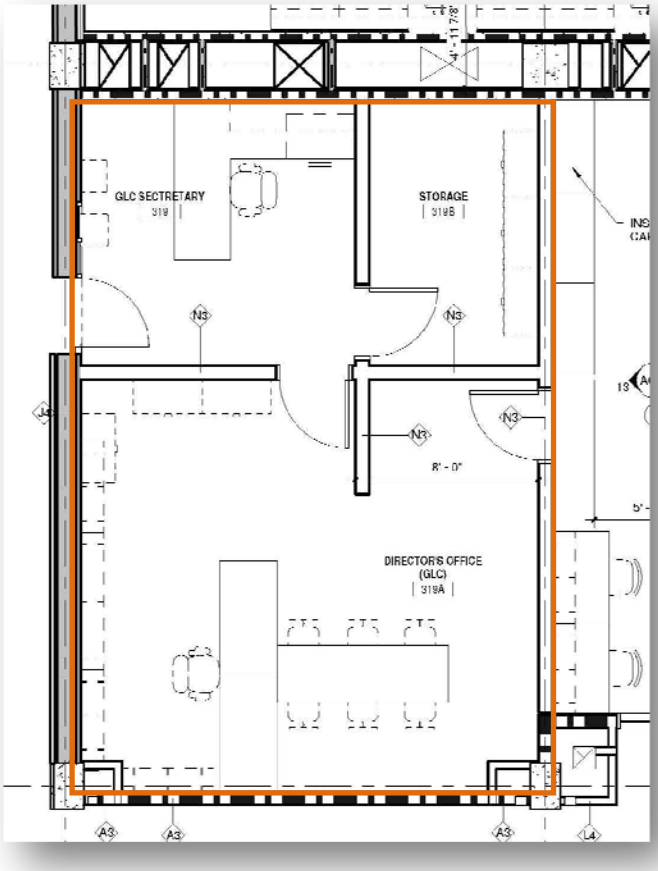


FIGURE 2-DIRECTOR'S OFFICE (ROOM 319A)

PROGRAM STATEMENT

The objective of the lighting design within the GLC director's office unit is to provide a comfortable yet functional and flexible space. It must meet minimal illuminance levels for daily tasks but also adapt to meeting functions when guests are being entertained or conducting business. In order to achieve these qualities, the

design incorporates diffuse ambient light, accent downlights, and wall-washing for presentation/conference functions.

DIMENSIONS

- GLC Secretary's Office: 12' x 11'-6" = 138 ft^2
- Storage: 7'-6" x 11'-6" = 86.25 ft^2
- GLC Director's Office: approximately 20' x 17'-10" ≈ 356 ft^2
- Gross Area of GLC Unit = 593 ft^2
- Net Area of GLC Office Unit = 580.25 ft^2

MATERIALS

The director's office is furnished relatively simply. The walls are covered in off-white, matte paint except for the dry erase surfacing area. Cabinetry and shelves are an oak color, the floors are a medium-to-dark brown, and the ceiling is a light colored ACT grid. Swatches of the materials are below followed by their reflectance values.

Furniture

Flooring

Ceiling

TABLE 1 – OFFICE SPACE MATERIALS

MATERIALS								
Special Purpose Space			Director's Office			Room 319A		
	Item	Key Name	Manufacturer	Series/Pattern	Style #	Color	Comments	Reflectance
Floor	Carpet Tile	CPT-1	Interface FLOR	Entropy	7223	Wheat	2'x2' Tile	0.34
	Carpet Tile	CPT-2	Interface FLOR	Cubic	6393	Height	2'x2' Tile	0.36
Wall	Paint	PNT-3	Sherwin Williams		SW 7014	Eider White		0.87
	Dry Erase Surfacing	DE-1	MDC Flooring	Idea Paint		White		0.95
Ceiling	Acoustic Panel Ceiling	APC-2	Armstrong	Optima		White	2'x4' Panels	0.90

DESIGN CRITERIA

- **Lighting Power Density** (LPD) values for the enclosed office space must be **≤ 1.10 W/ft^2** according to the ASHRAE Standard 90.1-2007. (1)
- **Horizontal and vertical illuminance levels** should meet a minimum value of 50fc/500lux and 5fc/50lux respectively on task plane surfaces. [2]
- **Color Appearance**: CCT of 3500 K and CRI ≥ 85
- **Direct Glare:** Indirect luminaires with matte finishes provide a more comfortable visual environment by reducing contrast between the lamp and housing and eliminating direct view of the source.
- **Reflected Glare**: Specular finishes throughout the space are not an issue, and VDT screens are effectively shielded with luminaire classification and positioning.
- **Shadows**: Diffuse light should be used in the space to avoid creating shadows on the task plane. Overhead lighting must be positioned so shadows are not created on writing surfaces.
- **Appearance of Space & Luminaires**: The space should provide a corporate image in terms of luminaire style and lighting mood. Fixtures must be laid out in the room so as not to create viewing issues for the occupant.
- **Psychological Reinforcement**: Since the space functions as a "corporate" office and conference room, it should possess the lighting settings to create a relaxed environment. In order to achieve these lighting characteristics, a design incorporating low-level light and non-uniform perimeter accents is implemented.

Office Lighting Design

Luminaires, Lamping + Ballasts

The office lighting design incorporates a combination of indirect, direct, and accent lighting fixtures. A detailed list of the luminaires, lamps, and ballasts specified is provided below in Table 3. Please note that manufacturer provided cut sheets for all associated equipment can be found in Appendix A. This is true for all spaces considered for lighting redesign.

TABLE 2 – OFFICE LIGHT LOSS FACTORS

	LLD	LDD	RSDD	BF	LLF
F1	0.95	0.85	0.96	1.00	0.78
F2	0.90	0.84	0.96	0.99	0.72
F3	0.95	0.85	0.96	0.98	0.76
F4	0.90	0.81	0.96	1.02	0.72
F5	0.85	0.85	0.96	0.98	0.68
F6	0.81	0.81	0.96	1.05	0.66

Light Loss Factor Assumptions:

- 0.96 was used for the RSDD value for all luminaires in all spaces
- Evaluation of Operating Atmosphere: Clean
- Cleaning Interval: 1.5 years/18 months

TABLE 3 – OFFICE LUMINAIRES

LUMINAIRE SCHEDULE												
LUMINAIRE		CLASSIFICATION	MOUNTING	LAMP			# LAMPS	BALLAST	VOLTAGE	OPTICS	HOUSING	MANUFACTURER
F1		0'-3-1/4"X4' SEMI-INDIRECT FLUORESCENT PENDANT	7 FT. AFF UNLESS OTHERWISE NOTED	F54T5HO PHILIPS 28W/835 MIN BIPIN T5 HE ALTO UNP	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	117W 2750 5000 3500K 85 V	2	ELEC/T5 ICN2S5490C PHILIPS ELEC, PS	277V	DIRECT LIGHT THROUGH PERFORATED SQUARE ALUMINUM AREA INDIRECT LIGHT CONTROLLED BY WIDE SPACING OPTIC EDGE SLOT PROJECTION	ALUMINUM, SLIM PROFILE	LIGHTOLIER-ULTRAFLAT 2 SL103BPIU
F2		4FT. RECESSED WALL WASH DIRECT	FLUSH WITH FINISHED CEILING	F54T5HO PHILIPS 54W/835 MIN BIPIN T5 H0 ALTO UNP	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	61W - 5000 3500K 85 IV	1	ELEC/T5HO ICN4S5490C 2LSG PHILIPS ADVANCE ELEC, PS	277V	EXTRUDED, FROSTED ACRYLIC SOFT GLOW LENS, FORMED SEMI-SPECULAR REFLECTOR	DIE-FORMED AND WELDED STEEL MATTE WHITE FINISH	LITECONTROL LG-WWD-4414T5HOS GLCWMINDDA/MK7 277
F3		7-3/8" DIAMETER RECESSED ADJUSTABLE DOWNLIGHT	FLUSH WITH FINISHED CEILING	F32WTT GE F32TBX 835/A/ECO	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	36W 2040 2400 3500K 82 V	1	ELEC/F32TT ICF-2S26-M1 -BS PHILIPS ADVANCE ELEC, PS	277	SPUN ALUMINUM REFLECTOR OPEN APERTURE ADJUSTABLE 30 DEGREE ELEVATION AIMING	ONE PIECE DIE CAST, MATTE BLACK	COOPER LIGHTING-PORTFOLIO CA7042ECP
F4		2FT., 1LAMP, SURFACE MOUNTED STRIP FLUORESCENT	9.0 FT. AFF UNLESS OTHERWISE NOTED	F24T5 PHILIPS 24W/835 MIN BIPIN T5 HO ALTO UNP	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	27 - 2000 3500 85 IV	1	ELEC/T5 ICN-2S24-277 PHILIPS ADVANCE ELEC, PS	277V	OPEN, UNAPERTURED STRIP LIGHT	20 GAUGE STEEL HOUSING WITH WHITE ENAMEL FINISH	PRUDENTIAL P-T5-STD-1T5-O2BWE277-B_
F5		4-1/2" X 8-1/2" RECESSED DOWNLIGHT	FLUSH WITH FINISHED CEILING	F32WTT GE F32TBX 835/A/ECO	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	36W 2040 2400 3500K 82 V	1	ELEC/F32TT ICF-2S26-M1 -BS PHILIPS ADVANCE ELEC, PS	277	SPECULAR PRIMARY REFLECTOR; MICROPRISM SPREAD LENS	RIGID HOUSING WITH PARABOLIC SPLAY TRIM	KURT VERSEN T4142
F6		1' X 0'-6" WALL SCONCE	6.0 FT. AFF WALL MOUNTED	F18DBX GE 835/ECO 4P	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	19 970 1200 3500 82 VI	1	ELEC/CFQ CFQ182/G24q GEC218-MVPS 3W GE ELEC,PS	277	20 GAUGE C.R.S. REFLECTOR HIGH REFLECTANCE WHITE POWDER COAT	STEEL HOUSING/REFLECTOR DIE-CAST ALUMINUM END CAPS	FOCAL POINT SOFTLITE VI-FS611BX18

Lighting plan

The lighting layout for the office is irregular in plan and does not strive to achieve uniform light except for the main task areas. A detail for this lighting layout, and the remaining three spaces, can be found in Appendix B. The LPD values and limits for this space are easily achieved, even without the decorative sconce fixtures excluded from the calculations.

Performance

LIGHTING POWER DENSITY:

Luminaire Type	Quantity	Total Input Power (W)
F1	2	234
F2	1	61
F3	2	72
F4	1	27
F5	6	216

TOTAL INPUT POWER: 648 W
REMAINING AVAILABLE INPUT POWER: 4.3 W
LPD: 1.09 W/ft^2

The design complies with lighting power density requirements from ASHRAE 90.1 2007.

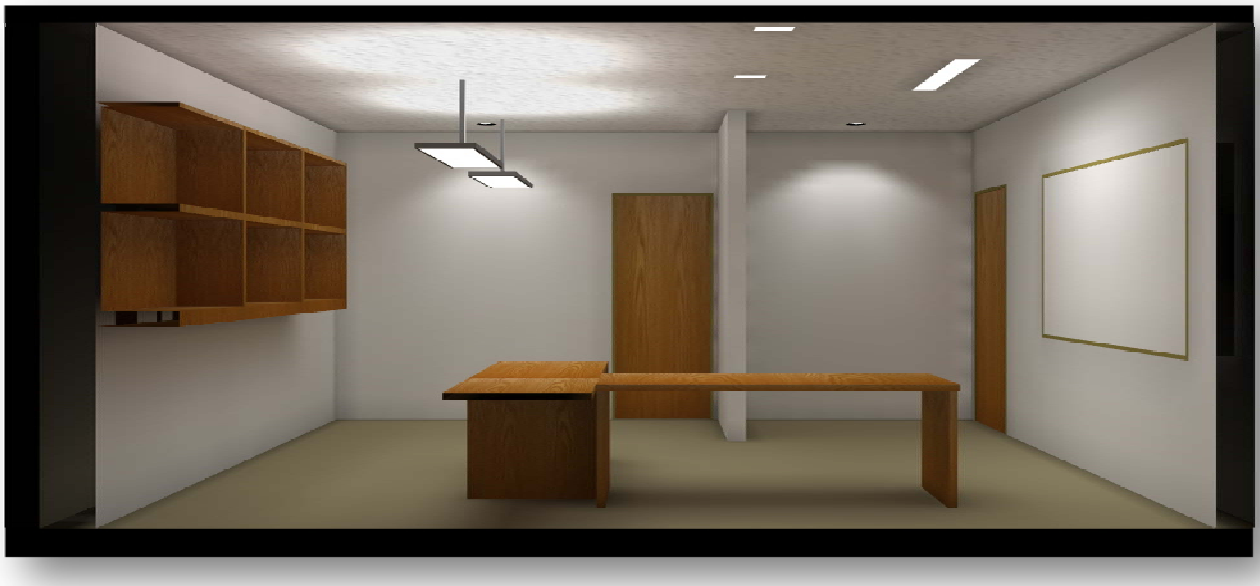
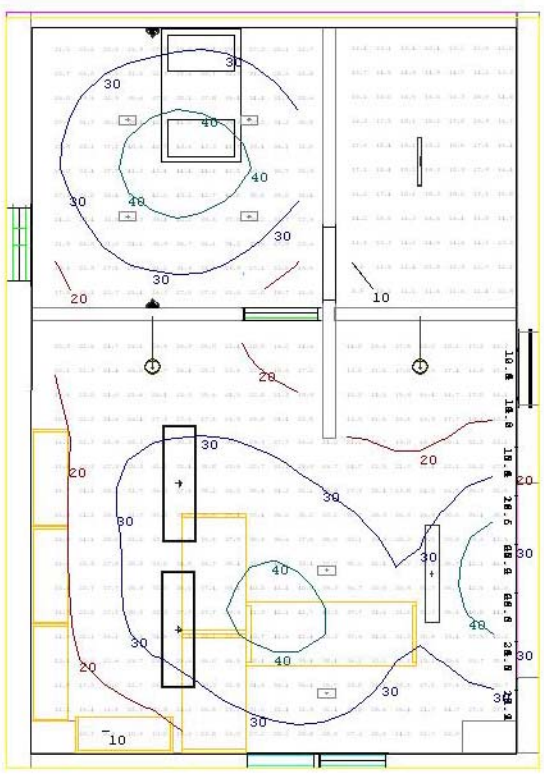


FIGURE 3 – INTERIOR PERSPECTIVE OF OFFICE WITH ALL LIGHTS ON

AVERAGE ILLUMINANCE: 11.7 FC | MAXIMUM 39.5 FC

The average illuminance levels for the space completely lit are clearly lower than the IESNA recommended levels for an office space. However, as can be illustrated in the following illuminance isolines, the design does provide sufficient levels at the desk and table areas. The non uniform lighting techniques and wall accents were implemented to highlight the space and functions with the room.



FIGRUE 4 - ALL ON

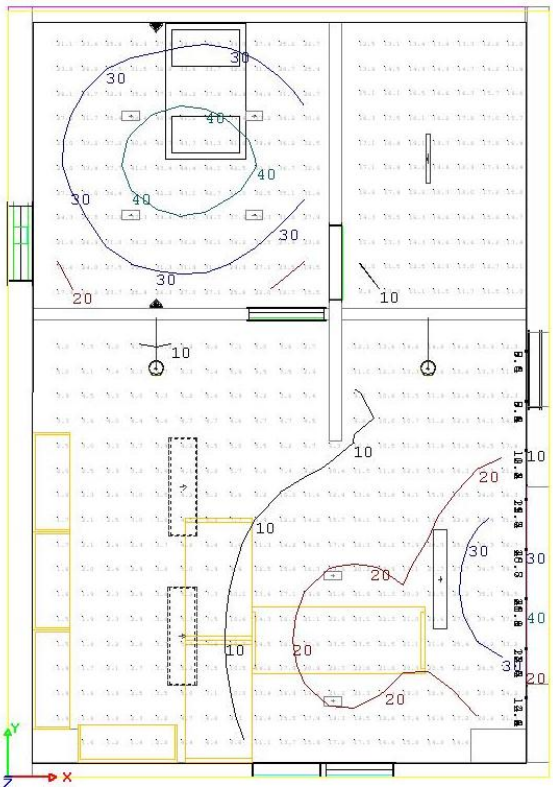
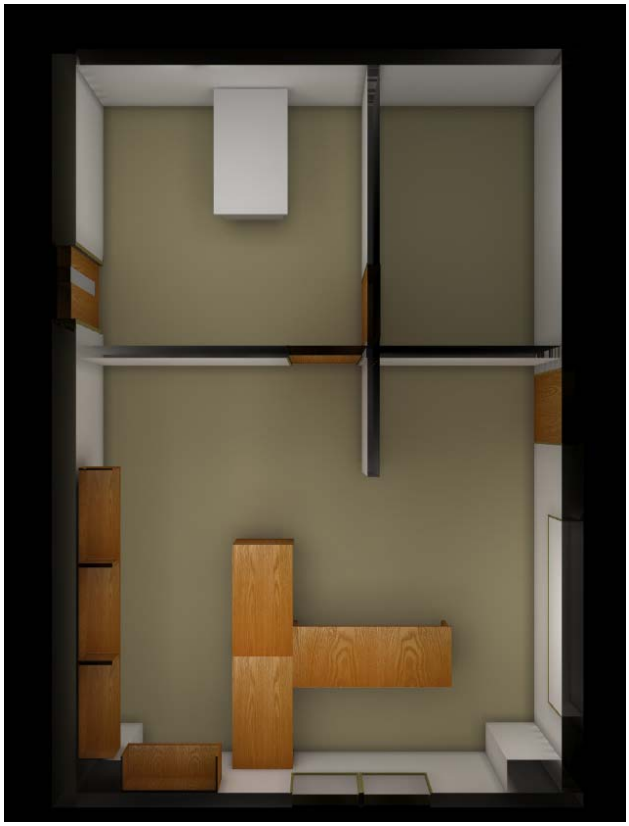
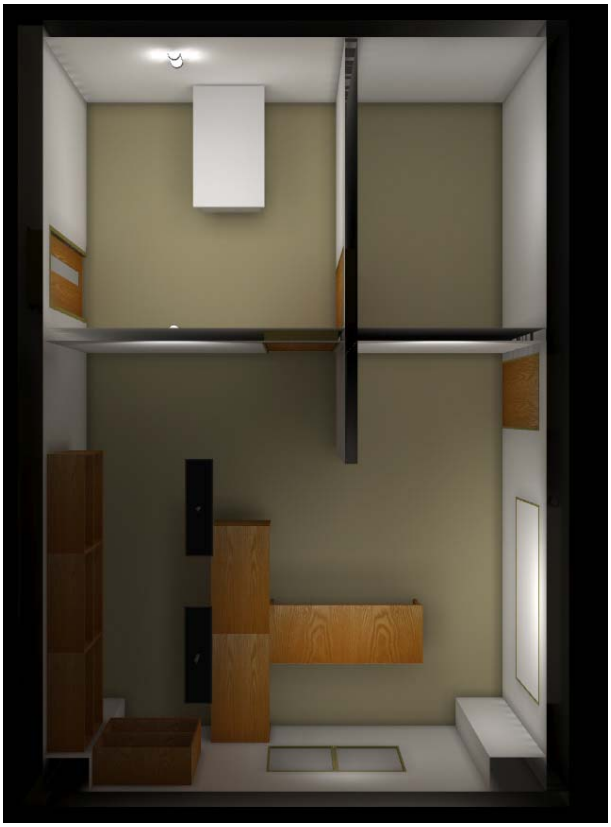


FIGURE 5 - TASK LIGHTS ABOVE DESK SWITCHED OFF





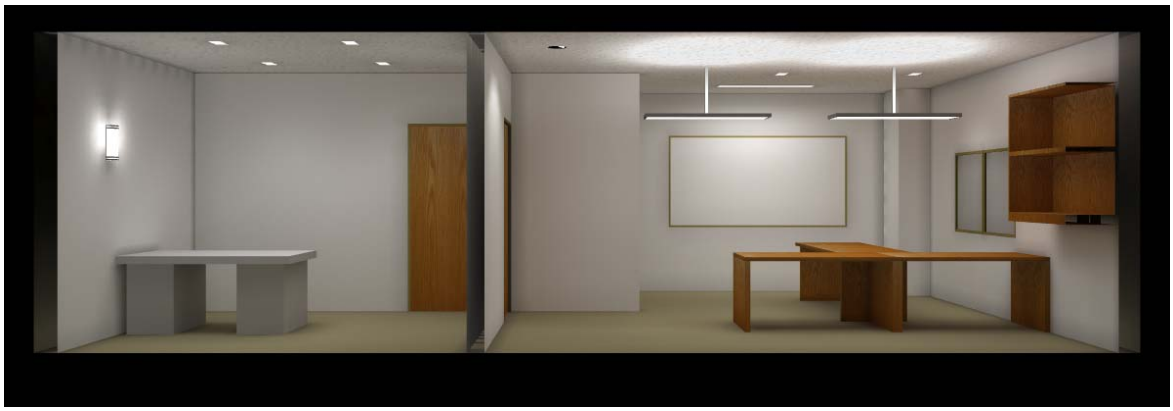


FIGURE 6 – SOUTH SECTION CUT OF OFFICE UNIT LOOKING, ALL ON

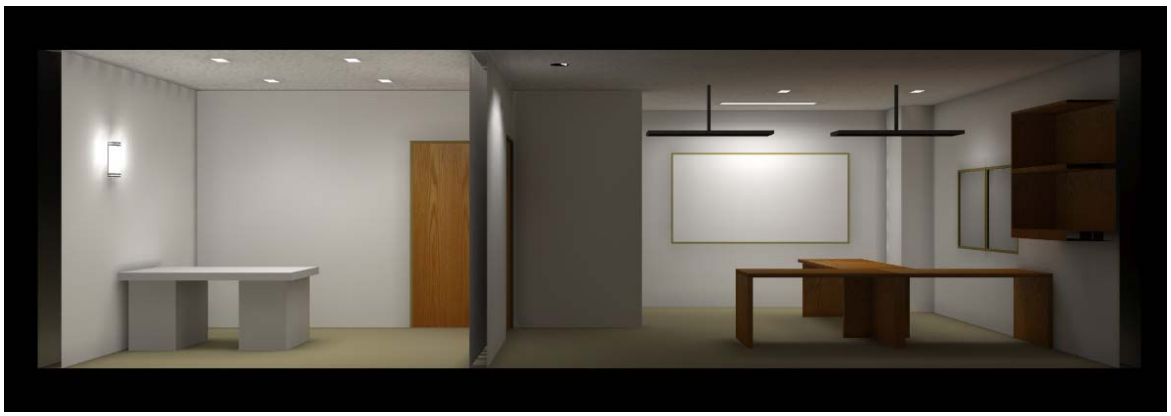


FIGURE 7 – SOUTH SECTION CUT OF OFFICE UNIT, TASK OFF/CONFERENCE SETTING

GENETICS TEACHING LAB – WORK SPACE

SPACE

The Genetics Teaching Lab (Room 306) is located on the northwest end of the building and borders the corridor overlooking the central atrium. It is surrounded on all sides by corridors or rooms, and therefore does not receive any natural light. The rectangular space serves as a teaching and experimental lab and is furnished with numerous pieces of casework to house tools and equipment. Tables are oriented perpendicular to the long wall in order to facilitate presentations that occur at the front of the room between the two entrances. A portion of the wall is painted with dry-erase surfacing paint to provide the writing surface. Finishes are plain and simple to create a space that is easy to work in and maintain.

PROGRAM STATEMENT

The objective of the lighting design within the Genetics Teaching Lab is to provide a bright, evenly lit environment without glare or shadows that would interfere with the visual tasks associated with experimentation and viewing. Since it also functions as a teaching lab, lighting should also highlight areas of presentation. In order to achieve these qualities, the design incorporates indirect/direct luminaires and baffled openings for ambient and board lighting fixtures. Task lighting is also incorporated in the rear and side of the room for experiment setup and cleaning.

DIMENSIONS

- 26’-11” x 41’-8”
- Area = 1157 ft^2

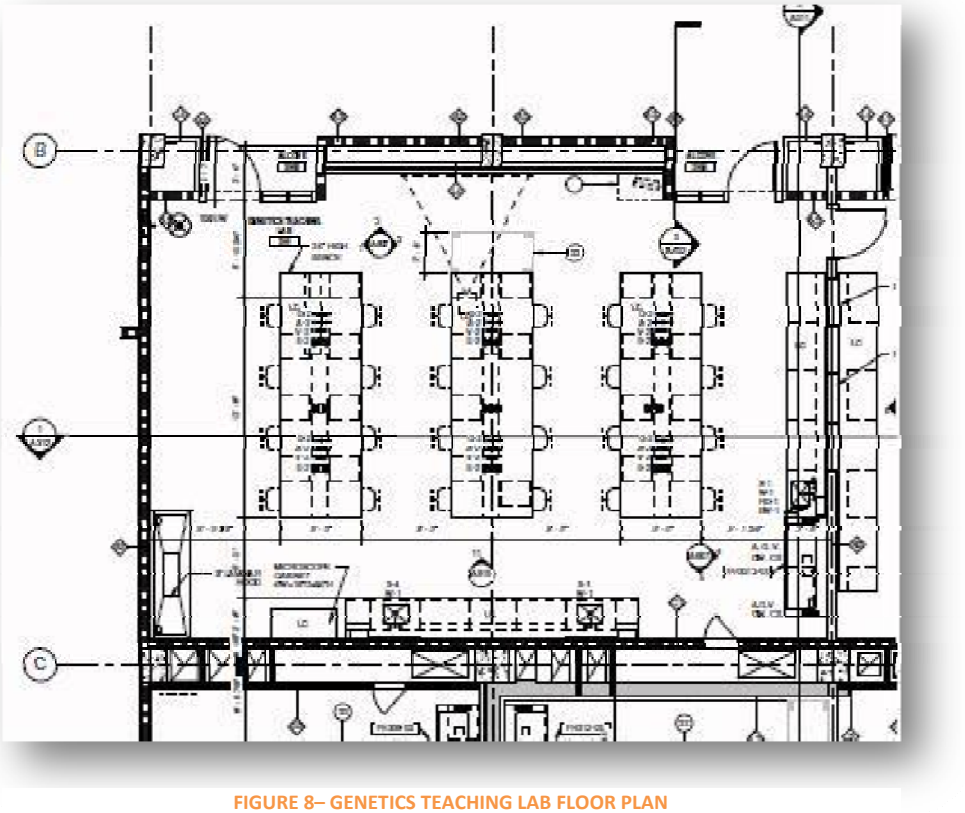


FIGURE 8– GENETICS TEACHING LAB FLOOR PLAN

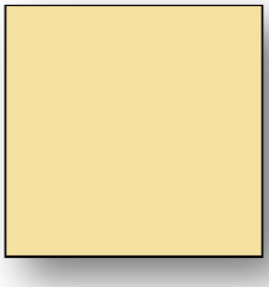
MATERIALS

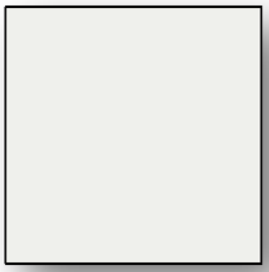
- The genetics lab is predominantly covered by a flat, matte white paint and light wood casework. However, the front of the room is painted a light yellow and hosts a white board surface. The ceiling is a light colored ACT grid and the floor is a gray, linoleum tile. Swatches of the materials are below followed by their reflectance values.

Furniture

Flooring

Walls





Ceiling

TABLE 4 –LAB CLASSROOM MATERIALS

MATERIALS								
Work Space			Genetics Teaching Lab			Room 306		
	Item	Key Name	Manufacturer	Series/Pattern	Style #	Color	Comments	Reflectance
Floor	Linoleum Tile Flooring	LTF-1	Forbo Flooring Systems	Marmoleum Composite Tile	MCT-621wt	Dove Gray	13"x13" tile	0.37
Wall	Paint	PNT-1	Sherwin Williams		SW 7006	Extra White		0.94
	Paint	PNT-2	Sherwin Williams		SW 6681	Butter up		0.88
	Dry Erase Surfacing	DE-1	MDC Flooring	Idea Paint		White		0.95
Ceiling	Acoustic Panel Ceiling	APC-2	Armstrong	Optima		White	2'x4' Panels	0.90

DESIGN CRITERIA

- **Lighting Power Density**: Lighting power allowance for the space should not exceed **1.4 W/ft^2**. Automatic controls should be integrated with the manual control system.
- **Horizontal and vertical illuminance levels** should meet a minimum value of 50fc/500lux and 30fc/300lux respectively. The work plane height is raised to a value of three feet due to the taller lab tables in the space.
- **Color Appearance + Color Contrast:** Since the space demands experimentation involving various viewing methods and tools, color rendering should be of good quality. CCT values should be no smaller than 3000K and CRI should be ≥ 80.
- **Direct Glare:** Luminaires with matte louvers provide a more comfortable visual environment by reducing contrast between the lamp and housing and minimizing direct view of the source.
- **Light Distribution on Task Plane:** Centrally positioned luminaires with a direct/indirect distribution provide more even luminance levels on the horizontal task plane. Uniformity is essential at the task surfaces in order to avoid distracting patterns or fatigue caused by inadequate luminance ratios.
- **Reflected Glare:** Luminaires should not be positioned in direct line with the task surface. Specular finishes on the task plane should be avoided to minimize veiling reflections.
- **Shadows:** Diffuse, semi-indirect or indirect light should be used in the space to avoid creating shadows on the task plane.
- **Source/Task/Eye Geometry:** Luminaires should be positioned outside of normal viewing angles at work spaces.
- **Points of Interest:** Luminance levels on the dry-erase surface should be no less than 30 fc. Contrast for the overall space should satisfy a ratio of 5:1.
- **Flicker and Strobe:** Flicker should be minimized by employing electronic ballasts.
- **Luminances of Room Surfaces:** Surfaces in the room should be sufficiently illuminated so as not to create the sensation of dark spots. Direct and indirect/diffuse sources create more even light on the surfaces and increase visual comfort.
- **Modeling of Faces of Objects:** Lighting should provide sufficient contrast for visual understanding of object textures and depths.

- Visual clarity should be emphasized with higher luminance levels at work surfaces and moderate levels at the perimeter. Preparation and cleaning tasks performed at the room perimeter require sufficient light levels.

Genetics Teaching Lab Lighting Design

Luminaires, Lamping + Ballasts

The lab lighting design incorporates a combination of indirect, direct, and task lighting fixtures. A detailed list of the luminaires, lamps, and ballasts specified is provided below in Table 5. For equipment cut sheets, please see Appendix A.

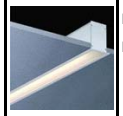
TABLE 5- LIGHT LOSS FACTORS

	LLD	LDD	RSDD	BF	LLF
F13	0.95	0.81	0.96	1	0.74
F14	0.95	0.87	0.96	1.00	0.79
F15	0.90	0.81	0.96	1.1	0.77
F16	0.95	0.87	0.96	1	0.79
F17	0.95	0.81	0.96	1	0.74

Light Loss Factor Assumptions:

- 0.96 was used for the RSDD value for all luminaires in all spaces
- Evaluation of Operating Atmosphere: Clean
- Cleaning Interval: 1.5 years/18 months

TABLE 6 – GENETICS TEACHING LAB LUMINAIRE SCHEDULE

LUMINAIRE SCHEDULE												
LUMINAIRE		CLASSIFICATION	MOUNTING	LAMP			# LAMPS	BALLAST	VOLTAGE	OPTICS	HOUSING	MANUFACTURER
F13		4FT. INDIRECT LINEAR, PENDANT	7 FT. AFF UNLESS OTHERWISE NOTED	F28T5 PHILIPS 28W/835 MIN BIPIN T5 HE ALTO UNP	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	62W 2750 2900 3500K 85 VI	2	ELEC/T5 ICN-2S28-N PHILIPS ADVANCE ELEC, PS	277V	PRECISION DIE-FORMED SEMI-SPECULAR ALUMINUM REFLECTOR	EXTRUDED ALUMINUM	LIGHTOLIER LSB-24A-28-277-WH
F14		4FT. WALL-MOUNTED CHALKBOARD FIXTURE	7FT. AFF UNLESS OTHERWISE NOTED	F28T5 PHILIPS 28W/835 MIN BIPIN T5 HE ALTO UNP	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	31W 2750 2900 3500K 85 III	1	ELEC/T5 ICN-2S28-N PHILIPS ELEC, PS	277V	DIE-FORMED STEEL WITH HIGH REFLECTANCE WHITE FINISH; PARABOLIC BAFFLE	DIE FORMED AND WELDED STEEL; 6" OPENING	LITECONTROL W-D-66N14T5-PARSS-CWM-ELB-277
F15		7" APERTURE RECESSED CIRCULAR DOWNLIGHT	FLUSH WITH FINISHED CEILING	PLT26 PHILIPS 26W/835 4P/ALTO 1CT	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	29W - 1800 3500K 82 III	1	ELEC/PLT ICF-2S26-H1-LD PHILIPS ELEC, PS	277V	HYDROFORMED ALUMINUM, SEMI-SPECULAR FINISH REFLECTOR; MATTE WHITE CROSS BLADE	1101F2642U FRAME IN KIT	LIGHTOLIER 1132-1101F2642U
F16		4FT. RECESSED LINEAR FLUORESCENT FLANGED EXTRUSION	FLUSH WITH FINISHED CEILING	F28T5 PHILIPS 28W/835 MIN BIPIN T5 HE ALTO UNP	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	31W 2750 2900 3500K 85 III	1	ELEC/T5 ICN-2S28-N PHILIPS ELEC, PS	277V	MATTE PARABOLIC LOUVERS	CONTINUOUS 6063-T5 EXTRUDED ALUMINUM PROFILE	SE'LUX M100-1T5-MA-004-WH-277
F17		4FT. LINEAR 1" MODULAR FLUORESCENT TASK LIGHTING	SURFACE MOUNTED UNDER CASEWORK	F28T5 PHILIPS 28W/835 MIN BIPIN T5 HE ALTO UNP	Input Watts Avg Lumens Initial Lumens CCT CRI Maint. Category	31W 2750 2900 3500K 85 VI	1	ELEC/T5 ICN-2S28-N PHILIPS ELEC, PS	277V	EXTRUDED ACRYLIC LINEAR PRISM LENS	0.060" EXTRUDED ALUMINUM; ENJECTION MOLDED POLYCARBONATE END CAPS	ALKCO/PHILIPS LINCS100FS46-277-WHG

Lighting plan

The drawings of the lab lighting layout can be found in Appendix B. In order to achieve the light levels within the space, two rows of indirect fluorescent lights were used to achieve the uniform levels of illuminance at the main work plane surface. Most luminaires are positioned within the space using typical mounting configurations. All pendant lights are offset from the floor surface (to the bottom of the luminaire) by a height of seven feet. The only luminaire specified with a mounting different from the standard recessed or surface mounting practice, is the chalkboard washer, which must be hung six inches from the wall surface with the factory provided bracket. An image of the mounting set up is provided in Figure 5.

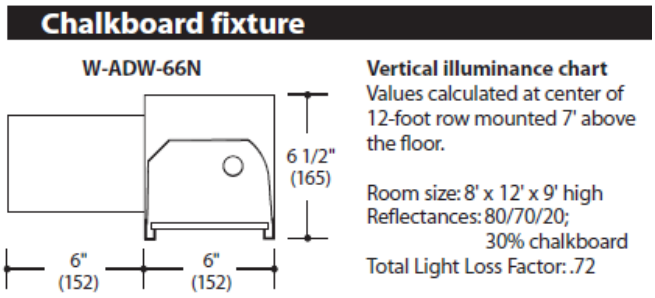


FIGURE 9 - BOARD WASH LUMINAIRE DETAIL

Though it was recommended that downlights be avoided for this type of space, several downlight luminaires are employed to supplement the dark spots resulting from the task/ambient lighting layout. Downlights have been positioned to maintain minimal direct and reflected glare and also include baffles or diffuse lenses for improved optics and light distribution.

Performance

LIGHTING POWER DENSITY:

Luminaire Type	Quantity	Total Input Power (W)
F13	16	992
F14	5	155
F15	9	261
F16	2	62
F17	1	31

TOTAL INPUT POWER: 1,501 W
REMAINING AVAILABLE INPUT POWER: 130 W
LPD: 1.29 W/ft^2

The design complies with lighting power density requirements from ASHRAE 90.1 2007.

FIGURE 10- PERSPECTIVE OF LAB LIGHTING (WITH ALL LUMINAIRES ON)

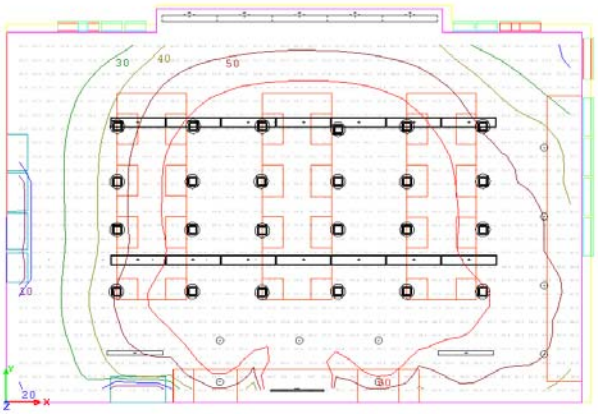


FIGURE 11 - AMBIENT AND TASK

AVERAGE ILLUMINANCE AT WORKPLANE: 52.64 FC

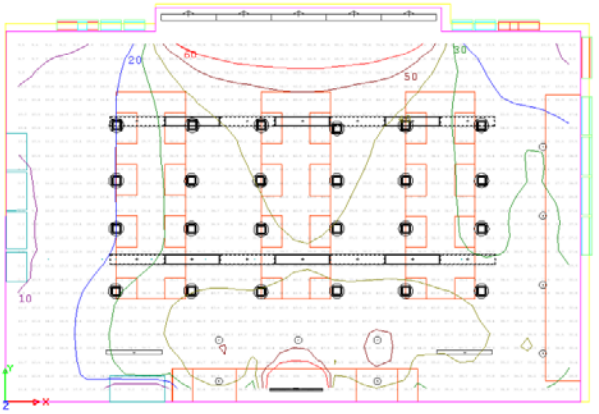


FIGURE 12 - SWITCHED AMBIENT, TASK + BOARD

AVERAGE ILLUMINANCE AT WORKPLANE: 33.75 FC

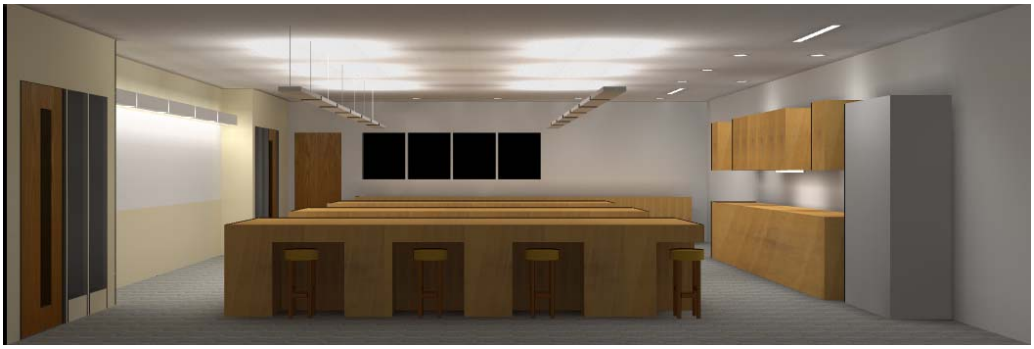


FIGURE 13 – SOUTH PERSPECTIVE SWITCHED AMBIENT

FIGURE 14 – EAST PERSPECTIVE SWITCHED AMBIENT

The average illuminance levels for the space completely lit are satisfy the IESNA recommended levels for a lab space, and exceed by only 5%. The switching allows for lower levels of light for different presentations and tasks within the room, while the perimeter lighting assists in maintaining high illuminance levels for preparatory and cleaning tasks.

FACADE

SPACE

The western curtain wall is the space considered for the outdoor redesign. The surface is composed of alternating metal and glass panels that vary in shape and depth. It runs parallel to a service road and athletic playing fields. Additionally, there is 286 ft. of sidewalk that runs from the main western entrance south to the end of the complex. The sidewalk and the main western entrance are also considered within the outdoor space lighting redesign.

PROGRAM STATEMENT

The façade is the defining architectural element of the BSC Science building and most thoroughly expresses the design goal and theme of the building. Consequently, the intent of the design is to accentuate and complement the existing architecture by highlighting the rectilinear geometries and creating a hierarchy of light. The western corridor which runs behind the curtain wall has a unique, multi-colored interior wall and creates a great deal of visual interest from exterior viewpoints. Bright, white highlights of the façade projections are incorporated to create a composition with depth and form that complements the seemingly irregular glazing and coloring patterns.

DIMENSIONS

Walkway = 286 ft. long
Main Entrance: 11 linear feet
Uppermost height of third level/roof = 43’

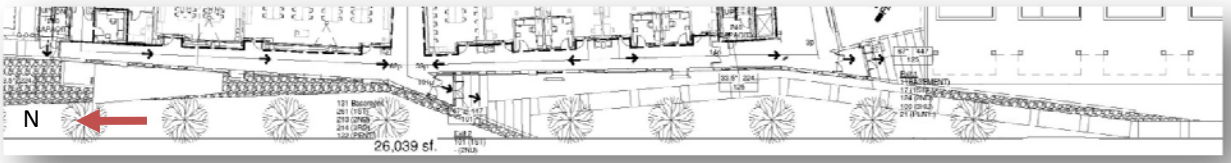


FIGURE 15 – EXTERIOR PLAN VIEW OF THE WESTERN FACADE

MATERIALS

The materials used for the façade are glass and aluminum curtain wall panels arranged in varying vertical shapes. The interior corridor walls that are visible from the exterior are gypsum wall board painted in several different matte colors.

DESIGN CRITERIA

- **Horizontal and vertical illuminance** levels should be **5fc and 3fc** respectively at the entrance and **5fc** on the walkway.
- **Lighting power allowance** for the walkway is 1 W/ft. Lighting power allowance for the main and alternate entrance door is 30 and 20 W/ft respectively.
- **Appearance of Space and Luminaires:** The area illuminated by the source should exhibit satisfactory contrast ratios and not interfere with the view of the landscape.
- **Direct Glare:** Luminaires should be mounted at proper heights and setbacks so as not to create glare issues for drivers or pedestrians.

- **Light Pollution/Trespass:** Any and all exterior luminaires should be shielded to cut off indirect light and prevent trespass into the building.
- **Reflected Glare:** Sources and aiming must be coordinated with surrounding surfaces to prevent visual impairment of viewers.
- **Modeling of Faces or Objects:** Light levels, CCT, CRI and distribution all must be considered in providing a light source that provides a secure environment.
- **Color Appearance + Color Contrast:** Sources with good/decent color rendering should be provided based on level of security needed for the area.

Facade Lighting Design

Luminaires, Lamping + Ballasts

TABLE 7- LIGHT LOSS FACTORS

	LLD	LDD	RSDD	BF	LLF
L1	0.80	0.64	-	1.0	0.51
F11	0.80	0.60	-	1.0	0.47
F12	0.80	0.64	-	1.0	0.51

Light Loss Factor Assumptions:

- Evaluation of Operating Atmosphere: Dirty
- Value of LLD value assumed 0.80 due to lack of information

TABLE 8– FACADE LUMINAIRE SCHEDULE

LUMINAIRE SCHEDULE												
LUMINAIRE		CLASSIFICATION	MOUNTING	LAMP			# LAMPS	BALLAST	VOLTAGE	OPTICS	HOUSING	MANUFACTURER
L1		1 FT. SURFACE MOUNTED LED STRIP LIGHT	SURFACE; HEIGHT VARIES WITH WALL PROJECTIONS	-	Input Watts	15	-	INTEGRAL DRIVER/ TRANSFORMER	277V	POLYCARBONATE CLEAR LENS	RIGID HOUSING; EXTRUDED ANODIZED ALUMINUM	PHILIPS-COLOR KINETICS eW GRAZE POWERCORE 523-000030-09
					Avg Lumens	-						
					Initial Lumens	477						
					CCT	4000						
					CRI	-						
					Maint. Category	VI						
F11		8" SURFACE MOUNTED DOWNLIGHT	SURFACE MOUNTED	PLC-26 PHILIPS ALTO 26W/835 2P	Input Watts	55W	2	ELEC/T4 INTEGRAL	277V	PARABOLIC CROSS BAFFLES; PRIMARY LINEAR REFLECTOR	SATIN BRUSHED ALUMINUM; INTERIOR MATTE WHITE FINISH	KURT VERSEN P639CB
					Avg Lumens	-						
					Initial Lumens	1760						
					CCT	3500						
					CRI	82						
					Maint. Category	IV						
F12		3FT. SURFACE MOUNTED BOLLARD	SURFACE MOUNT PLATE	PLC-26 PHILIPS ALTO 26W/835 2P	Input Watts	29W	1	ELEC/T4 ICF-2S26-H1-LD PHILIPS ELEC, PS	277V	DIFFUSER LENS	316 MARINE GRADE STAINLESS STEEL	LUMASCAPE LS482-262-F-A3-R-9
					Avg Lumens	-						
					Initial Lumens	1760						
					CCT	3500						
					CRI	82						
					Maint. Category	VI						

Lighting plan

A series of LED grazers are mounted six inches from the tops of the projected aluminum panels by "L" brackets. Walkway light is provided by bollards, and the interior glow from the corridor is integrated within the design to create an interesting, layered aesthetic. The layout of these fixtures and the other outdoor luminaires can be found in Appendix B. All luminaires around the façade are connected to a lighting control panel and switched via a photo cell positioned on the roof.

Performance

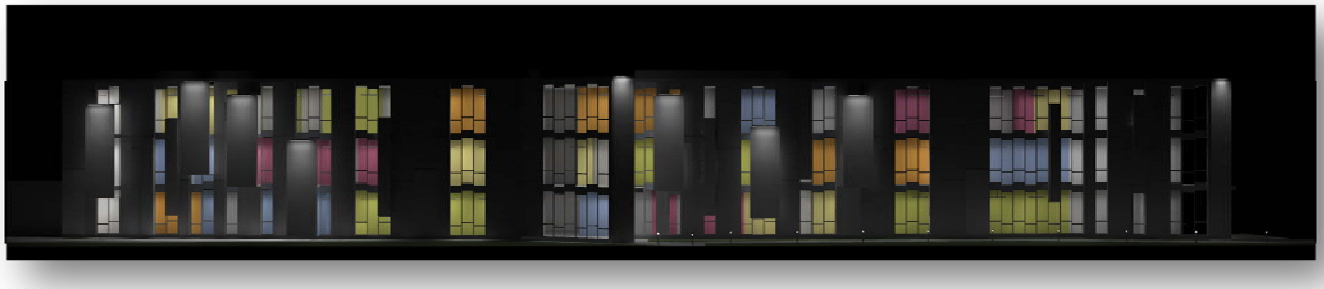


FIGURE 15 – WEST ELEVATION

LIGHTING POWER DENSITY:

Building Exterior Measured Areas		
Door	11	feet
Walkway	286	feet
Façade	2648.4	sq. ft

Luminaire Type	Quantity	Total Input Power (W)
L1	40	600
F11	1	55
F12	18	522

ASHRAE Allowance		Total Allowable Power		Actual Power	Net Difference
30	W/lin. Ft.	330		55	275
1	W/lin. Ft.	286		522	-236
0.2	W/sq. ft	529.68		600	-70.32
		1145.68	Grand Total	1177	-31.32
		1202.964	+ 5%	COMPLIES	25.964

TOTAL INPUT POWER: 1,177 W
REMAINING AVAILABLE INPUT POWER: 26 W (with 5% unrestricted allowance)

The design satisfies lighting power density requirements from ASHRAE 90.1 2007 on the condition that the excess allowable power from the building grounds is traded. The entrance has an excess of 275 W

which is greater than the walkway net difference of -236W. Therefore, the trade between the two areas affords LPD compliance. Even though the building façade lighting is over the permitted levels, the grand total of the design is less than the total allowable levels (with the addition of the 5% unrestricted allowance).

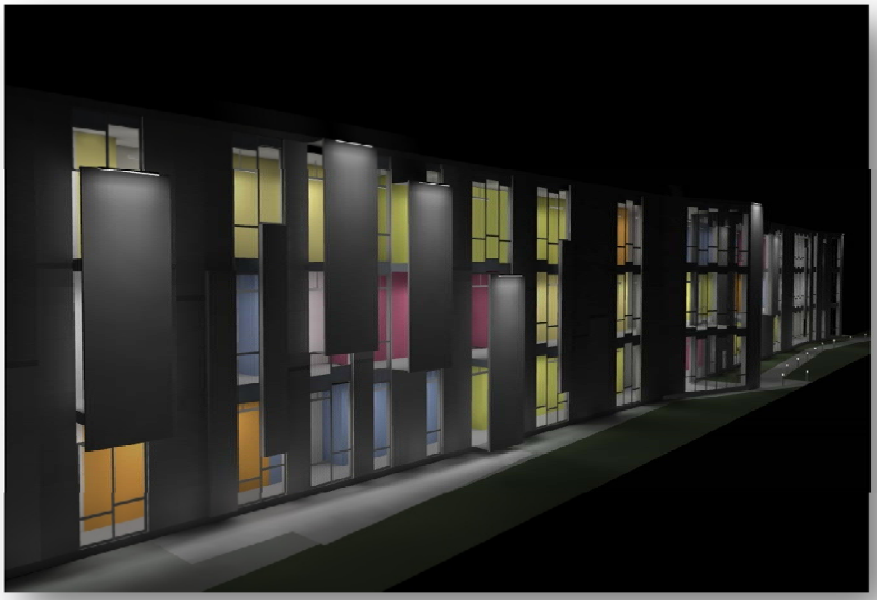


FIGURE 16 – SOUTHEAST PERSPECTIVE

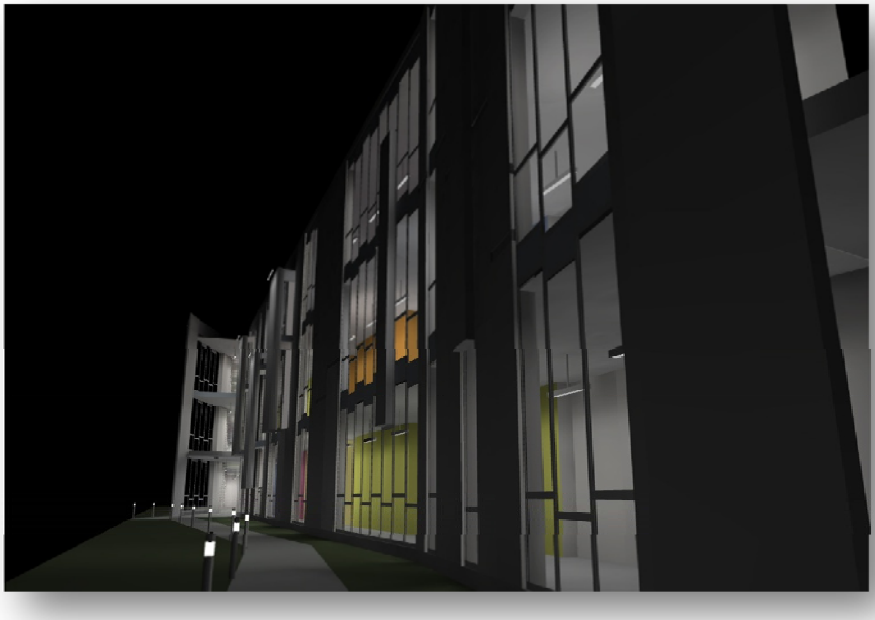
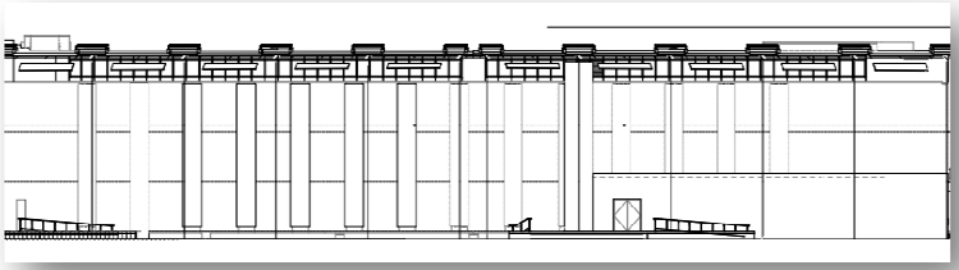


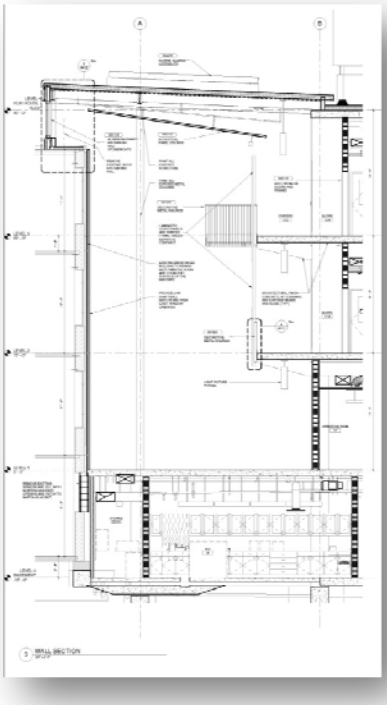
FIGURE 17 – NORTHWEST PERSPECTIVE VIEWING WEST MAIN ENTRANCE

ATRIUM

SPACE

The atrium space spans the length of the addition and covers 6,273 ft^2 at three levels. It serves primarily as a circulation space, though it is also intended for students to use as a casual meeting place. The atrium joins the existing Science 1 Building at its western façade, and therefore has an interior wall composed of brick with light colored acoustical wall panels on its eastern side. The western side of the atrium/lobby is essentially corridor space with a stair case extending from the second to third level. The roof of the atrium supplies daylighting into the space via a system of 12 sloped skylights and clerestories. The finishes of the majority of the atrium surfaces are presented in Table 9.





FIGURES 18 + 19 – EASTERN ATRIUM WALL AND SOUTHERN SECTION

PROGRAM STATEMENT

The atrium space is one of the most challenging design spaces within the Science Building. It functions as a means of conveyance, and has dimensions and volume that give the impression of a canyon. It is the location where the new building meets the old and where daylight mixes with electric light. Keeping all these traits and characteristics in mind when designing, yields a practical, geometric solution that emphasizes the shape and flow of the space with decorative and functional luminaires using fluorescent and HID sources. Additionally, the space is again considered for breadths and studies in daylighting, acoustics, and mechanical performance.

DIMENSIONS

Length = approximately 249 ft.
Width = approximately 33 ft at the center

MATERIALS

Walls

Ceiling

Floor, Accent Wall

TABLE 9 – ATRIUM MATERIALS

MATERIALS								
Work Space			Atrium			Levels 1-3		
	Item	Key Name	Manufacturer	Series/Pattern	Style #	Color	Comments	Reflectance
Floor	Porcelain Tile	PT-1	Caesar	More		Eclipse	24”x48” Tile (1/16” Joint)	0.15
	Porcelain Tile	PT-2	Caesar	More		Eclipse	12”x48” Tile (1/16” Joint)	0.15
Wall	Existing Brick	BRK	Existing					0.25
	Painted Wall Board		Sherwin Williams					0.50
Ceiling	Acoustic Panel Ceiling	APC-2	Armstrong	Optima		White	2’x4’ Panels	0.90
	Glazing	G-1						$\tau = 0.7$

DESIGN CRITERIA

- **Illuminance:** Horizontal levels should meet a minimum value of 10fc/100 lux.
- **Lighting Power Density:** The level one floor area must not exceed **0.6 W/ft^2** while the upper corridor levels must remain under **0.5 W/ft^2**.
- **Daylighting Integration and Control:** Daylight penetration is the key function of an atrium. Since this atrium functions primarily as a circulation space, clear glazing is acceptable in the skylight assembly. Issues of glare must be addressed with proper orientation, shading, and positioning of glazing.
- **Direct Glare:** Luminaires at eyelevel or below must be addressed to ensure they will not create any discomfort to the viewer.
- **Light Distribution on Surfaces:** Distributions must meet the design intent of the space. Since the atrium is not a dedicated work space, the accent and decorative lighting creates more isolated spots of light to guide the viewer in a certain direction.
- **Luminances of Room Surfaces:** Horizontal and vertical luminances must be sufficient for circulation.
- **Shadows:** Shadows from any downlight fixtures must be limited so as not to interfere with work surfaces.
- **Color Appearance + Color Contrast:** Color matching is an important criterion in the atrium space. Light sources must be carefully matched so that CCT values do not create great differences in warm or cool light.
- **Modeling of Faces or Objects:** The atrium serves as a decorative space within the building, and therefore, aiming angles and sources must be coordinated with the surfaces to obtain the desired effect.
- **Reflected Glare:** Luminaires and interior glazing must be carefully located to prevent reflections of natural or interior light toward direct view of an occupant.

Atrium Lighting Design

Luminaires, Lamping + Ballasts

TABLE 10- LIGHT LOSS FACTORS

	LLD	LDD	RSDD	BF	LLF
F6	0.81	0.81	0.96	1	0.63
F7	0.88	0.81	0.96	1.00	0.69
F8	0.92	0.81	0.96	1.16	0.83
M1	0.79	0.84	0.96	1.00	0.63

Light Loss Factor Assumptions:

- 0.96 was used for the RSDD value for all luminaires in all spaces
- Evaluation of Operating Atmosphere: Clean
- Cleaning Interval: 1.5 years/18 months

TABLE 11 - ATRIUM LUMINAIRE SCHEDULE

LUMINAIRE SCHEDULE												
LUMINAIRE		CLASSIFICATION	MOUNTING	LAMP			# LAMPS	BALLAST	VOLTAGE	OPTICS	HOUSING	MANUFACTURER
F6		1' X 0'-6" WALL SCONCE	6.0 FT. AFF WALL MOUNTED	F18DBX GE 835/ECO 4P	Input Watts	18	1	ELEC/CFQ CFQ182/G24q GEC218-MVPS 3W GE ELEC,PS	277	20 GAUGE C.R.S. REFLECTOR HIGH REFLECTANCE WHITE POWDER COAT	STEEL HOUSING/REFLECTOR DIE-CAST ALUMINUM END CAPS	FOCAL POINT SOFTLITE VI-FS611BX18
					Avg Lumens	970						
					Initial Lumens	1200						
					CCT	3500						
					CRI	82						
					Maint. Category	VI						
F7		1FT. TAPERED SQUARE SURFACE MOUNT	SURFACE MOUNT 12 FT AFF	FPC22 SYLVANIA 22W T5 835	Input Watts	25	1	ELEC/T5 INTEGRAL	277V	INJECTION MOLDED POLYCARBONATE DIFFUSER	EXTRUDED ALUMINUM	LIGHTOLIER - OPTIMO SERIES ST12AL-S122U-22W-120/277V-1
					Avg Lumens	1585						
					Initial Lumens	1800						
					CCT	3500						
					CRI	82						
					Maint. Category	VI						
F8		3'-2" SUSPENDED DECORATIVE	14' AFF UNLESS OTHERWISE NOTED	F21T5 GE F21W/T5/ 835/ECO	Input Watts	31	1	ELEC/T5 GE228MVPS-A GE ELEC, PS	277	MATTE WHITE ACRYLIC BOTTOM DIFFUSER, TOP COVER	COLD-ROLLED STEEL FRAME AND ALUMINUM BODY; DOUBLE STEM SUSPENSION FABRIC SHADES	SHAPER LIGHTING 101-P FABRIQUE RECTILINEAR 101-P-38-T52-21-SWH (SCA FOR SLOPED CEILING)
					Avg Lumens	1930						
					Initial Lumens	2100						
					CCT	3500						
					CRI	85						
					Maint. Category	VI						
M1		17-13/16"x8" LARGE MH WALL WASHER	EXTERNAL YOKE WITH CANTILEVER PENDANT MOUNT	CMH150T6 GE CMH150TU 830/G12	Input Watts	186	1	MAG/CMH150 GEM150ML TLC3D-5 GE MAG	277V	HIGH PURITY ALUMINUM REFLECTOR AND END PLATES MICRO PRISMATIC TEMPERED LENS	SMOOTH STEEL HOUSING	ELLIPTIPAR STYLE M104 1104-150G-X-01-2-00-0
					Avg Lumens	11000						
					Initial Lumens	14000						
					CCT	3000						
					CRI	82						
					Maint. Category	IV						

Lighting plan

The ambient lighting in the atrium is provided by a linear arrangement of fluorescent pendant and surface mounted luminaires positioned over the corridors and centered along the center of the space by suspension from the ACT grids. The luminaires suspended through the center of level one have a cable length of 23' which is less than the manufacturer's listed maximum standard length of 25'. Accent lighting is provided by a series of six sconces (of the same style used in the office space). Wall washing is provided from a horizontal pendant-mounted metal halide aligned with the acoustical panel treatments over the existing brick wall. The metal halide lights are to be controlled by an astronomical time clock while the remainders are designed for photosensor switching control, which is analyzed in the daylighting breadth.

Performance

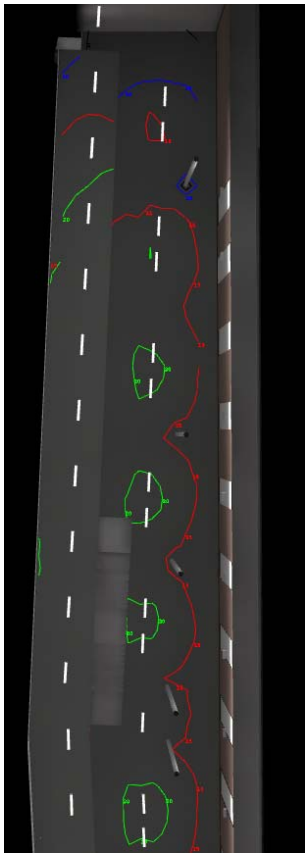
LIGHTING POWER DENSITY:

Building Measured Areas		
Atrium – Level One	6273	ft^2
Corridor – Level Two	2318	ft^2
Corridor – Level Three	2290	ft^2

Luminaire Type	Quantity	Location
F6	6	Level One
F7	26	Level One
	26	Level Two
F8	26	Level Three
	21	Level One
M1	14	Mounted to East Wall @ 35' AFF

ASHRAE Allowance		Total Allowable Power	Actual Power	Net Difference	LPD
Level One	$0.6W/ft^2$	3763.8 W	3905W	-141.2W	0.62
Level Two	$0.5W/ft^2$	1159W	650W	509W	0.28
Level Three	$0.5W/ft^2$	1145W	806W	339W	0.35

Since the total net difference of the level two and three corridors is greater than the power density deficit at Level One, the values can be traded to achieve LPD standards according to ASHRAE.



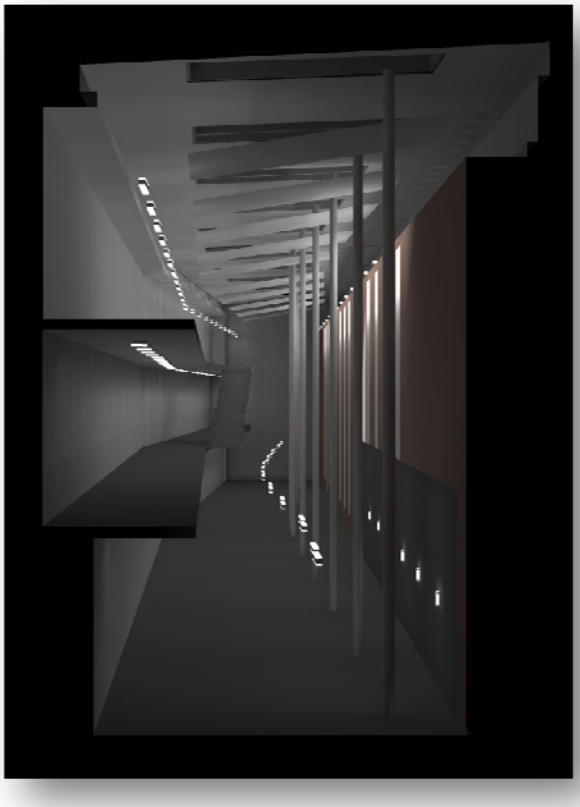


FIGURE 20 - NORTH SECTION AT NIGHT TIME

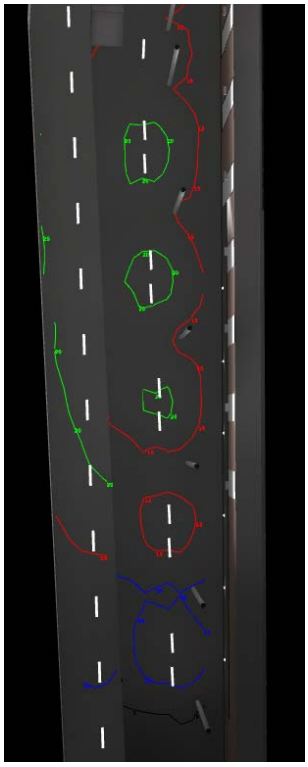


FIGURE 21 - NORTHWEST PERSPECTIVE FROM LEVEL ONE

ELECTRICAL REDESIGN

LIGHTING REDESIGN

Four spaces within the Buffalo State College New Science Building were chosen for a redesign of the lighting systems. The first, the Director's Office (Room 319A), houses the Great Lakes Center's Director, his secretary, and some small storage space. It functions as a work and meeting space and the proposed design incorporates a layout of switched, CFL spotlights and linear fluorescents to address the flexibility of the space while providing a pleasing environment. The second, the Genetics Teaching Lab (Room 306), employs a new switching scheme and additional task lighting at the perimeter lab counters along with possible incorporation of an ambient LED luminaire. The atrium redesign includes additional pendant fixtures within the open space floor area and decorative, fixtures within the corridor. The exterior redesign of the western facade relies primarily on interior glow, but also incorporates a grazing LED light to enhance and highlight façade projections.

For each of the spaces and affected areas, any and all adjustments to the branch circuits and distribution equipment has been recalculated and resized.

TABLE 12 – PANELBOARD CHANGES SUMMARY

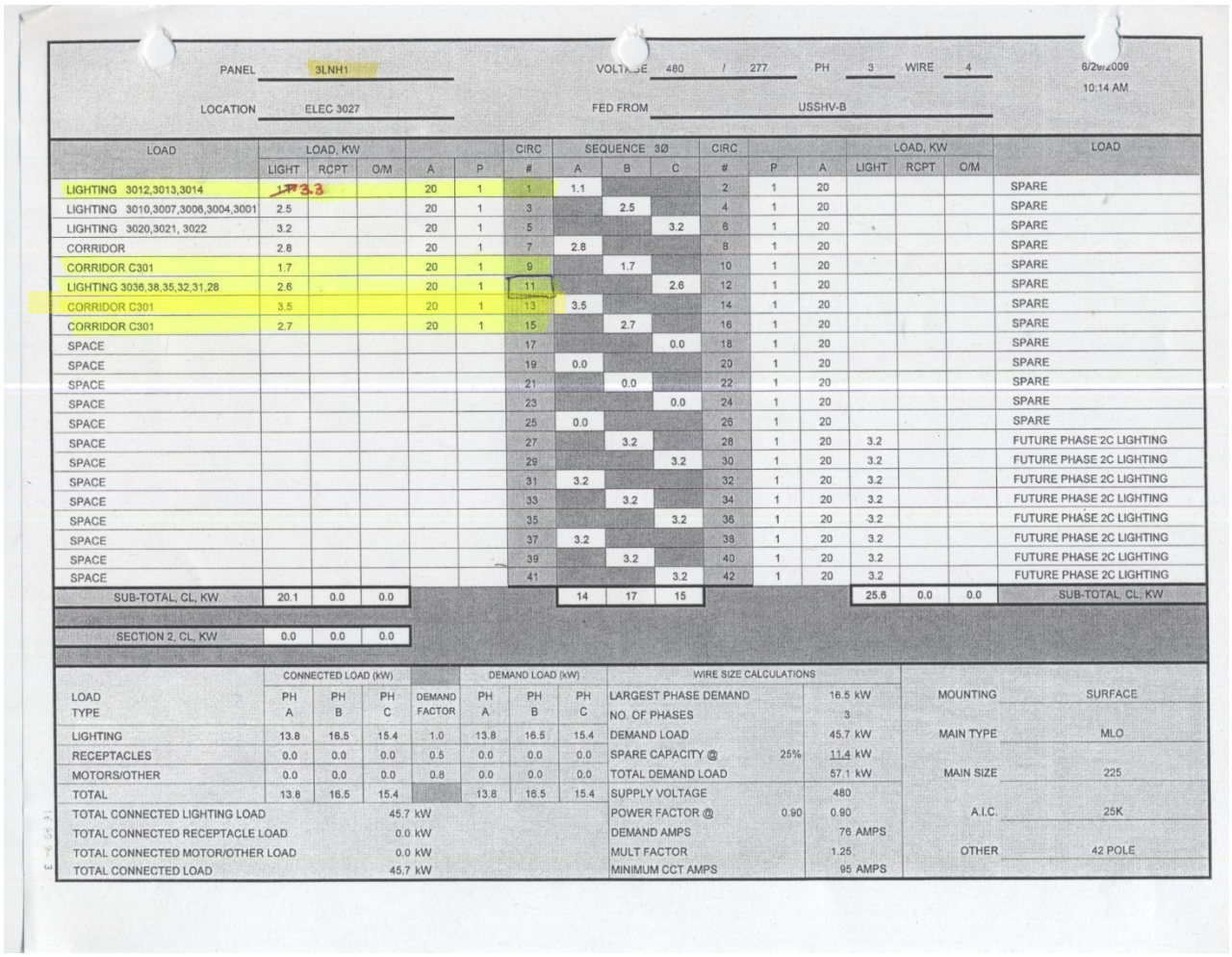
Existing Panelboard Changes & Locations Served						
Panel Tag	Voltage	N/EM Indicators	Office	Gen. Lab.	Atrium	Façade
3LNH1	480/277	N	X	X		X
PPSH1	480/277	EM		X		
1LNH1	480/277	N			X	
2LNH1	480/277	N			X	
2LEH1	480/277	EM			X	X

DIRECTOR'S OFFICE

All lights within the space are controlled by line voltage switching. The manual switches are located next to the door leading into the director's office from the secretary's office. The wall-washer F2 fixture is controlled by a manual, single pole switch next to the whiteboard. A lighting plan for the director's office can be found in Appendix B.

The affected lighting loads for the Director's office and most of the other spaces can be found on panel 3LNH1.

PANELBOARD ADJUSTMENTS



PANEL 3LNH1 VOLTAGE 480 / 277 PH 3 WIRE 4 6/2/2009 10:14 AM

LOCATION ELEC 3027 FED FROM USSHV-B

LOAD	LOAD, KW					CIRC	SEQUENCE 3Ø			CIRC			LOAD, KW			LOAD
	LIGHT	RCPT	O/M	A	P	#	A	B	C	#	P	A	LIGHT	RCPT	O/M	
LIGHTING 3012,3013,3014	3.3			20	1	1	1.1			2	1	20				SPARE
LIGHTING 3010,3007,3006,3004,3001	2.5			20	1	3		2.5		4	1	20				SPARE
LIGHTING 3020,3021, 3022	3.2			20	1	5			3.2	6	1	20				SPARE
CORRIDOR	2.8			20	1	7	2.8			8	1	20				SPARE
CORRIDOR C301	1.7			20	1	9		1.7		10	1	20				SPARE
LIGHTING 3036,38,35,32,31,28	2.6			20	1	11			2.6	12	1	20				SPARE
CORRIDOR C301	3.5			20	1	13	3.5			14	1	20				SPARE
CORRIDOR C301	2.7			20	1	15		2.7		16	1	20				SPARE
SPACE						17			0.0	18	1	20				SPARE
SPACE						19	0.0			20	1	20				SPARE
SPACE						21		0.0		22	1	20				SPARE
SPACE						23			0.0	24	1	20				SPARE
SPACE						25	0.0			26	1	20				SPARE
SPACE						27		3.2		28	1	20	3.2			FUTURE PHASE 2C LIGHTING
SPACE						29			3.2	30	1	20	3.2			FUTURE PHASE 2C LIGHTING
SPACE						31	3.2			32	1	20	3.2			FUTURE PHASE 2C LIGHTING
SPACE						33		3.2		34	1	20	3.2			FUTURE PHASE 2C LIGHTING
SPACE						35			3.2	36	1	20	3.2			FUTURE PHASE 2C LIGHTING
SPACE						37	3.2			38	1	20	3.2			FUTURE PHASE 2C LIGHTING
SPACE						39		3.2		40	1	20	3.2			FUTURE PHASE 2C LIGHTING
SPACE						41			3.2	42	1	20	3.2			FUTURE PHASE 2C LIGHTING
SUB-TOTAL, CL, KW	20.1	0.0	0.0				14	17	15				25.6	0.0	0.0	SUB-TOTAL, CL, KW
SECTION 2, CL, KW	0.0	0.0	0.0													

LOAD TYPE	CONNECTED LOAD (kW) PH A	PH B	PH C	DEMAND FACTOR	DEMAND LOAD (kW) PH A	PH B	PH C
LIGHTING	13.8	16.5	15.4	1.0	13.8	16.5	15.4
RECEPTACLES	0.0	0.0	0.0	0.5	0.0	0.0	0.0
MOTORS/OTHER	0.0	0.0	0.0	0.8	0.0	0.0	0.0
TOTAL	13.8	16.5	15.4		13.8	16.5	15.4

TOTAL CONNECTED LIGHTING LOAD 45.7 kW
TOTAL CONNECTED RECEPTACLE LOAD 0.0 kW
TOTAL CONNECTED MOTOR/OTHER LOAD 0.0 kW
TOTAL CONNECTED LOAD 45.7 kW

WIRE SIZE CALCULATIONS		
LARGEST PHASE DEMAND		16.5 kW
NO. OF PHASES		3
DEMAND LOAD		45.7 kW
SPARE CAPACITY @	25%	11.4 kW
TOTAL DEMAND LOAD		57.1 kW
SUPPLY VOLTAGE		480
POWER FACTOR @	0.90	0.90
DEMAND AMPS		76 AMPS
MULT FACTOR		1.25
MINIMUM CCT AMPS		95 AMPS

MOUNTING	SURFACE
MAIN TYPE	MLO
MAIN SIZE	225
A.I.C.	25K
OTHER	42 POLE

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: 3LNH1	MIN. C/B AIC: 25K
SIZE/TYPE BUS: 225A	PANEL LOCATION: ELEC. RM. 328	OPTIONS:
SIZE/TYPE MAIN: 200A/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
LTG-LAB	306	3702	20A/1P	1	*			2	20A/1P	300	North End	LTG-FAÇADE
LTG	310	2500	20A/1P	3		*		4	20A/1P	300	South End	LTG-FAÇADE
LTG	320	3200	20A/1P	5			*	6	20A/1P	0		SPARE
LTG	CORR	2800	20A/1P	7	*			8	20A/1P	0		SPARE
LTG-ATRIUM	C301	806	20A/1P	9		*		10	20A/1P	0		SPARE
LTG - OFFICE	319	2600	20A/1P	11			*	12	20A/1P	0		SPARE
LTG-ATRIUM	C301	2604	20A/1P	13	*			14	20A/1P	0		SPARE
SPACE	0	0	20A/1P	15		*		16	20A/1P	0		SPARE
SPACE		0	20A/1P	17			*	18	20A/1P	0		SPARE
SPACE		0	20A/1P	19	*			20	20A/1P	0		SPARE
SPACE		0	20A/1P	21		*		22	20A/1P	0		SPARE
SPACE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPACE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPACE		0	20A/1P	27		*		28	20A/1P	3200	0	LTG-PHASE2
SPACE		0	20A/1P	29			*	30	20A/1P	3200	0	LTG-PHASE2
SPACE		0	20A/1P	31	*			32	20A/1P	3200	0	LTG-PHASE2
SPACE		0	20A/1P	33		*		34	20A/1P	3200	0	LTG-PHASE2
SPACE		0	20A/1P	35			*	36	20A/1P	3200	0	LTG-PHASE2
SPACE		0	20A/1P	37	*			38	20A/1P	3200	0	LTG-PHASE2
SPACE		0	20A/1P	39		*		40	20A/1P	3200	0	LTG-PHASE2
SPACE		0	20A/1P	41			*	42	20A/1P	3200	0	LTG-PHASE2

CONNECTED LOAD (KW) - A Ph.	15.81	TOTAL DESIGN LOAD (KW)	69.39
CONNECTED LOAD (KW) - B Ph.	13.21	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	15.40	TOTAL DESIGN LOAD (AMPS)	93

3LNH1

Sizing Feeder

Spare(s) Contributio	55	(# of Spares*Breaker Size*0.25)
Design Ampacity	93	
Total	148	
OCPD	200	

Sets	1
Wire Size	
Phase	3/0
Neutral	3/0
"Table 250.122" Ground	6
Wire Area (table 5, sq. in.)	
Each Phase	0.2679
Total -Phase Conductors	0.8037
Neutral	0.2679
Ground	0.0507
Total Area	1.1223
Min. Conduit Area (above *2.5)	2.80575
Conduit Size (table 4)	2"
Conduit Size (table C.2)	2"
Remarks	

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					3LNH1	Panel Location:			ELEC. RM. 328		
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	LTG-LAB	3	306	3702	w		3702	4113		
2	A	LTG-FAÇADE		North End	300	w		300	333		
3	B	LTG	3	310	2500	w		2500	2778		
4	B	LTG-FACADE		South End	300	w		300	333		
5	C	LTG	3	320	3200	w		3200	3556		
6	C	SPARE			0	w		0	0		
7	A	LTG	3	CORR	2800	w		2800	3111		
8	A	SPARE			0	w		0	0		
9	B	LTG-ATRIUM	3	C301	806	w		806	896		
10	B	SPARE			0	w		0	0		
11	C	LTG - OFFICE	3	319	2600	w		2600	2889		
12	C	SPARE				w		0	0		
13	A	LTG-ATRIUM	4	C301	2604	w		2604	2893		
14	A	SPARE			0	w		0	0		
15	B	SPACE				w		0	0		
16	B	SPARE			0	w		0	0		
17	C	SPACE			0	w		0	0		
18	C	SPARE			0	w		0	0		
19	A	SPACE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	SPACE			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	SPACE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPACE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPACE			0	w		0	0		
28	B	LTG-PHASE2	3		3200	w		3200	3556		
29	C	SPACE			0	w		0	0		
30	C	LTG-PHASE2	3		3200	w		3200	3556		
31	A	SPACE			0	w		0	0		
32	A	LTG-PHASE2	3		3200	w		3200	3556		
33	B	SPACE			0	w		0	0		
34	B	LTG-PHASE2	3		3200	w		3200	3556		
35	C	SPACE			0	w		0	0		
36	C	LTG-PHASE2	3		3200	w		3200	3556		
37	A	SPACE			0	w		0	0		
38	A	LTG-PHASE2	3		3200	w		3200	3556		
39	B	SPACE			0	w		0	0		
40	B	LTG-PHASE2	3		3200	w		3200	3556		
41	C	SPACE			0	w		0	0		
42	C	LTG-PHASE2	3		3200	w		3200	3556		
PANEL TOTAL								44.4	49.3	Amps=	59.4

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					15.8	17.6	36%	63.4
PHASE TOTAL	B					13.2	14.7	30%	53.0
PHASE TOTAL	C					15.4	16.8	34%	60.5

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		41.2	45.8	1.25	51.5	57.2	0.90		
4	HID lighting		2.6	2.9	1.25	3.3	3.6	0.90		
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		0.6	0.7	1.25	0.8	0.8	0.90		
Total Demand Loads						55.5	61.7			
Spare Capacity			25%			13.9	15.4			
Total Design Loads						69.4	77.1	0.90	Amps=	92.8

Default Power Factor =	0.90
Default Demand Factor =	100 %

See Appendix B for lighting plans and Appendix C for associated equipment.

GENETICS TEACHING LAB

See existing copy of panel 3LNH1 and new panel 3LNH1 above for updated normal branch circuits and panelboard. The circuit for the teaching lab is in position one. The teaching lab also had minor loads on panel PPSH1 which were removed, see panel below.

PANEL PPSH1 VOLTAGE 480 / 277 PH 3 WIRE 4 6/26/2009 11:04 AM

LOCATION PENTHOUSE FED FROM BPSH1

LOAD	LOAD, KW					CIRC	SEQUENCE 3Ø			CIRC			LOAD, KW			LOAD
	LIGHT	RCPT	O/M	A	P	#	A	B	C	#	P	A	LIGHT	RCPT	O/M	
AHU-2 (125 HP) VSD			35.0	225	3		36.3				1	20	1.3			PENTHOUSE P001
-			35.0	-	-	1		36.4		2	1	20	1.4			3RD FLOOR LIGHTING
-			35.0	-	-				36.5		1	20	1.5			2ND FLOOR LIGHTING
							0.8				3	15			0.8	EF-3 (2 HP)
						3		0.8		4	-	-			0.8	-
									0.8		-	-			0.8	-
PLSL1 (P-TS1)	0.0	2.0	0.0	30	3		2.0				3	15				EF-4 (2 HP) BACKUP TO EF-3
-	0.0	1.2	0.0	-	-	5		1.2		6	-	-				-
-	0.0	0.0	0.5	-	-				0.5		-	-				-
SERVICE ELEVATOR **********			14.4	100	3		23.3				3	80			8.9	SEF-1 (30 HP)
EST 50 HP			14.4	-	-	7		23.3		8	-	-			8.9	-
-			14.4	-	-				23.3		-	-			8.9	-
							8.9				3	80			8.9	SEF-2 (30 HP)
						9		8.9		10	-	-			8.9	-
									8.9		-	-			8.9	-
							27.5				3	200			27.5	LEF-1 (100 HP) VSD
						11		27.5		12	-	-			27.5	-
									27.5		-	-			27.5	-
							1.3				3	30	0.0	0.8	0.5	PLSL2 (P-TS2)
						13		1.7		14	-	-	0.0	1.2	0.5	-
									1.2		-	-	0.0	1.2	0.0	-
SUB-TOTAL, CL, KW	0.0	3.2	148.7				100	100	99				4.2	3.2	139.3	SUB-TOTAL, CL, KW
SECTION 2, CL, KW	0.0	0.0	0.0													

LOAD TYPE	CONNECTED LOAD (kW) PH A	PH B	PH C	DEMAND FACTOR	DEMAND LOAD (kW) PH A	PH B	PH C
LIGHTING	1.3	1.4	1.5	1.0	1.3	1.4	1.5
RECEPTACLES	2.8	2.4	1.2	0.5	1.4	1.2	0.6
MOTORS/OTHER	96.0	96.0	96.0	0.8	76.8	76.8	76.8
TOTAL	100.1	99.8	98.7		79.5	79.4	78.9

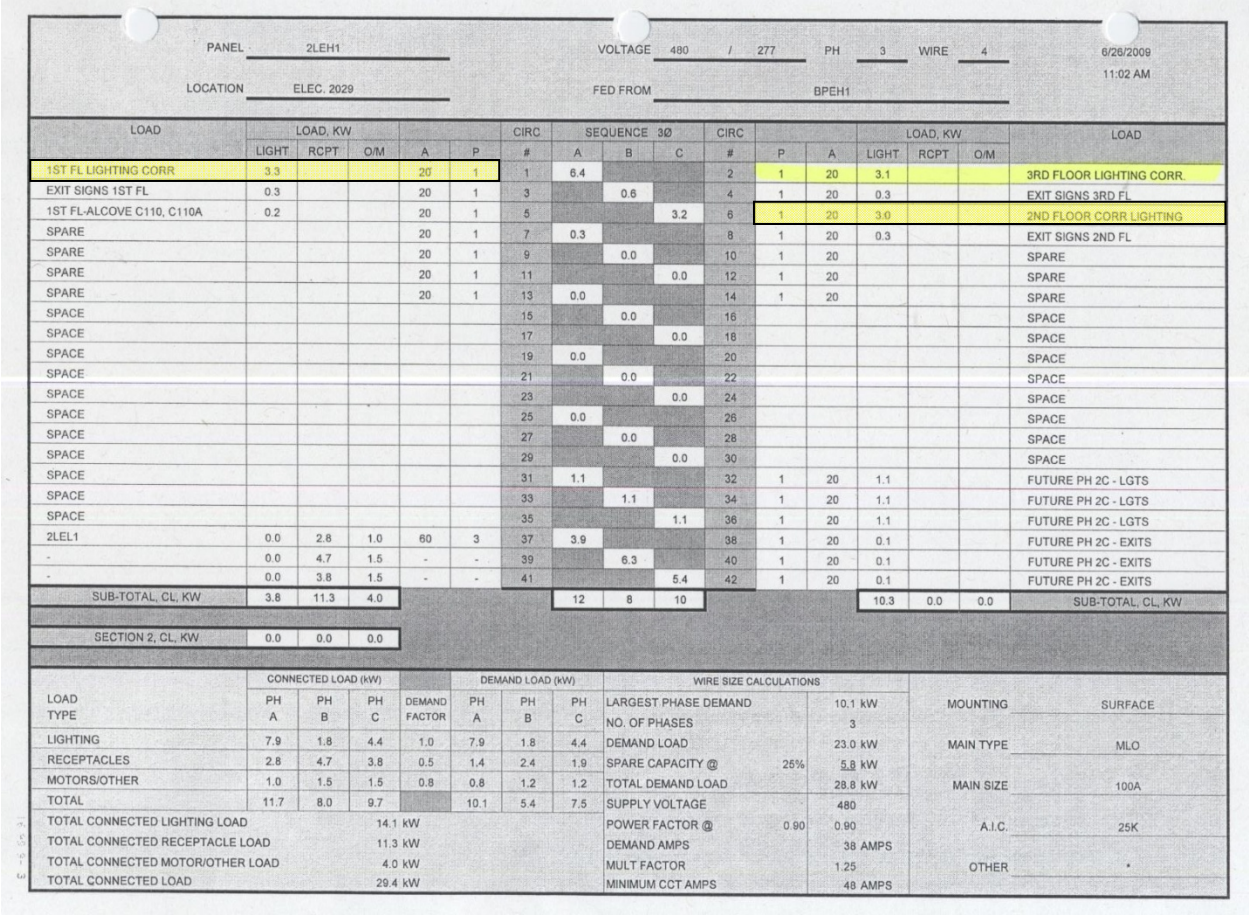
TOTAL CONNECTED LIGHTING LOAD	4.2 kW
TOTAL CONNECTED RECEPTACLE LOAD	6.4 kW
TOTAL CONNECTED MOTOR/OTHER LOAD	288.0 kW
TOTAL CONNECTED LOAD	298.6 kW

WIRE SIZE CALCULATIONS		
LARGEST PHASE DEMAND		79.5 kW
NO. OF PHASES		3
DEMAND LOAD		237.8 kW
SPARE CAPACITY @	10%	23.8 kW
TOTAL DEMAND LOAD		261.6 kW
SUPPLY VOLTAGE		480
POWER FACTOR @	0.90	0.90
DEMAND AMPS		350 AMPS
MULT FACTOR		1.25
MINIMUM CCT AMPS		438 AMPS

MOUNTING	SURFACE
MAIN TYPE	MLO
MAIN SIZE	600
A.I.C.	35K
OTHER	*

ATRIUM

THIRD LEVEL: Existing loads on 3LNH1 (ckts. 9, 13, and 15) for the general corridor lighting and ceiling uplighting have been edited and relocated. See above for 3LNH1 and below for panel 2LEH1.



PANEL 2LEH1 VOLTAGE 480 / 277 PH 3 WIRE 4 6/26/2009 11:02 AM

LOCATION ELEC. 2029 FED FROM BPEH1

LOAD	LOAD, KW					CIRC	SEQUENCE 3Ø			CIRC			LOAD, KW			LOAD
	LIGHT	RCPT	O/M	A	P	#	A	B	C	#	P	A	LIGHT	RCPT	O/M	
1ST FL LIGHTING CORR	3.3			20	1	1	6.4			2	1	20	3.1			3RD FLOOR LIGHTING CORR.
EXIT SIGNS 1ST FL	0.3			20	1	3		0.6		4	1	20	0.3			EXIT SIGNS 3RD FL
1ST FL-ALCOVE C110, C110A	0.2			20	1	5			3.2	6	1	20	3.0			2ND FLOOR CORR LIGHTING
SPARE				20	1	7	0.3			8	1	20	0.3			EXIT SIGNS 2ND FL
SPARE				20	1	9		0.0		10	1	20				SPARE
SPARE				20	1	11			0.0	12	1	20				SPARE
SPARE				20	1	13	0.0			14	1	20				SPARE
SPACE						15		0.0		16						SPACE
SPACE						17			0.0	18						SPACE
SPACE						19	0.0			20						SPACE
SPACE						21		0.0		22						SPACE
SPACE						23			0.0	24						SPACE
SPACE						25	0.0			26						SPACE
SPACE						27		0.0		28						SPACE
SPACE						29			0.0	30						SPACE
SPACE						31	1.1			32	1	20	1.1			FUTURE PH 2C - LGTS
SPACE						33		1.1		34	1	20	1.1			FUTURE PH 2C - LGTS
SPACE						35			1.1	36	1	20	1.1			FUTURE PH 2C - LGTS
2LEL1	0.0	2.8	1.0	60	3	37	3.9			38	1	20	0.1			FUTURE PH 2C - EXITS
-	0.0	4.7	1.5	-	-	39		6.3		40	1	20	0.1			FUTURE PH 2C - EXITS
-	0.0	3.8	1.5	-	-	41			5.4	42	1	20	0.1			FUTURE PH 2C - EXITS
SUB-TOTAL, CL, KW	3.8	11.3	4.0				12	8	10				10.3	0.0	0.0	SUB-TOTAL, CL, KW
SECTION 2, CL, KW	0.0	0.0	0.0													

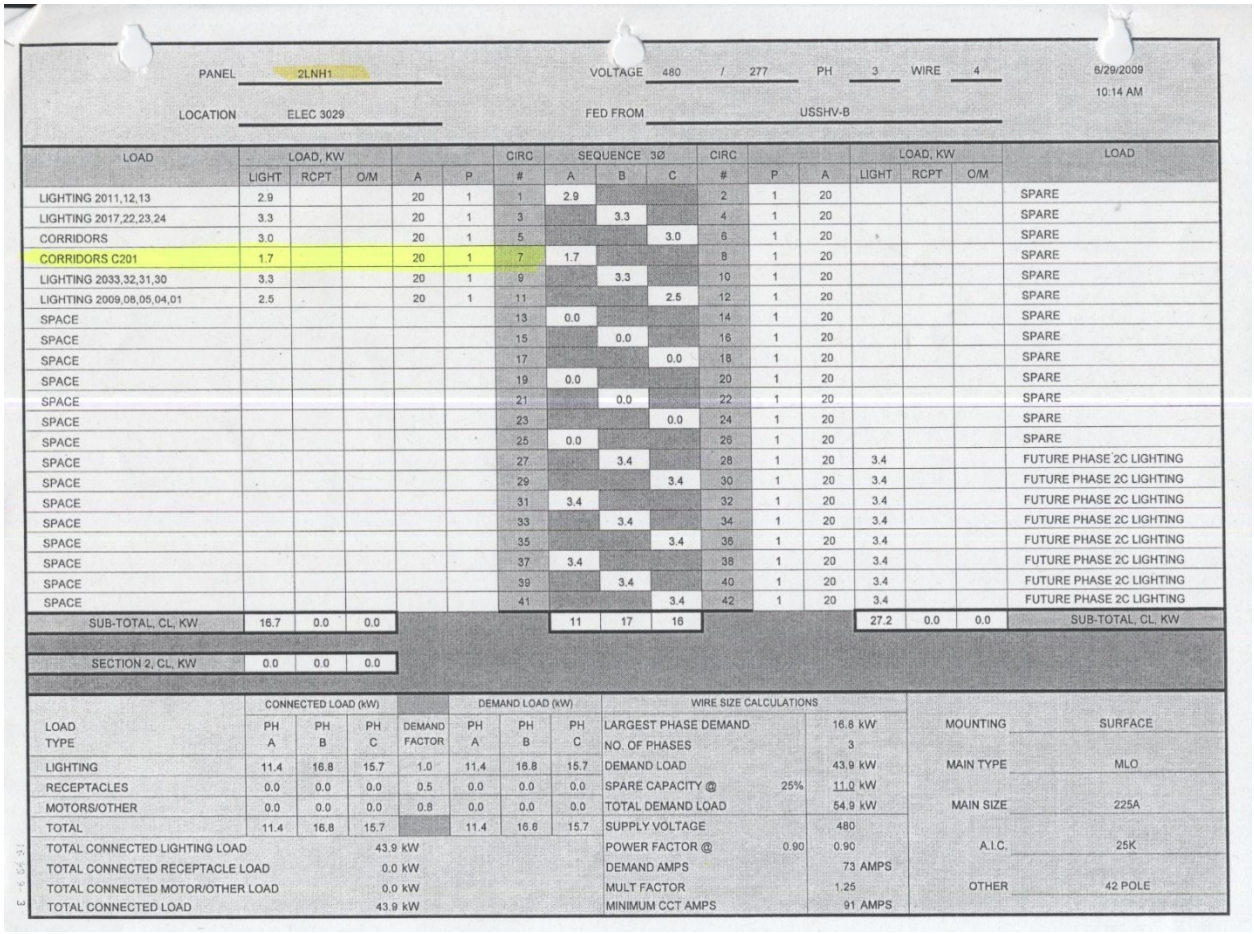
LOAD TYPE	CONNECTED LOAD (kW) PH A	PH B	PH C	DEMAND FACTOR	DEMAND LOAD (kW) PH A	PH B	PH C
LIGHTING	7.9	1.8	4.4	1.0	7.9	1.8	4.4
RECEPTACLES	2.8	4.7	3.8	0.5	1.4	2.4	1.9
MOTORS/OTHER	1.0	1.5	1.5	0.8	0.8	1.2	1.2
TOTAL	11.7	8.0	9.7		10.1	5.4	7.5

WIRE SIZE CALCULATIONS		
LARGEST PHASE DEMAND		10.1 kW
NO. OF PHASES		3
DEMAND LOAD		23.0 kW
SPARE CAPACITY @	25%	5.8 kW
TOTAL DEMAND LOAD		28.8 kW
SUPPLY VOLTAGE		480
POWER FACTOR @	0.90	0.90
DEMAND AMPS		38 AMPS
MULT FACTOR		1.25
MINIMUM CCT AMPS		48 AMPS

TOTAL CONNECTED LIGHTING LOAD	14.1 kW
TOTAL CONNECTED RECEPTACLE LOAD	11.3 kW
TOTAL CONNECTED MOTOR/OTHER LOAD	4.0 kW
TOTAL CONNECTED LOAD	29.4 kW

MOUNTING	SURFACE
MAIN TYPE	MLO
MAIN SIZE	100A
A.I.C.	25K
OTHER	*

SECOND LEVEL: Existing loads on 2LNH1 and 2LEH1 were updated for new lighting design.



PANEL 2LNH1 VOLTAGE 480 / 277 PH 3 WIRE 4 6/29/2009 10:14 AM

LOCATION ELEC 3029 FED FROM USSHV-B

LOAD	LOAD, KW					CIRC	SEQUENCE 3Ø			CIRC			LOAD, KW			LOAD
	LIGHT	RCPT	O/M	A	P	#	A	B	C	#	P	A	LIGHT	RCPT	O/M	
LIGHTING 2011,12,13	2.9			20	1	1	2.9			2	1	20				SPARE
LIGHTING 2017,22,23,24	3.3			20	1	3		3.3		4	1	20				SPARE
CORRIDORS	3.0			20	1	5			3.0	6	1	20				SPARE
CORRIDORS C201	1.7			20	1	7	1.7			8	1	20				SPARE
LIGHTING 2033,32,31,30	3.3			20	1	9		3.3		10	1	20				SPARE
LIGHTING 2009,08,05,04,01	2.5			20	1	11			2.5	12	1	20				SPARE
SPACE						13	0.0			14	1	20				SPARE
SPACE						15		0.0		16	1	20				SPARE
SPACE						17			0.0	18	1	20				SPARE
SPACE						19	0.0			20	1	20				SPARE
SPACE						21		0.0		22	1	20				SPARE
SPACE						23			0.0	24	1	20				SPARE
SPACE						25	0.0			26	1	20				SPARE
SPACE						27		3.4		28	1	20	3.4			FUTURE PHASE 2C LIGHTING
SPACE						29			3.4	30	1	20	3.4			FUTURE PHASE 2C LIGHTING
SPACE						31	3.4			32	1	20	3.4			FUTURE PHASE 2C LIGHTING
SPACE						33		3.4		34	1	20	3.4			FUTURE PHASE 2C LIGHTING
SPACE						35			3.4	36	1	20	3.4			FUTURE PHASE 2C LIGHTING
SPACE						37	3.4			38	1	20	3.4			FUTURE PHASE 2C LIGHTING
SPACE						39		3.4		40	1	20	3.4			FUTURE PHASE 2C LIGHTING
SPACE						41			3.4	42	1	20	3.4			FUTURE PHASE 2C LIGHTING
SUB-TOTAL, CL, KW	16.7	0.0	0.0				11	17	16				27.2	0.0	0.0	SUB-TOTAL, CL, KW
SECTION 2, CL, KW	0.0	0.0	0.0													

LOAD TYPE	CONNECTED LOAD (kW) PH A	PH B	PH C	DEMAND FACTOR	DEMAND LOAD (kW) PH A	PH B	PH C
LIGHTING	11.4	16.8	15.7	1.0	11.4	16.8	15.7
RECEPTACLES	0.0	0.0	0.0	0.5	0.0	0.0	0.0
MOTORS/OTHER	0.0	0.0	0.0	0.8	0.0	0.0	0.0
TOTAL	11.4	16.8	15.7		11.4	16.8	15.7

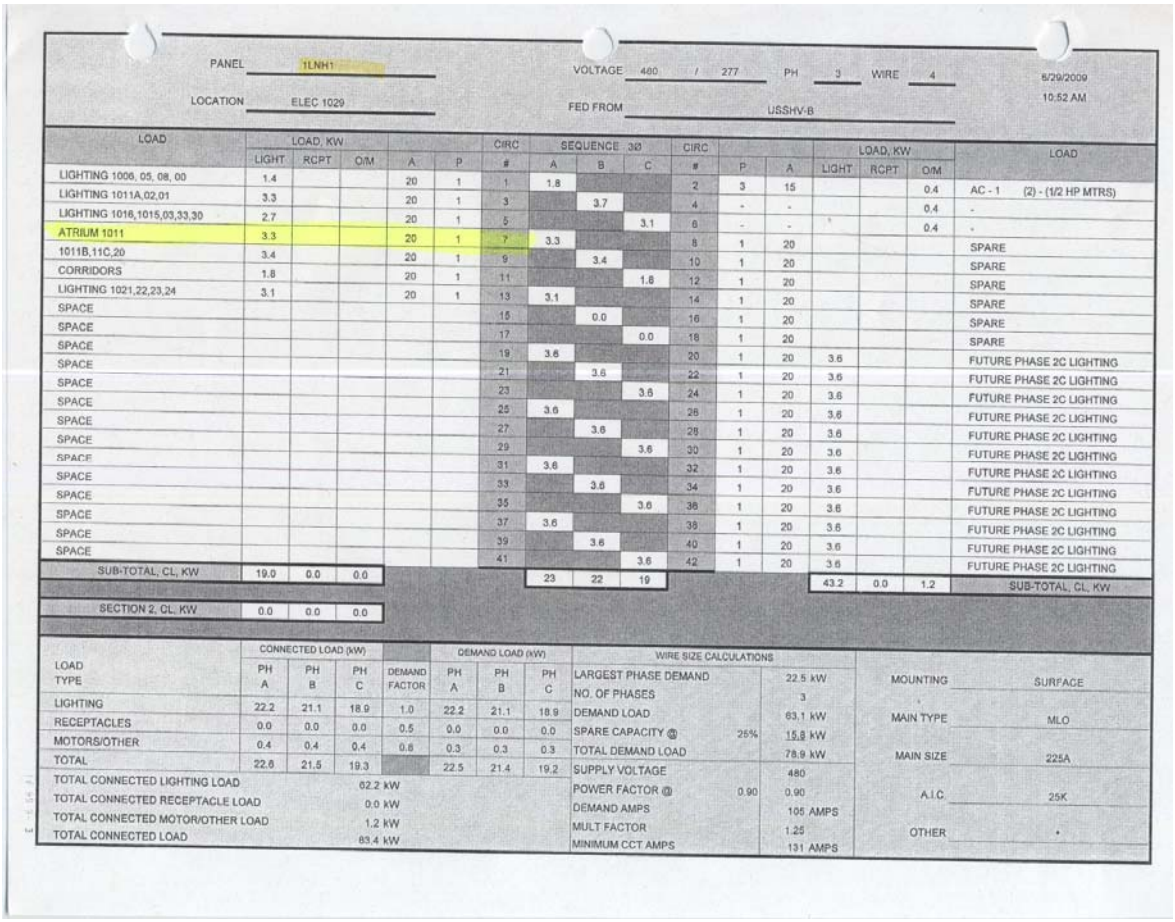
WIRE SIZE CALCULATIONS		
LARGEST PHASE DEMAND		16.8 kW
NO. OF PHASES		3
DEMAND LOAD		43.9 kW
SPARE CAPACITY @	25%	11.0 kW
TOTAL DEMAND LOAD		54.9 kW
SUPPLY VOLTAGE		480
POWER FACTOR @	0.90	0.90
DEMAND AMPS		73 AMPS
MULT FACTOR		1.25
MINIMUM CCT AMPS		91 AMPS

TOTAL CONNECTED LIGHTING LOAD	43.9 kW
TOTAL CONNECTED RECEPTACLE LOAD	0.0 kW
TOTAL CONNECTED MOTOR/OTHER LOAD	0.0 kW
TOTAL CONNECTED LOAD	43.9 kW

MOUNTING	SURFACE
MAIN TYPE	MLO
MAIN SIZE	225A
A.I.C.	25K
OTHER	42 POLE

LEVEL ONE: Existing loads on 1LNH1 and 2LEH1 were updated.

EXTERIOR: All lighting designed for the exterior has been added to 2LEH1 and 3LNH1.



PANEL 1LNH1 VOLTAGE 480 / 277 PH 3 WIRE 4 5/29/2009 10:52 AM

LOCATION ELEC 1029 FED FROM USSHV-B

LOAD	LOAD, KW LIGHT	RCPT	O/M	CIRC A	CIRC P	CIRC #	SEQUENCE 3Ø A	B	C	CIRC #	CIRC P	CIRC A	LOAD, KW LIGHT	RCPT	O/M	LOAD
LIGHTING 1006, 05, 08, 00	1.4			20	1	1	1.8			2	3	15			0.4	AC - 1 (2) - (1/2 HP MTRS)
LIGHTING 1011A,02,01	3.3			20	1	3		3.7		4	-	-			0.4	-
LIGHTING 1016,1015,03,33,30	2.7			20	1	5			3.1	6	-	-			0.4	-
ATRIUM 1011	3.3			20	1	7	3.3			8	1	20				SPARE
1011B,11C,20	3.4			20	1	9		3.4		10	1	20				SPARE
CORRIDORS	1.8			20	1	11			1.8	12	1	20				SPARE
LIGHTING 1021,22,23,24	3.1			20	1	13	3.1			14	1	20				SPARE
SPACE						15		0.0		16	1	20				SPARE
SPACE						17			0.0	18	1	20				SPARE
SPACE						19	3.6			20	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						21		3.6		22	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						23			3.6	24	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						25	3.6			26	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						27		3.6		28	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						29			3.6	30	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						31	3.6			32	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						33		3.6		34	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						35			3.6	36	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						37	3.6			38	1	20	3.6			FUTURE PHASE 2C LIGHTING
SPACE						39		3.6		40	1	20	3.6			FUTURE PHASE 2C LIGHTING
						41			3.6	42	1	20	3.6			FUTURE PHASE 2C LIGHTING
SUB-TOTAL, CL, KW	19.0	0.0	0.0				23	22	19				43.2	0.0	1.2	SUB-TOTAL, CL, KW
SECTION 2, CL, KW	0.0	0.0	0.0													

LOAD TYPE	CONNECTED LOAD (kW) PH A	PH B	PH C	DEMAND FACTOR	DEMAND LOAD (kW) PH A	PH B	PH C
LIGHTING	22.2	21.1	18.9	1.0	22.2	21.1	18.9
RECEPTACLES	0.0	0.0	0.0	0.5	0.0	0.0	0.0
MOTORS/OTHER	0.4	0.4	0.4	0.8	0.3	0.3	0.3
TOTAL	22.6	21.5	19.3		22.5	21.4	19.2

TOTAL CONNECTED LIGHTING LOAD	62.2 kW
TOTAL CONNECTED RECEPTACLE LOAD	0.0 kW
TOTAL CONNECTED MOTOR/OTHER LOAD	1.2 kW
TOTAL CONNECTED LOAD	63.4 kW

WIRE SIZE CALCULATIONS		
LARGEST PHASE DEMAND		22.5 kW
NO. OF PHASES		3
DEMAND LOAD		63.1 kW
SPARE CAPACITY @	25%	15.8 kW
TOTAL DEMAND LOAD		78.9 kW
SUPPLY VOLTAGE		480
POWER FACTOR @	0.90	0.90
DEMAND AMPS		105 AMPS
MULT FACTOR		1.25
MINIMUM CCT AMPS		131 AMPS

MOUNTING	SURFACE
MAIN TYPE	MLO
MAIN SIZE	225A
A.I.C.	25K
OTHER	-

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	2LEH1	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	SECOND FLOOR	OPTIONS:	
SIZE/TYPE MAIN:	125A/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
LTG-1ST FLOOR	CORR	2750	20A/1P	1	*			2	20A/1P	2600	ATR CORR	LTG-3RD FLOOR
EXIT SIGNS	1ST FL	300	20A/1P	3		*		4	20A/1P	300	3RD FL	EXIT SIGNS
LTG-ALCOVE	1ST FL	200	20A/1P	5			*	6	20A/1P	2449	2ND FL	LTG-CORR
LTG-CORR	1ST FL	114	20A/1P	7	*			8	20A/1P	300	2ND FL	EXIT SIGNS
LTG-GRNDS	Exterior	577	20A/1P	9		*		10	20A/1P	0		SPARE
SPARE		0	20A/1P	11			*	12	20A/1P	0		SPARE
SPARE		0	20A/1P	13	*			14	20A/1P	0		SPARE
SPACE		0	20A/1P	15		*		16	20A/1P	0		SPACE
SPACE		0	20A/1P	17			*	18	20A/1P	0		SPACE
SPACE		0	20A/1P	19	*			20	20A/1P	0		SPACE
SPACE		0	20A/1P	21		*		22	20A/1P	0		SPACE
SPACE		0	20A/1P	23			*	24	20A/1P	0		SPACE
SPACE		0	20A/1P	25	*			26	20A/1P	0		SPACE
SPACE		0	20A/1P	27		*		28	20A/1P	0		SPACE
SPACE		0	20A/1P	29			*	30	20A/1P	0		SPACE
SPACE		0	20A/1P	31	*			32	20A/1P	1100	FUTURE	PHASE 2 LTG
SPACE		0	20A/1P	33		*		34	20A/1P	1100	FUTURE	PHASE 2 LTG
SPACE		0	20A/1P	35			*	36	20A/1P	1100	FUTURE	PHASE 2 LTG
2LEL1	-	3800	60A/3P	37	*			38	20A/1P	1100	FUTURE	PHASE 2 LTG
-	-	6200	-	39		*		40	20A/1P	1100	FUTURE	PHASE 2 LTG
-	-	5300	-	41			*	42	20A/1P	1100	FUTURE	PHASE 2 LTG

CONNECTED LOAD (KW) - A Ph.	11.76	TOTAL DESIGN LOAD (KW)	44.14
CONNECTED LOAD (KW) - B Ph.	9.58	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	10.15	TOTAL DESIGN LOAD (AMPS)	59

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				2LEH1	Panel Location:			SECOND FLOOR			
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	LTG-1ST FLOOR	3	CORR	2750	w	0.90	2750	3056		
2	A	LTG-3RD FLOOR	3	ATR CORR	2600	w	0.90	2600	2889		
3	B	EXIT SIGNS	9	1ST FL	300	w	0.90	300	333		
4	B	EXIT SIGNS	9	3RD FL	300	w	0.90	300	333		
5	C	LTG-ALCOVE	3	1ST FL	200	w	0.90	200	222		
6	C	LTG-CORR	3	2ND FL	2449	w	0.90	2449	2721		
7	A	LTG-CORR	3	1ST FL	114	w	0.90	114	127		
8	A	EXIT SIGNS	9	2ND FL	300	w	0.90	300	333		
9	B	LTG-GRNDS	3	Exterior	577	w	0.90	577	641		
10	B	SPARE			0	w	0.90	0	0		
11	C	SPARE			0	w	0.90	0	0		
12	C	SPARE			0	w	0.90	0	0		
13	A	SPARE			0	w	0.90	0	0		
14	A	SPARE			0	w	0.90	0	0		
15	B	SPACE			0	w	0.90	0	0		
16	B	SPACE			0	w	0.90	0	0		
17	C	SPACE			0	w	0.90	0	0		
18	C	SPACE			0	w	0.90	0	0		
19	A	SPACE			0	w	0.90	0	0		
20	A	SPACE			0	w	0.90	0	0		
21	B	SPACE			0	w	0.90	0	0		
22	B	SPACE			0	w	0.90	0	0		
23	C	SPACE			0	w	0.90	0	0		
24	C	SPACE			0	w	0.90	0	0		
25	A	SPACE			0	w	0.90	0	0		
26	A	SPACE			0	w	0.90	0	0		
27	B	SPACE			0	w	0.90	0	0		
28	B	SPACE			0	w	0.90	0	0		
29	C	SPACE			0	w	0.90	0	0		
30	C	SPACE			0	w	0.90	0	0		
31	A	SPACE			0	w	0.90	0	0		
32	A	PHASE 2 LTG	3	FUTURE	1100	w	0.90	1100	1222		
33	B	SPACE			0	w	0.90	0	0		
34	B	PHASE 2 LTG	3	FUTURE	1100	w	0.90	1100	1222		
35	C	SPACE			0	w	0.90	0	0		
36	C	PHASE 2 LTG	3	FUTURE	1100	w	0.90	1100	1222		
37	A	2LEL1	1	-	3800	w	0.90	3800	4222		
38	A	PHASE 2 LTG	3	FUTURE	1100	w	0.90	1100	1222		
39	B	-	1	-	6200	w	0.90	6200	6889		
40	B	PHASE 2 LTG	3	FUTURE	1100	w	0.90	1100	1222		
41	C	-	1	-	5300	w	0.90	5300	5889		
42	C	PHASE 2 LTG	3	FUTURE	1100	w	0.90	1100	1222		
PANEL TOTAL								31.5	35.0	Amps=	42.1

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	11.8	13.1	38%	47.2
PHASE TOTAL	B	9.6	10.6	31%	38.4
PHASE TOTAL	C	10.1	10.6	31%	38.1

LOAD CATAGORIES		Connected			Demand				Ver. 104
		kW	kVA	DF	kW	kVA	PF		
1	receptacles	15.3	17.0	1.00	15.3	17.0	0.90		
2	computers	0.0	0.0		0.0	0.0			
3	fluorescent lighting	15.3	17.0	1.25	19.1	21.2	0.90		
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	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	0.9	1.0		0.9	1.0	0.90		
Total Demand Loads					35.3	39.2			
Spare Capacity		25%			8.8	9.8			
Total Design Loads					44.1	49.0	0.90	Amps=	59.0

Default Power Factor =	0.90
Default Demand Factor =	100 %

2LEH1

Sizing Feeder

Spares	35	(# of Spares*Breaker Size*0.25)
Design Ampacity	59	
Total	94	

OCPD	125

Sets	1
Wire Size	
Phase	1
Neutral	1
"Table 250.122" Ground	6
Wire Area (table 5, sq. in.)	
Each Phase	0.1562
Total -Phase Conductors	0.4686
Neutral	0.1562
Ground	0.0507
Total Area	0.6755
Min. Conduit Area (above *2.5)	1.68875
Conduit Size (table 4)	1.5"
Conduit Size (table C.2)	1.5"
Remarks	

PANELBOARD SCHEDULE

VOLTAGE:	480Y/208V,3PH,4W	PANEL TAG:	2LNH1	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	ELEC. RM. 227	OPTIONS:	
SIZE/TYPE MAIN:	200A/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
LTG-2nd Floor	Classrooms	2900	20A/1P	1	*			2	20A/1P	0		SPARE
LTG-2nd Floor	Classrooms	3300	20A/1P	3		*		4	20A/1P	0		SPARE
LTG-2nd Floor	Corridors	3000	20A/1P	5			*	6	20A/1P	0		SPARE
LTG-2nd Floor	Atrium	600	20A/1P	7	*			8	20A/1P	0		SPARE
LTG-2nd Floor	Classrooms	3300	20A/1P	9		*		10	20A/1P	0		SPARE
LTG-2nd Floor	Classrooms	2500	20A/1P	11			*	12	20A/1P	0		SPARE
SPACE		0	20A/1P	13	*			14	20A/1P	0		SPARE
SPACE		0	20A/1P	15		*		16	20A/1P	0		SPARE
SPACE		0	20A/1P	17			*	18	20A/1P	0		SPARE
SPACE		0	20A/1P	19	*			20	20A/1P	0		SPARE
SPACE		0	20A/1P	21		*		22	20A/1P	0		SPARE
SPACE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPACE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPACE		0	20A/1P	27		*		28	20A/1P	3400	PHASE 2	LTG
SPACE		0	20A/1P	29			*	30	20A/1P	3400	PHASE 2	LTG
SPACE		0	20A/1P	31	*			32	20A/1P	3400	PHASE 2	LTG
SPACE		0	20A/1P	33		*		34	20A/1P	3400	PHASE 2	LTG
SPACE		0	20A/1P	35			*	36	20A/1P	3400	PHASE 2	LTG
SPACE		0	20A/1P	37	*			38	20A/1P	3400	PHASE 2	LTG
SPACE		0	20A/1P	39		*		40	20A/1P	3400	PHASE 2	LTG
SPACE		0	20A/1P	41			*	42	20A/1P	3400	PHASE 2	LTG

CONNECTED LOAD (KW) - A Ph.	10.30	TOTAL DESIGN LOAD (KW)	66.88
CONNECTED LOAD (KW) - B Ph.	16.80	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	15.70	TOTAL DESIGN LOAD (AMPS)	89

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					2LNH1	Panel Location:			ELEC. RM. 227		
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	LTG-2nd Floor	3	Classrooms	2900	w		2900	3222		
2	A	SPARE			0	w		0	0		
3	B	LTG-2nd Floor	3	Classrooms	3300	w		3300	3667		
4	B	SPARE			0	w		0	0		
5	C	LTG-2nd Floor	3	Corridors	3000	w		3000	3333		
6	C	SPARE			0	w		0	0		
7	A	LTG-2nd Floor	3	Atrium	600	w		600	667		
8	A	SPARE			0	w		0	0		
9	B	LTG-2nd Floor	3	Classrooms	3300	w		3300	3667		
10	B	SPARE			0	w		0	0		
11	C	LTG-2nd Floor	3	Classrooms	2500	w		2500	2778		
12	C	SPARE			0	w		0	0		
13	A	SPACE			0	w		0	0		
14	A	SPARE			0	w		0	0		
15	B	SPACE			0	w		0	0		
16	B	SPARE			0	w		0	0		
17	C	SPACE			0	w		0	0		
18	C	SPARE			0	w		0	0		
19	A	SPACE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	SPACE			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	SPACE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPACE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPACE			0	w		0	0		
28	B	LTG	3	PHASE 2	3400	w		3400	3778		
29	C	SPACE			0	w		0	0		
30	C	LTG	3	PHASE 2	3400	w		3400	3778		
31	A	SPACE			0	w		0	0		
32	A	LTG	3	PHASE 2	3400	w		3400	3778		
33	B	SPACE			0	w		0	0		
34	B	LTG	3	PHASE 2	3400	w		3400	3778		
35	C	SPACE			0	w		0	0		
36	C	LTG	3	PHASE 2	3400	w		3400	3778		
37	A	SPACE			0	w		0	0		
38	A	LTG	3	PHASE 2	3400	w		3400	3778		
39	B	SPACE			0	w		0	0		
40	B	LTG	3	PHASE 2	3400	w		3400	3778		
41	C	SPACE			0	w		0	0		
42	C	LTG	3	PHASE 2	3400	w		3400	3778		
PANEL TOTAL								42.8	47.6	Amps=	57.2

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL		A				10.3	11.4	24%	41.3
PHASE TOTAL		B				16.8	18.7	40%	67.4
PHASE TOTAL		C				15.7	17.1	36%	61.6

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		42.8	47.6	1.25	53.5	59.4	0.90		
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		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		0.0	0.0		0.0	0.0			
Total Demand Loads						53.5	59.4			
Spare Capacity			25%			13.4	14.9			
Total Design Loads						66.9	74.3	0.90	Amps=	89.4

Default Power Factor =	0.90	
Default Demand Factor =	100	%

2LNH1

Sizing Feeder

Spares	65	(# of Spares*Breaker Size*0.25)
Design Ampacity	89	
Total	154	
OCPD	200	

Sets	1
Wire Size	
Phase	3/0
Neutral	3/0
"Table 250.122" Ground	6
Wire Area (table 5, sq. in.)	
Each Phase	0.2679
Total -Phase Conductors	0.8037
Neutral	0.2679
Ground	0.0507
Total Area	1.1223
Min. Conduit Area (above *2.5)	2.80575
Conduit Size (table 4)	2"
Conduit Size (table C.2)	2"
Remarks	

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	1LNH1	MIN. C/B AIC:	10K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	ELEC. RM. 125	OPTIONS:	
SIZE/TYPE MAIN:	200A/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
LTG-1st Floor	Classrms	1400	20A/1P	1	*			2	20A/1P	400		AC-1
LTG-1st Floor	Classrms	3300	20A/1P	3		*		4	20A/1P	400	0	AC-1
LTG-1st Floor	Classrms	2700	20A/1P	5			*	6	20A/1P	400	0	AC-1
LTG-1st Floor	Atrium	2901	20A/1P	7	*			8	20A/1P	0		SPARE
LTG-1st Floor	Classrooms	3400	20A/1P	9		*		10	20A/1P	0		SPARE
LTG-1st Floor	Corridors	1800	20A/1P	11			*	12	20A/1P	0		SPARE
LTG-1st Floor	Classrooms	3100	20A/1P	13	*			14	20A/1P	0		SPARE
SPACE		0	20A/1P	15		*		16	20A/1P	0		SPARE
SPACE		0	20A/1P	17			*	18	20A/1P	0		SPARE
SPACE		0	20A/1P	19	*			20	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	21		*		22	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	23			*	24	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	25	*			26	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	27		*		28	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	29			*	30	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	31	*			32	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	33		*		34	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	35			*	36	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	37	*			38	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	39		*		40	20A/1P	3600	Phase-2	LTG
SPACE		0	20A/1P	41			*	42	20A/1P	3600	Phase-2	LTG

CONNECTED LOAD (KW) - A Ph.	22.20	TOTAL DESIGN LOAD (KW)	97.76
CONNECTED LOAD (KW) - B Ph.	21.50	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	19.30	TOTAL DESIGN LOAD (AMPS)	131

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				1LNH1	Panel Location:			ELEC. RM. 125				
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	LTG-1st Floor	3	Classrms	1400	w		1400	1556			
2	A	AC-1	6		400	w		400	444			
3	B	LTG-1st Floor	3	Classrms	3300	w		3300	3667			
4	B	AC-1	6		400	w		400	444			
5	C	LTG-1st Floor	3	Classrms	2700	w		2700	3000			
6	C	AC-1	6		400	w		400	444			
7	A	LTG-1st Floor	3	Atrium	2901	w		2901	3223			
8	A	SPARE			0	w		0	0			
9	B	LTG-1st Floor	3	Classrooms	3400	w		3400	3778			
10	B	SPARE			0	w		0	0			
11	C	LTG-1st Floor	3	Corridors	1800	w		1800	2000			
12	C	SPARE			0	w		0	0			
13	A	LTG-1st Floor	3	Classrooms	3100	w		3100	3444			
14	A	SPARE				w		0	0			
15	B	SPACE			0	w		0	0			
16	B	SPARE			0	w		0	0			
17	C	SPACE			0	w		0	0			
18	C	SPARE			0	w		0	0			
19	A	SPACE			0	w		0	0			
20	A	LTG	3	Phase-2	3600	w		3600	4000			
21	B	SPACE			0	w		0	0			
22	B	LTG	3	Phase-2	3600	w		3600	4000			
23	C	SPACE			0	w		0	0			
24	C	LTG	3	Phase-2	3600	w		3600	4000			
25	A	SPACE			0	w		0	0			
26	A	LTG	3	Phase-2	3600	w		3600	4000			
27	B	SPACE			0	w		0	0			
28	B	LTG	3	Phase-2	3600	w		3600	4000			
29	C	SPACE			0	w		0	0			
30	C	LTG	3	Phase-2	3600	w		3600	4000			
31	A	SPACE			0	w		0	0			
32	A	LTG	3	Phase-2	3600	w		3600	4000			
33	B	SPACE			0	w		0	0			
34	B	LTG	3	Phase-2	3600	w		3600	4000			
35	C	SPACE			0	w		0	0			
36	C	LTG	3	Phase-2	3600	w		3600	4000			
37	A	SPACE			0	w		0	0			
38	A	LTG	3	Phase-2	3600	w		3600	4000			
39	B	SPACE			0	w		0	0			
40	B	LTG	3	Phase-2	3600	w		3600	4000			
41	C	SPACE			0	w		0	0			
42	C	LTG	3	Phase-2	3600	w		3600	4000			
PANEL TOTAL								63.0	70.0	Amps=	84.2	
PHASE LOADING								kW	kVA	%	Amps	
PHASE TOTAL			A					22.2	24.7	35%	89.1	
PHASE TOTAL			B					21.5	23.9	34%	86.2	
PHASE TOTAL			C					19.3	21.0	30%	76.0	
LOAD CATAGORIES				Connected			Demand				Ver. 104	
				kW	kVA	DF	kW	kVA	PF			
1	receptacles			0.0	0.0	1.00	0.0	0.0				
2	computers			0.0	0.0		0.0	0.0				
3	fluorescent lighting			61.8	68.7	1.25	77.3	85.8	0.90			
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			1.2	1.3	0.80	1.0	1.1	0.90			
7	heating			0.0	0.0		0.0	0.0				
8	kitchen equipment			0.0	0.0		0.0	0.0				
9	unassigned			0.0	0.0		0.0	0.0				
Total Demand Loads							78.2	86.9				
Spare Capacity				25%			19.6	21.7				
Total Design Loads							97.8	108.6	0.90	Amps=	130.7	
Default Power Factor =			0.90									
Default Demand Factor =			100	%								

1LNH1

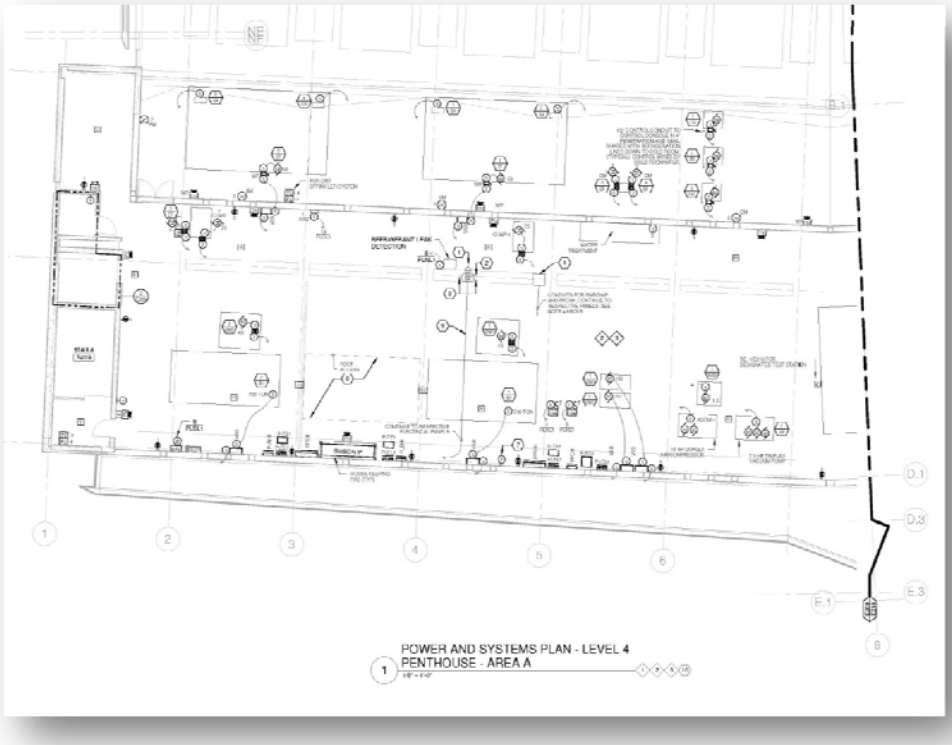
Sizing Feeder		
Spares	30	(# of Spares * Breaker Size * 0.25)
Design Ampacity	131	
Total	161	
OCPD	200	

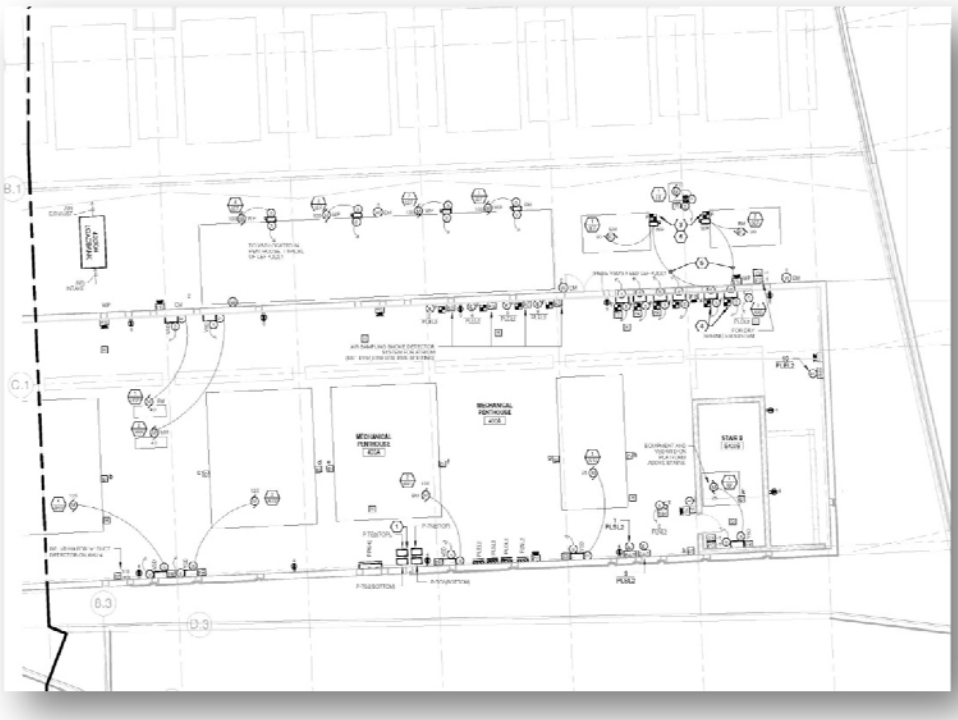
Sets	1
Wire Size	
Phase	3/0
Neutral	3/0
"Table 250.122" Ground	6
Wire Area (table 5, sq. in.)	
Each Phase	0.2679
Total -Phase Conductors	0.8037
Neutral	0.2679
Ground	0.0507
Total Area	1.1223
Min. Conduit Area (above *2.5)	2.80575
Conduit Size (table 4)	2"
Conduit Size (table C.2)	2"
Remarks	

Depth Topic 1: MCC Design

Depth Topic One includes the design and layout of a MCC (motor controller center) for the penthouse mechanical equipment as a substitute to the existing switchboard, SWBDN-P. A motor controller center design was initially proposed due to the extent of motors and mechanical equipment that are located in the penthouse. This study seeks to determine whether such a piece of equipment would be a better substitute for the existing configuration and switchboard. All equipment for the basis of the design is specified from the Allen-Bradley Centerline 2100 product series.

Images of the existing power plan and layout for the mechanical penthouse are shown in Figures 11 and 12.





FIGURES 22 + 23 – MECHANICAL PENTHOUSE POWER PLAN

The first step in this design process was to determine which loads would be housed within the MCC. First, the loads for all the mechanical equipment fed from the switchboard were calculated. Calculations provided a total motor load of 2867.9 A, with the largest motor load (the 700 Ton Chiller) being counted as 125% in accordance with the NEC. The existing switchboard has a 3000 A bus and if it were to be directly interchanged with a MCC that housed the same over current protective devices in addition to the starters for the equipment (highlighted in green in the table below), the MCC would also need a 3000A incoming feeder. The only manufacturer that could be found to regularly provide an incoming feeder bus of this size was Rockwell Automation through their Centerline MCC design. Due to the configuration of the horizontal bus, the sections have the capability to provide 300 A or 600 A above or below the horizontal bus, for a maximum 600 A or 1200 A in one section.

As a result of the design, panelboards PPNH1 and PPNH2 were removed. Their loads were primarily the mechanical motors which have been fed directly through the MCC. The remaining lighting panels in the penthouse are fed through three units: one feeder circuit breaker and two transformer units.

TABLE 13 – MCC MOTOR LOAD CALCULATIONS

MECHANICAL EQUIPMENT									
EQUIPMENT TAG	LOAD DESCRIPTION	LOAD MAGNITUDE	LOAD UNITS	MOTOR AMPS	VOLTAGE	PHASE	ASSUMED POWER FACTOR	LOAD IN KVA	LOAD IN KW
E1	AHU S-1	15	HP	46.2	208	3	0.95	11.8	11.19
E2	EXHAUST FAN EF-1	10	HP	30.8	208	3	0.95	7.85	7.46
E3	EXHAUST FAN EF-2	10	HP	30.8	208	3	0.95	7.85	7.46
E4	EXHAUST FAN EF-3	1	HP	4.6	208	3	0.85	0.88	0.75
E5	EXHAUST FAN EF-4	1/2	HP	2.4	208	3	0.85	0.44	0.37
E7	SUPPLY FAN S-9	3/4	HP	3.5	208	3	0.85	0.66	0.56
E10	EXHAUST FAN EF-5	1 1/2	HP	6.6	208	3	0.85	1.32	1.12
E13	CONDENSATE PUMP 14A	1 1/2	HP	6.6	208	3	0.85	1.32	1.12
E14	CONDENSATE PUMP 14B	1 1/2	HP	6.6	208	3	0.85	1.32	1.12
E15	CONDENSATE PUMP 16A	3/4	HP	3.5	208	3	0.85	0.66	0.56
E16	CONDENSATE PUMP 16B	3/4	HP	3.5	208	3	0.85	0.66	0.56
E17	AHU-1	10	HP	30.8	208	3	0.95	7.85	7.46
E20	RETURN FAN-1	10	HP	30.8	208	3	0.95	7.85	7.46
CRU-1	CONDENSATE RETURN UNIT	3/4	HP	3.50	480	3	0.85	0.66	0.56
CRU-2	CONDENSATE RETURN UNIT	3/4	HP	3.50	480	3	0.85	0.66	0.56
CRU-3	CONDENSATE RETURN UNIT	3/4	HP	3.50	480	3	0.85	0.66	0.56
CRU-4	CONDENSATE RETURN UNIT	3/4	HP	3.50	480	3	0.85	0.66	0.56
HWP-1	HOT WATER PUMP	75	HP	96.0	480	3	0.95	58.9	56.0
HWP-2	HOT WATER PUMP	75	HP	96.0	480	3	0.95	58.9	56.0
HRP-1	HEAT RECOVERY PUMP	40	HP	52.0	480	3	0.95	31.4	29.8
HRP-2	HEAT RECOVERY PUMP	40	HP	52.0	480	3	0.95	31.4	29.8
CT-1	COOLING TOWER FAN	40	HP	52.0	480	3	0.95	31.4	29.8
CT-2	COOLING TOWER FAN	40	HP	52.0	480	3	0.95	31.4	29.8
SH-1	CT-1 SUMP HEATER	9	KW	-	480	3	1.00	9.0	9.0
SH-2	CT-1 SUMP HEATER	9	KW	-	480	3	1.00	9.0	9.0
SH-3	CT-2 SUMP HEATER	9	KW	-	480	3	1.00	9.0	9.0
SH-4	CT-2 SUMP HEATER	9	KW	-	480	3	1.00	9.0	9.0
AHU-1	AIR HANDLING UNIT	75	HP	96.0	480	3	0.95	58.9	56.0
AHU-2	AIR HANDLING UNIT	125	HP	156	480	3	0.95	98.2	93.3
AHU-3	AIR HANDLING UNIT	125	HP	156	480	3	0.95	98.2	93.3
AHU-4	AIR HANDLING UNIT	125	HP	156	480	3	0.95	98.2	93.3
AHU-5	AIR HANDLING UNIT	10	HP	30.8	208	3	0.95	7.9	7.5
AHU-6	AIR HANDLING UNIT	1	HP	4.6	208	3	0.85	0.9	0.7
AHU-7	AIR HANDLING UNIT	1	HP	4.6	208	3	0.85	0.9	0.7
RF-1	INLINE RETURN FAN	25	HP	34.0	480	3	0.95	19.6	18.7
LEF-1	STROBIC TYPE EXHAUST FAN	100	HP	124.0	480	3	0.95	78.5	74.60
LEF-2	STROBIC TYPE EXHAUST FAN	100	HP	124.0	480	3	0.95	78.5	74.60
LEF-3	STROBIC TYPE EXHAUST FAN	100	HP	124.0	480	3	0.95	78.5	74.60
LEF-4	STROBIC TYPE EXHAUST FAN	100	HP	124.0	480	3	0.95	78.5	74.60
EF-1	EXHAUST FAN	1	HP	2.1	480	3	0.85	0.9	0.75
EF-2	EXHAUST FAN	3	HP	4.8	480	3	0.85	2.63	2.24
EF-3	EXHAUST FAN	2	HP	3.4	480	3	0.85	1.76	1.49
EF-4	EXHAUST FAN	2	HP	3.4	480	3	0.85	1.76	1.49
EF-5	EXHAUST FAN	3/4	HP	1.6	480	3	0.85	0.66	0.56
EF-6	EXHAUST FAN	15	HP	21.0	480	3	0.95	11.8	11.2
SEF-1	SMOKE EVAC FAN	30	HP	40.0	480	3	0.95	23.6	22.4
SEF-2	SMOKE EVAC FAN	30	HP	40.0	480	3	0.95	23.6	22.38
CH-1	700-TON CHILLER (.577KW/TON)	404	KW	-	480	3	0.95	425.3	404
CH-2	700-TON CHILLER (.577KW/TON)	404	KW	-	480	3	0.95	425.3	404
CWP-1	CHILLED WATER PUMP	40	HP	52.0	480	3	0.95	31.4	30
CWP-2	CHILLED WATER PUMP	40	HP	52.0	480	3	0.95	31.4	30
CLWP-1	CONDENSER WATER PUMP	75	HP	96.0	480	3	0.95	58.9	56
CLWP-2	CONDENSER WATER PUMP	75	HP	96.0	480	3	0.95	58.9	56
CWS-1	CHILLED WATER SUPPLY	150	HP	180.0	480	3	0.95	117.8	111.9
CWS-2	CHILLED WATER SUPPLY	150	HP	180.0	480	3	0.95	117.8	111.9
CR-1	COLD ROOM	10	KW	-	208	3	0.95	10.5	10.0
CR-2	COLD ROOM	10	KW	-	208	3	0.95	10.5	10.0
CR-3	COLD ROOM	10	KW	-	208	3	0.95	10.5	10.0
CR-1A	COLD ROOM	0.6	KW	-	120	1	0.9	0.67	0.60
CR-2A	COLD ROOM	0.6	KW	-	120	1	0.9	0.67	0.60
CR-3A	COLD ROOM	0.6	KW	-	120	1	0.9	0.67	0.60
A/C-1A	MAIN TELECOM ROOM A/C	69.8	FLA	-	208	3	0.95	26.5	25.1
A/C-1B	MAIN TELECOM ROOM A/C	69.8	FLA	-	208	3	0.95	26.5	25.1
A/C-2	NMR	7.2	FLA	-	208	3	0.85	3.1	2.6
A/C-3	XRD	7.2	FLA	-	208	3	0.85	3.1	2.6
ACCU-1A	MAIN TELECOM ROOM A/C	4.8	FLA	-	208	3	0.85	2.0	1.7
ACCU-1B	MAIN TELECOM ROOM A/C	4.8	FLA	-	208	3	0.85	2.0	1.7
ACCU-2	NMR	11.4	FLA	-	208	3	0.85	4.8	4.1
ACCU-3	XRD	11.4	FLA	-	208	3	0.85	4.8	4.1
ACCU-4	*SEE E7	-	-	-	208	3	-	-	-
FIRE PUMP	FIRE PUMP	40	HP	52.0	480	3	0.95	31.41	29.84
JOCKY	JOCKEY PUMP	3	HP	4.8	480	3	0.85	2.63	2.24
FOP-1	FUEL OIL PUMPS	1/2	HP	1.1	480	3	0.85	0.44	0.37
FOP-2	FUEL OIL PUMPS	1/2	HP	1.1	480	3	0.85	0.44	0.37
DI SYS A	DI WATER SYSTEM	1 1/2	HP	3.0	480	3	0.85	1.32	1.12
DBP-1	DOMESTIC BOOSTER PUMP	5	HP	7.6	480	3	0.9	4.14	3.73
DBP-2	DOMESTIC BOOSTER PUMP	5	HP	7.6	480	3	0.9	4.14	3.73
DSP-1	DUPLEX SUMP PUMP	1/2	HP	2.4	208	3	0.85	0.44	0.37
DSP-2	DUPLEX SUMP PUMP	1/2	HP	2.4	208	3	0.85	0.44	0.37
DSE-1	DUPLEX SEWAGE EJECTOR	2	HP	3.4	480	3	0.85	1.76	1.49
DSE-2	DUPLEX SEWAGE EJECTOR	2	HP	3.4	480	3	0.85	1.76	1.49
ACOM-1	AIR COMPRESSOR	15	HP	21.0	480	3	0.95	11.78	11.19
	AIR COMPRESSOR	15	HP	21.0	480	3	0.95	11.78	11.19
VP-1	VACUUM PUMP	7 1/2	HP	11.0	480	3	0.95	5.89	5.60
	VACUUM PUMP	7 1/2	HP	11.0	480	3	0.95	5.89	5.60
	VACUUM PUMP	7 1/2	HP	11.0	480	3	0.95	5.89	5.60
AWS-1	AREA WAY SUMP PUMP	1/2	HP	1.1	480	3	0.85	0.44	0.37
AWS-2	AREA WAY SUMP PUMP	1/2	HP	1.1	480	3	0.85	0.44	0.37
FDS-1	FOUNDATION DRAIN SUMP	1/2	HP	1.1	480	3	0.85	0.44	0.37
FDS-2	FOUNDATION DRAIN SUMP	1/2	HP	1.1	480	3	0.85	0.44	0.37
VAV 140	VAV ELEC. COIL	13.3	KW	-	208	3	1.00	13.3	13.30
VAV 141	VAV ELEC. COIL	2.3	KW	-	208	3	1.00	2.3	2.30
VAV 142	VAV ELEC. COIL	2.3	KW	-	208	3	1.00	2.3	2.30
VAV 143	VAV ELEC. COIL	2.3	KW	-	208	3	1.00	2.3	2.30
RAD-1	REFRIGERATED AIR DRYER	1.5	HP	3.0	480	3	0.85	1.3	1.12
								TOTAL LOAD	2449.2
NOTES:	Exisiting equipment denoted by gray font. (e.g. AHU S-1)								
			Motor Load	2867.4	A				

Proposed Design:

The following diagrams document the layout and equipment of the proposed MCC. With this configuration, the MCC is atypically large at a length of 35'. Though this is unusual, it would technically fit within the mechanical penthouse and still afford the clearance for NEC Condition 2 minimum clear distance for maintenance of 3'-6".

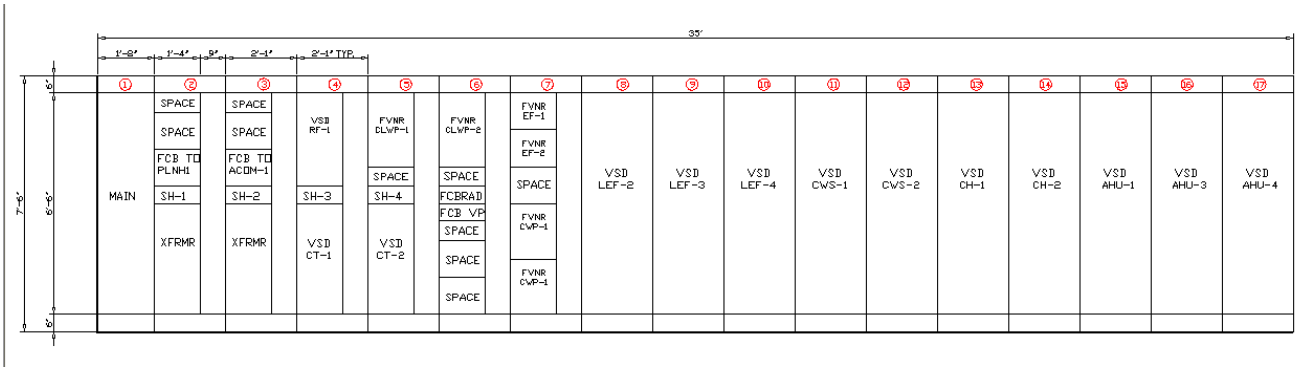


FIGURE 24 – MCC ELEVATION

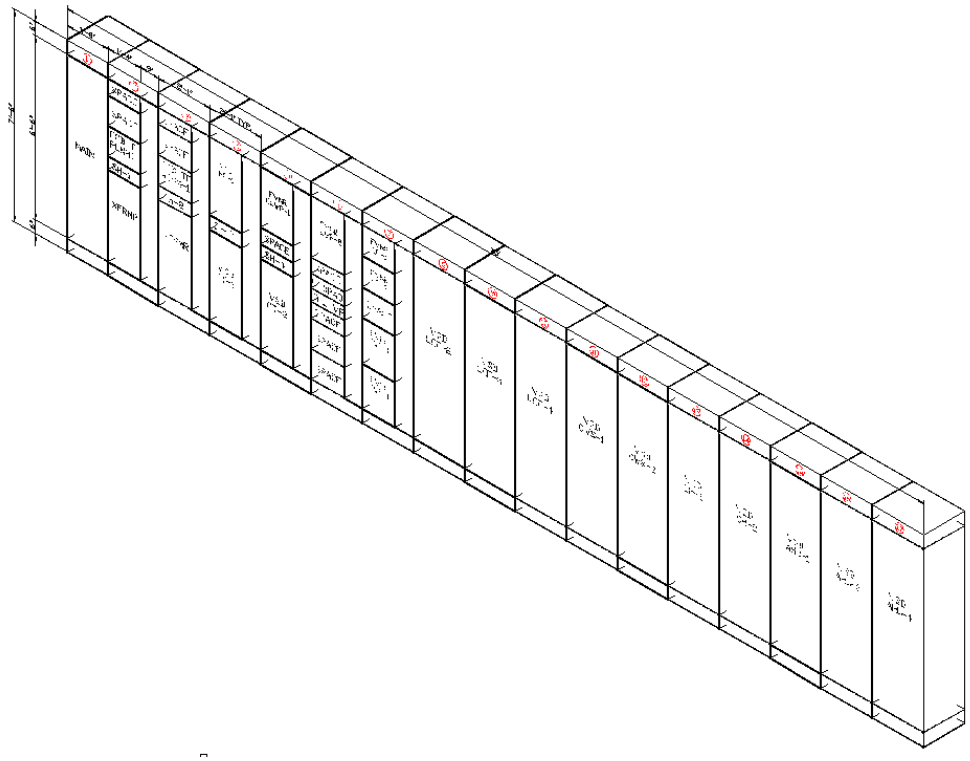


FIGURE 25 – MCC ISOMETRIC

TABLE 14 – MCC SCHEDULE

Motor Controller Center												
Section	Item Served	Load		Overcurrent Protection			Motor Controller			Transformer	†Space Factor	Catalog Number
		HP	FLA	Phase	Amps	Device	Type	NEMA SIZE	Control	kVA		
1	Main Lugs/Incoming		3000	3	3000	CB*	-	-	-		6	2191MB-MKC-60-88FNT
2	Sump Heater, SH-1	-	-	3	20	CB	Packaged	3R			0.5	2193FZ-AKC-32CB-79UT
2	Transformer, P-TN-1	-	-	3	50	CB	-	-	-	30	3	2197-TKBH-36CB
3	Sump Heater, SH-2	-	-	3	20	CB	Packaged	3R			0.5	2193FZ-AKC-32CB-79UT
3	Air Compressor, ACOM-1	(2) 15	(2)21	3	60	CB	Packaged				1	2193FZ-AKC-35CB-79UT
3	Transformer, P-TN-2	-	-	3	50	CB				30	3	2197-TKBH-36CB
4	Cooling Tower Fan, CT-1	40	52	3	90	CB	VSD	1			3	2163RA-052NKB-14HBA3-46CA-79UT
4	Sump Heater, SH-3	-	-	3	20	CB	Packaged	3R			0.5	2193FZ-AKC-32CB-79UT
4	Inline Return Fan, RF-1	25	34	3	70	CB	VSD				2.5	2163RA-034NKB-14DA1D-14HBA3-44CA-79UT
5	Condenser Water Pump, CLWP-1	75	96	3	125	MCP	ALC	4	H-O-A		2	2113B-EAB-6P-49CA-79UT
5	Cooling Tower Fan, CT-2	40	52	3	90	CB	VSD	1			3	2163RA-052NKB-14HBA3-46CA-79UT
5	Sump Heater, SH-4	-	-	3	20	CB	Packaged	3R			0.5	2193FZ-AKC-32CB-79UT
6	Condenser Water Pump, CLWP-2	75	96	3	125	MCP	ALC	4	H-O-A		2	2113B-EAB-6P-49CA-79UT
6	Refrigerated Air Dryer, RAD-1	1.5	3	3	15	CB	Packaged				0.5	2193FZ-AKC-32CB-79UT
6	Vacuum Pump, VP-1	(3) 7.5	(3)11	3	50	CB	Packaged				0.5	2193FZ-AKC-36CB-79UT
7	Bathroom Exhaust Fan, EF-1	1	2.1	3	15	MCP	ALC	1	H-O-A		1	2113B-EAB-6P-35CA-79UT
7	Exhaust Fan, EF-2	3	4.8	3	15	MCP	ALC	1	H-O-A		1	2113B-EAB-6P-38CA-79UT
7	Chilled Water Pump, CWP-1	40	52	3	90	MCP	ALC	3	H-O-A		1.5	2113B-DAB-6P-46CA-79UT
7	Chilled Water Pump, CWP-2	40	52	3	90	MCP	ALC	3	H-O-A		1.5	2113B-DAB-6P-46CA-79UT
8	Strobic Type Exhaust Fan, LEF-2	100	124	3	200	CB	VSD				6	2163QA-***NKB-50CA
9	Strobic Type Exhaust Fan, LEF-3	100	124	3	200	CB	VSD				6	2163QA-***NKB-50CA
10	LEF-4 (BACKUP)	100	124	3	200	CB	VSD				6	2163QA-***NKB-50CA
11	Chilled Water Supply, CWS-1	150	180	3	250	CB	VSD				6	2163QA-***NKB-52CA
12	CWS-2 (BACKUP)	150	180	3	250	CB	VSD				6	2163QA-***NKB-52CA
13	Chiller 1, CH-1	-	-	3	1200	CB	VSD				6	2163QA-***NKB-**CM
14	Chiller 2, CH-2	-	-	3	1200	CB	VSD				6	2163QA-***NKB-**CM
15	Air Handling Unit, AHU-1	75	96	3	125	CB	VSD				6	2163RA-096NKB-14DA1D-14HBA3-49CA
16	Air Handling Unit, AHU-3	125	156	3	225	CB	VSD				6	2163RA-156NKB-14DA1D-14HBA3-51CA
17	Air Handling Unit, AHU-4	125	156	3	225	CB	VSD				6	2163RA-156NKB-14DA1D-14HBA3-51CA
NOTES:	* Located in basement substation USSHV-B											
	† Space Factor of 1 = 13", 2 = 26", etc.											

This proposed design would most likely not be implemented since the MCC is so large and typically would be more expensive than switchboard units. Even if the two chillers and their VSDs were removed from the MCC, the overall length would only be reduced to 30'-4", which is not a significant savings in space or units. Though the feeder bus could be reduced from 3000A to 1400A or 1600A, separate sets of feeders would then need to be run to the two chiller VSDs.

DEPTH TOPIC 2: SKM ANALYSIS

The SKM Power Tools software was chosen for the second electrical depth in order to conduct several studies around the existing electrical distribution system. While the process of modeling the distribution system was very helpful in understanding all the components and settings of the system, several studies were conducted for a more focused analysis of the existing design. The three main studies conducted with the generated SKM model were arc flash evaluation, over-current device coordination study, and a fault current analysis. Copies of the printed reports can be found in the appendices.

When looking at the model created in SKM, one will notice it is not the full distribution system. This is due to the limit of bus components in the licensed copies of the software within the computer labs. Consequently, the system was modeled with the largest loads and normal branches only.

In working with the model and consulting with the project engineer, several assumptions and project specific conditions became evident. The largest issue discovered was managing voltage drop along the feeders and branches to within the 5% limit. The issues encountered were easily rectified by adjusting the primary taps of the transformers. By setting the taps to -2.5%, the entire system properly satisfied voltage drop conditions, even though the secondary voltage was slightly higher than usual.

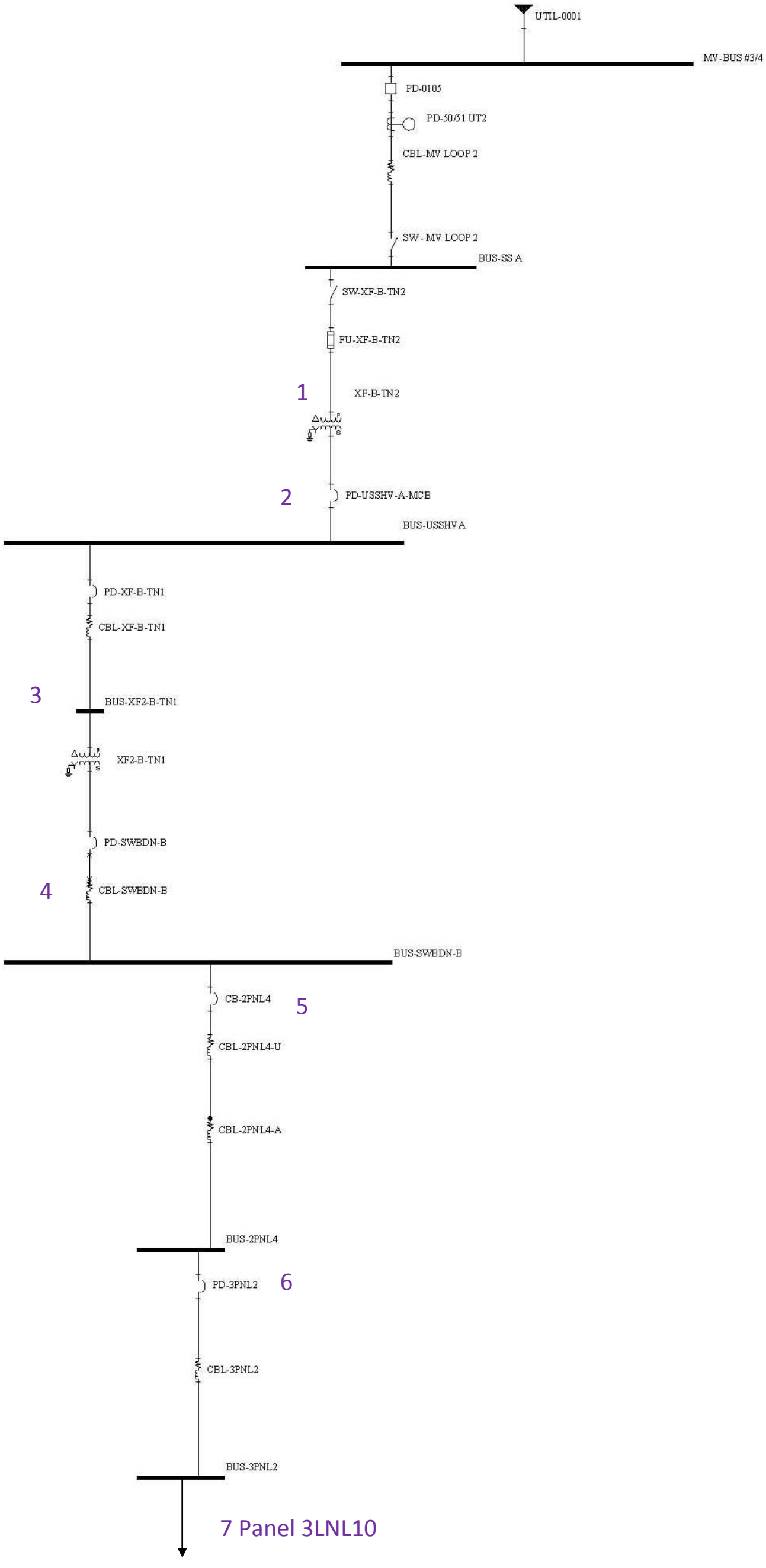
Interestingly, I was also able to learn some of the issues the project engineer encountered in the design phase. Because the building is large and comprised mostly of labs, it would not be likely that it operates at full capacity for any extended period of time. However, a diversity factor was unable to be applied, so the engineer created a "dummy load" to correct for the high voltage drop across the transformers in the full load calculations.

Short Circuit Study + Calculations

Fault current calculations and overcurrent device coordination studies are important because they ensure the safe and proper function of protective devices for branch circuits and equipment. Short circuits within distribution systems can cause fault currents up to tens of thousands of amperes, and if they are not isolated within cycles the resulting damages could be very harmful to personnel and/or equipment. Primarily, the resulting damage is evident in thermal or mechanical stresses to connected equipment. The calculations presented in the following pages were conducted in addition to those run through SKM, and follow the same path. The whole branch indicated in Figure 26 was studied in SKM whereas the trip curve coordination in Figure 27 was generated with layered manufacturer's data for local panel 3LNL10 to 2PNL4 (points 5-7). A summarized list of the available fault current at each component (calculated in SKM) is available in Appendix D. A comparison of the SKM short circuit study and the calculated results follows.

POINT	LOCATION
1	XF-B-TN2
2	USSHV-A
3	XF-B-TN1
4	SWBDN-B
5	MDP-2PNL4
6	MDP-3PNL2
7	PANEL 3LNL10

FIGURE 26 – ISOLATED PATH FOR PROTECTIVE DEVICE COORDINATION STUDY



Given:	System Voltage	480
	Base kVA	2500
	Utility Company Available Fault	100000

Transformer Secondary Side (XF-B-TN2)

%Z	5.75	Zutil	2.304		mΩ
X/R	5.66	Rutil	0.400859		mΩ
X(%)	2.5	Xutil	0.394745		mΩ
R(%)	0.313	Rxfrmr	0.921975		mΩ
kVA	2500	Xxfrmr	5.218379		mΩ
		Ztotal	1.322834	5.613124	mΩ
		Isc	48033		A

BUS-USSHVA - SUBSTATION

FEEDER			
L	5		
Rcon	0.0124	mΩ	2.97 mΩ/100ft
Xcon	0.0160	mΩ	3.85 mΩ/100ft
Ztotal	1.3352	5.6292	
Isc	47880	A	

BTN1

FEEDER	4 Sets 500kcmil in plastic		
L	40		
Rfeed	0.22	mΩ	2.2 mΩ/100ft
Xfeed	0.303	mΩ	3.03 mΩ/100ft
Zpri	1.5552	5.9322	(At Primary Windings)
α	2.308		
Zsec	0.2920	1.1139	

TRANSFORMER

%Z	5				
X/R	4.9				
		Rxfrmr	0.865107		mΩ
kVA	500	Xxfrmr	4.239024		mΩ
		Ztotal	1.1571	5.3530	mΩ
		Isc	21911		A

SWBDN-B			
FEEDER	6 Sets 400 kcmil in plastic		
L	30		
Rcon	0.205	mΩ	2.73 mΩ/100ft
Xcon	0.231	mΩ	3.08 mΩ/100ft
Ztotal	1.3619	5.5840	
Isc	20878	A	

At 2PNL4			
L	125		
2 sets	#350 Copper		
2	3" Conduits		
	Assume Plastic Conduit		
R	1.944	mΩ	3.11 mΩ/100ft
X	1.944	mΩ	3.11 mΩ/100ft
Ztotal	3.3056	7.5277	
Isc	14596	A	

At 3PNL2			
L	25		
2 SETS	3/0		
2	2" Conduits		
R	0.804	mΩ	6.43 mΩ/100ft
X	0.4	mΩ	3.20 mΩ/100ft
Ztotal	4.1094	7.9277	
Isc	13439		

At 3LNL10			
L	25		
1 SET	1/0		
R	2.550	mΩ	10.2 mΩ/100ft
X	0.835	mΩ	3.34 mΩ/100ft
Ztotal	6.6594	8.7627	
Isc	10903		

SHORT CIRCUIT STUDY RESULTS:

POINT	LOCATION	AVAILABLE FAULT (A)	SKM AVAILABLE FAULT (A)	STANDARD BREAKER RATING (kA)	EXISTING DESIGN
1	XF-B-TN2	48,033	-	50	63
2	USSHV-A	47,880	43,312	50	100
3	XF-B-TN1	21,911	40,812	25	100
4	SWBDN-B	20,878	19,362	22	65
5	MDP-2PNL4	14,596	13,591	18	100
6	MDP-3PNL2	13,439	12,530	18	65
7	PANEL 3LNL10	10,903	-	18	25

One can see from the short circuit study results that values from SKM and those generated from the direct-ohmic method do not vary greatly except at Transformer B-TN1. This is most likely due to the assumptions associated with the reactance and resistance values of the transformer or the locations upstream. However, there are significant differences between the standard breaker rating column (based on column three values generated by the direct-ohmic method) and the existing design kAIC ratings. In all cases, the existing design values are higher. This is most likely due to the anticipated loads of the phase two addition. While these loads have been configured into existing panelboard layouts, they are still estimates and could considerably contribute to any overdrawn current throughout the system.

PROTECTIVE DEVICE COORDINATION STUDY

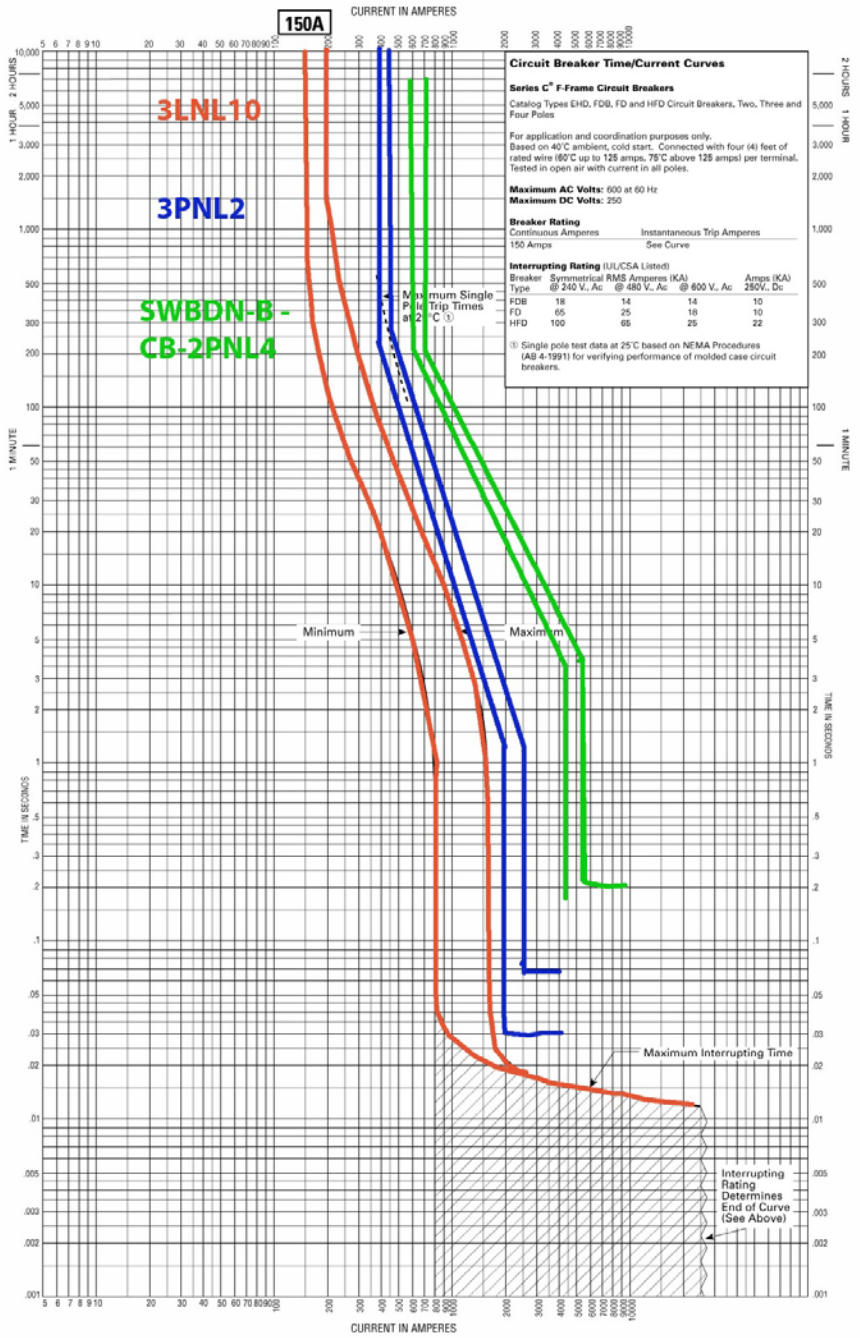
The trip curves in Figure 27, generated from overlaying manufacturer's information of points 5-7 highlighted above in orange, indicate the selected devices are coordinated properly. The load-side breaker (3LNL10) trips first at a rating between 150 A and 200 A followed by the devices upstream. Additional curves for points one through seven were studied in SKM and are included in Appendix D. These further validate the coordination of the overcurrent-protective devices along the path. Additionally, the trip/delay times are summarized in the arc flash evaluation reports (also generated in SKM and included in Appendix D).

Application Data
29-167F

Page 36

AB DE-ION Circuit Breakers

Types FDB, FD and HFD 150 Amperes



Curve No. SC-4149-87B

October 1997

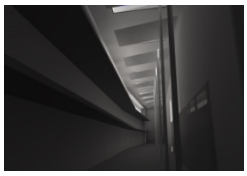
FIGURE 27 – COORDINATION STUDY FOR SPECIFIED OCPDS

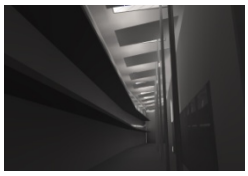
ARC FLASH EVALUATION STUDY

The arc flash evaluation report generated from SKM builds upon the short circuit study and coordination study to provide data for breaker opening times, arc flash boundaries, and the associated required protective clothing (for maintenance) among other data. The images below are an example of the information presented in the arc flash evaluation study for points six and seven. Since the trip/delay times and protective device arcing faults are smaller for 3LNL10 than 3PNL2, the study proves these components are satisfactorily coordinated.

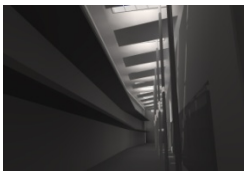
Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category
BUS-3LNH1	PD-3LNH1	0.480	11.87	7.59	11.87	7.59	0.017	0.000	Yes	PNL	25	9	18	0.41	Category 0
BUS-3LNL1	CB-3LNL1	0.208	7.12	2.91	7.12	2.91	0.031	0.000	Yes	PNL	25	7	18	0.27	Category 0 (*N3)
BUS-3LNL10	CB-3LNL10	0.208	10.21	4.41	10.21	4.41	0.018	0.000	Yes	PNL	25	7	18	0.24	Category 0
BUS-3PNL2	PD-3PNL2	0.208	11.74	4.87	11.74	4.87	0.04	0.000	Yes	PNL	25	12	18	0.61	Category 0

Daylighting (MAE)


3/22 08:00


3/22 10:00


3/22 12:00


3/22 14:00


3/22 16:00

The objective of this study is to evaluate the existing toplighting and sidelighting systems in the atrium and the potential energy savings associated with a proposed photosensor controlled lighting system. The current lighting design for the atrium space does not provide any sensor-triggered automatic lighting controls, but has the potential to reach significant energy savings by properly integrating the daylight and electric lighting. In order to quantify the existing daylight conditions and measure energy savings, a model of the space was imported into the daylight analysis program, Daysim.

PROCEDURE:

- A model of the space was imported into Daysim and AGI32 to establish existing daylight values within the space at the vernal equinox, summer solstice, and winter solstice. While providing visual clues as to daylight penetration and the solar path, these calculations also indicated that the majority of daylight hours provide illuminance levels that surpass the minimum requirement of 10 fc.
    - Inputs for the model were adjusted to keep the most accurate site representation for Buffalo, NY. For example, the scene building rotation was set for a +10°41’ to adjust for the difference between magnetic and polar north.

- Building occupancy was modeled for 8:00am to 11:00 pm weekdays from January 10 to May 20; 8:00am to 5:00pm weekdays from May 21 to August 23; and 8:00am to 11:00pm again on weekdays from August 24 to December 23. These dates and times were chosen to represent the operation of the building as a college facility, which would be in session throughout fall, spring, and summer sessions.

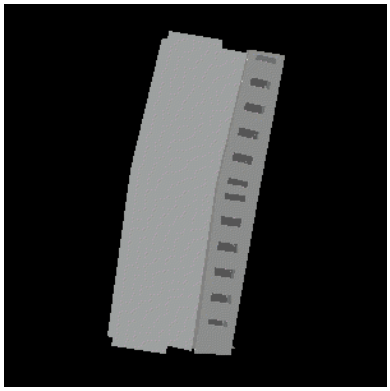
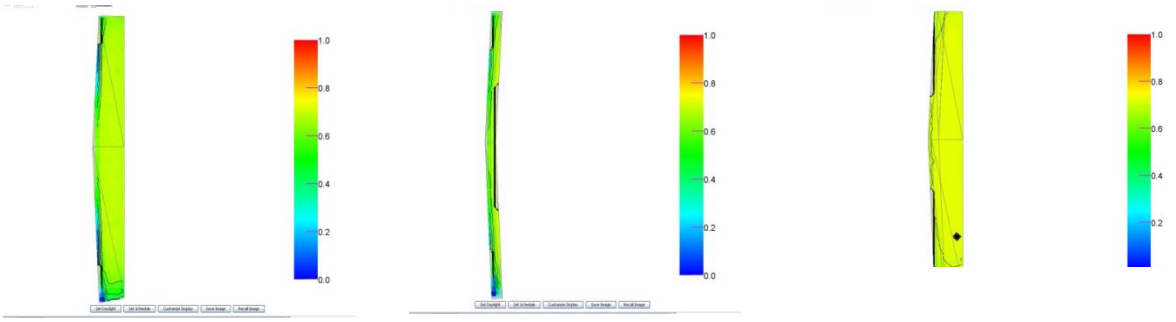


FIGURE 28 – BUILDING SET-UP IN DAYSIM

- The adjacent mechanical penthouse was also modeled to provide more accurate results.

- From the initial daylight analyses in Daysim, it was determined that the month of December had the lowest numbers for useful daylight illuminance and daylight autonomy. Therefore, December 21 was chosen as the baseline date to use for the experimentation in determining the effects of daylight switching on the energy consumption.



Level One – DA 12/21 Level Two – DA 12/21 Level Three – DA 12/21

FIGURE 29 – DA VALUES BY FLOOR LEVEL

- Initially, the daylight and electrical light were going to be analyzed together with the application of a photosensor file and open switching algorithm. However, due to a discovered limitation of the current version of the software, the method was altered to rely solely on daylight autonomy.
- It has been discussed in the current Daylighting course (AE 565), that daylight autonomy can be used as an approximation of the percentage energy saved because it is very close to the values for the critical point, or the area in a space receiving the least contribution from daylight and electric light.
- Daysim calculations were conducted for sensor points at the first, second, and third floors to analyze the daylight signals at each level or zone. The proposed lighting control arrangement would divide each corridor area on each level into a separate zone controlled by a designated photosensor.

- Then results for daylight autonomy were converted into text and viewed with Excel. From here the value of the Daylight Autonomy at the critical point could be selected and applied to the total kilowatt-hrs of energy consumption for illuminating each zone to the target 10 fc/100 lux. The product is approximately equivalent to the energy saved.

CALCULATIONS:

JULIAN	# DAYS	HOURS	
10	131	15	1965
141	95	8	760
236	139	15	2085
365			
		Σ	4810
	TOTAL ANNUAL		3562

FIRST FLOOR:

DA @ CP	0.457			
			W	kW
Total Luminaire Input Power			1301	1.301
Hours of Operation			3562	
TOTAL kWh			4634.162	4634.162
Estimated Annual Savings (kWh)			2117.8	2117.812

SECOND FLOOR:

DA @ CP	0.499			
			W	kW
Total Luminaire Input Power			650	0.65
Hours of Operation			3562	
TOTAL kWh			2315.3	2315.3
Estimated Annual Savings (kWh)			1155.3	1155.33

THIRD FLOOR:

DA @ CP	0.506			
			W	kW
Total Luminaire Input Power			806	0.806
Hours of Operation			3562	
TOTAL kWh				2870.972
Estimated Annual Savings (kWh)			1452.7	1452.712

RESULTS:

- The switching arrangement for the fluorescent luminaires considered here provides an annual total savings of 4725.8 kWh.

MECHANICAL BREADTH

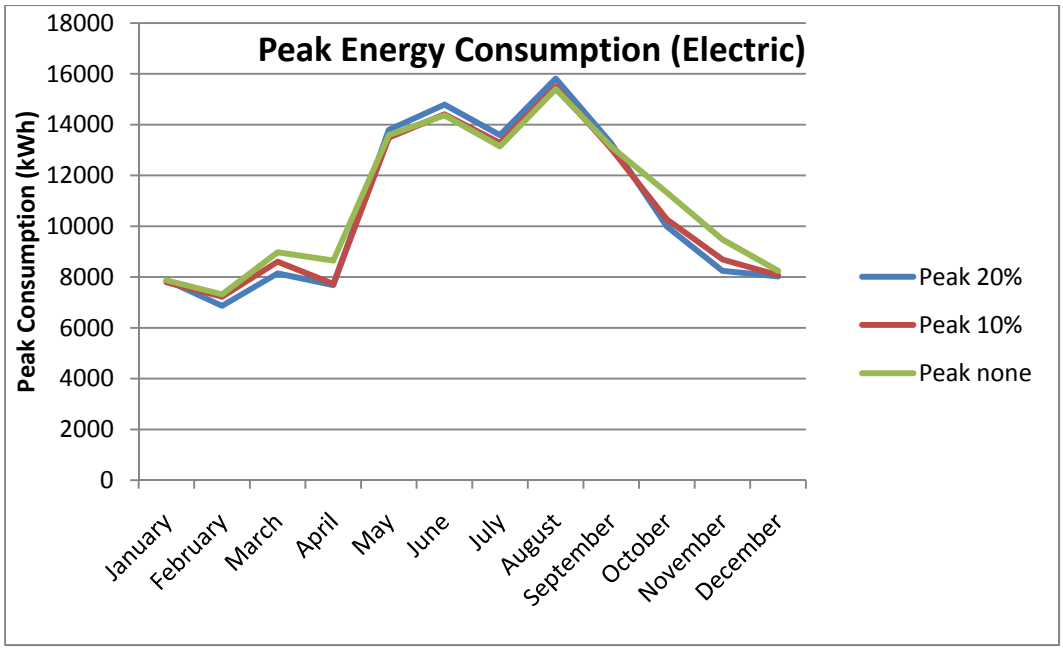
The purpose of this study is to analyze and understand how the heating and cooling loads are affected by toplighting, or skylights. More specifically, this study focuses on the effect of percent area of skylight glazing compared to the roof area. In order to perform this study, a model of the atrium space was created as a room in TRACE with a simultaneous study conducted in SkyCalc. Glazing for the studies is double, low-e clear glass with a SHGC of 0.38, U value of 0.28 Btu/h-°F-ft^2, and transmittance of 0.70.

After setting up the model with appropriate site and occupancy/operation schedules, calculations were run for the space for three different scenarios:

1. Existing Skylight Glazing (20.51% of the roof area)
2. Skylights at 10% of the roof area
3. No Skylights

The results are broken into heating and cooling consumption according to fuel type, gas versus electricity.

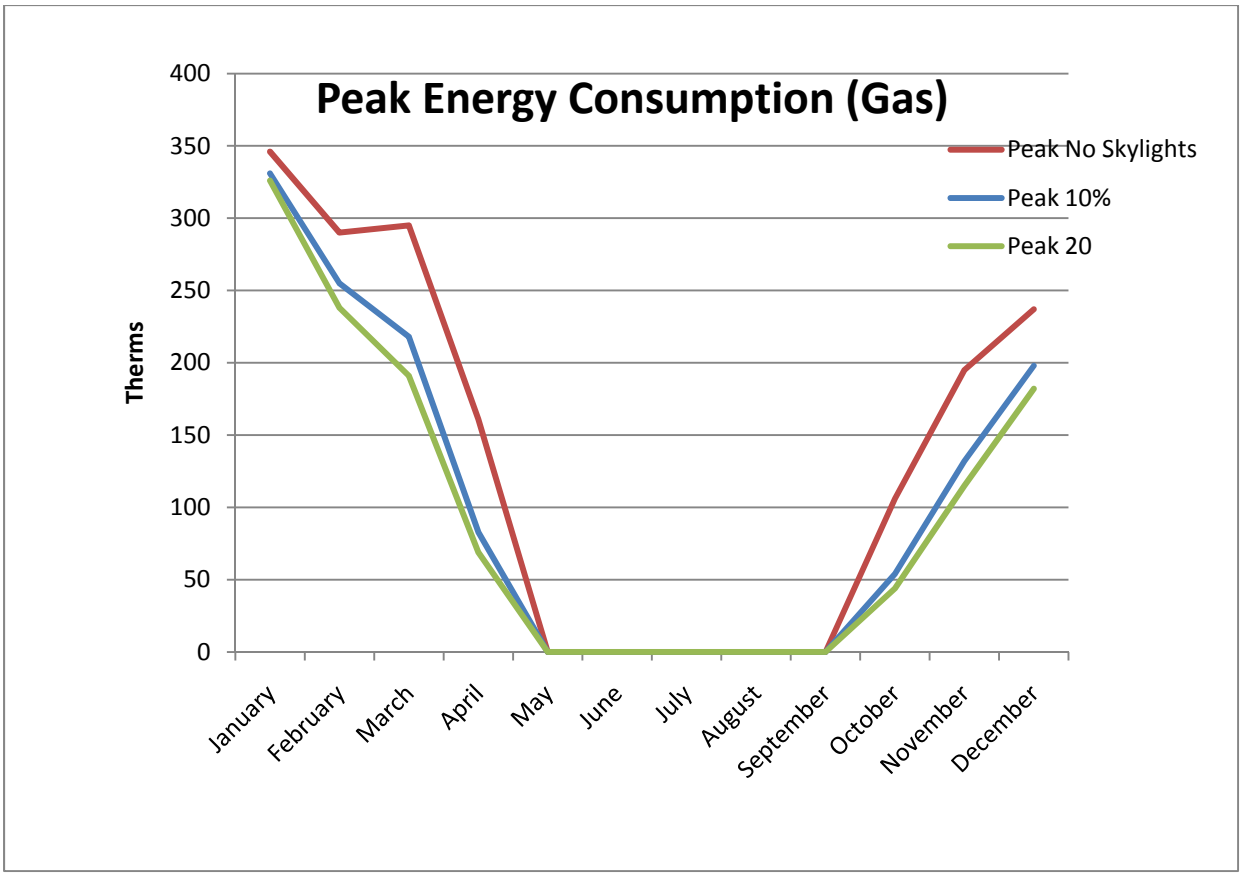
With Skylights modeled	(20.51% roof)											
	January	February	March	April	May	June	July	August	September	October	November	December
Electric												
On Pk (kWh)	7875	6866	8144	7685	13796	14793	13588	15811	13256	9986	8243	8022
Off Peak (kWh)	3439	3239	3928	3641	4635	5742	6118	6269	5265	4107	3927	3803
Demand (kW)	119	119	120	125	143	145	146	147	146	140	126	123
With Skylights modeled	(10% roof)											
	January	February	March	April	May	June	July	August	September	October	November	December
Electric												
On Pk (kWh)	7789	7224	8601	7726	13494	14408	13276	15487	13050	10266	8693	8074
Off Peak (kWh)	3429	3168	3934	3655	4525	5439	5758	6194	5227	4134	3944	3885
Demand (kW)	119	119	121	125	143	145	146	147	146	140	126	123
Without Skylights modeled												
	January	February	March	April	May	June	July	August	September	October	November	December
Electric												
On Pk (kWh)	7875	7319	8972	8648	13594	14368	13144	15404	13134	11327	9479	8241
Off Peak (kWh)	3445	3173	3958	3837	4409	5335	5619	6104	5209	4197	3987	3923
Demand (kW)	120	121	122	129	149	145	146	147	146	140	128	125



With Skylights Modeled (20.51%)												
	January	February	March	April	May	June	July	August	September	October	November	December
Gas												
Peak Cons. (therms)	326	238	191	69	0	0	0	0	0	44	115	182
Peak Demand (therms/hr.)	3	3	3	3	0	0	0	0	0	1	3	3

With Skylights modeled (10% roof)												
	January	February	March	April	May	June	July	August	September	October	November	December
Gas												
Peak	331	255	218	83	0	0	0	0	0	54	132	198
Off Peak	3	3	3	3	0	0	0	0	0	1	3	3

Without Skylights												
	January	February	March	April	May	June	July	August	September	October	November	December
Gas												
Peak	346	290	295	161	0	0	0	0	0	106	195	237
Off Peak	2	2	2	2	0	0	0	0	0	2	2	2



The results from TRACE would suggest that the toplight glazing creates higher cooling (electric) loads in the summer. Also, the graph generated from these results would indicate there is a law of diminishing returns in terms of the effect the glazing has on expenditures for gas fuel. That is to say, the largest decrease in consumption of energy occurs in the winter months with 10% toplight glazing area, due to solar heat gain.

These trends are again achieved with the studies conducted in SkyCalc, which also account for lighting load alterations. In the SkyCalc evaluation of scenario one versus two, it is evident that scenario one has a larger overall heating energy consumption simply by direct comparison of the figures for annual energy savings (-17,321 kWh/yr < -7,178 kWh/yr). However, if comparing the percentages of heating to overall HVAC energy savings/costs, scenario two heating is more effective because it only accounts for 56% of the negative energy savings as opposed to 62% of negative energy savings in scenario one. In other words, scenario one heating consumption is greater than that of scenario two.

The addition of an on/off lighting control system provides even more proof that a smaller skylight area (in this case 10% of the roof) is more beneficial for this location. For scenario one, the inclusion of an automatic on/off lighting control for 70% of the lighting yields annual energy savings of -13,462 kWh/yr and annual cost savings of -$191. While annual energy savings for scenario two with the abovementioned lighting control are still negative overall, there is a positive annual cost savings of $627. The results for the SkyCalc simulations are presented below:

SCENARIO 1 VS. SCENARIO 2 – NO LIGHTING CONTROL

	Savings from Design Skylighting System		
	Savings	Annual Energy Savings (kWh/yr)	Annual Cost Savings
	Lighting	0	$0
	Cooling	-6,557	-$1,311
	Heating	-10,764	-$367
	Total	**-17,321**	**-$1,679**

Skylighting System Description		**Site Description**		
Skylight unit size (ft2)	107.2	Climate Location	Buffalo, NY	
Number of Skylights	12	Climate Zone	ASHRAE B-17	
Total Skylight Area (ft2)	1,286	Building Type	Class, Universi	
Skylight to Floor Ratio (SFR)	20.5%	Building Area	6,273	(ft2)
Effective Aperture	9.4%			
Floor Area per Skylight	523	**Elecric Lighting System Description**		
Skylight U-value	0.280	Lighting Type	Lensed fluorescent	
Skylight SHGC	38%	Lighting Control	No Daylight Control	
Skylight Tvis	70%	Light Level Setpoint	10	fc
Well Efficiency (WF)	82%	Lighting Density	0.50	W/ft2
Dirt and Screen Factor	80%	Connected Load	3.1	kW
Overall Skylight System Tvis	46%	Fraction Controlled	0%	

SCENARIO 1

	Savings from Design Skylighting System		
	Savings	Annual Energy Savings (kWh/yr)	Annual Cost Savings ($/yr)
	Lighting	0	$0
	Cooling	-3,139	-$628
	Heating	-4,040	-$138
	Total	**-7,178**	**-$766**

Skylighting System Description		**Site Description**		
Skylight unit size (ft2)	107.2	Climate Location	Buffalo, NY	
Number of Skylights	6	Climate Zone	ASHRAE B-17	
Total Skylight Area (ft2)	643	Building Type	Class, University	
Skylight to Floor Ratio (SFR)	10.3%	Building Area	6,273	(ft2)
Effective Aperture	4.7%			
Floor Area per Skylight	1,046	**Elecric Lighting System Description**		
Skylight U-value	0.280	Lighting Type	Lensed fluorescent	
Skylight SHGC	38%	Lighting Control	No Daylight Control	
Skylight Tvis	70%	Light Level Setpoint	10	fc
Well Efficiency (WF)	82%	Lighting Density	0.50	W/ft2
Dirt and Screen Factor	80%	Connected Load	3.1	kW
Overall Skylight System Tvis	46%	Fraction Controlled	0%	
Skylight CU	52%			

SCENARIO 2

SCENARIO 1 VS. SCENARIO 2 – WITH ON/OFF SWITCHED LIGHTING CONTROL

	Savings from Design Skylighting System		
	Savings	Annual Energy Savings (kWh/yr)	Annual Cost Savings ($/yr)
	Lighting	7,236	$1,447
	Cooling	-5,620	-$1,124
	Heating	-15,079	-$515
	Total	**-13,462**	**-$191**

Skylighting System Description		**Site Description**		
Skylight unit size (ft2)	107.2	Climate Location	Buffalo, NY	
Number of Skylights	12	Climate Zone	ASHRAE B-17	
Total Skylight Area (ft2)	1,286	Building Type	Class, University	
Skylight to Floor Ratio (SFR)	20.5%	Building Area	6,273	(ft2)
Effective Aperture	9.4%			
Floor Area per Skylight	523	**Elecric Lighting System Description**		
Skylight U-value	0.280	Lighting Type	Lensed fluorescent	
Skylight SHGC	38%	Lighting Control	On/Off	
Skylight Tvis	70%	Light Level Setpoint	10	fc
Well Efficiency (WF)	82%	Lighting Density	0.50	W/ft2
Dirt and Screen Factor	80%	Connected Load	3.1	kW
Overall Skylight System Tvis	46%	Fraction Controlled	70%	
Skylight CU	52%			

SCENARIO 1

	Savings from Design Skylighting System		
	Savings	Annual Energy Savings (kWh/yr)	Annual Cost Savings ($/yr)
	Lighting	6,820	$1,364
	Cooling	-2,254	-$451
	Heating	-8,388	-$286
	Total	**-3,823**	**$627**

Skylighting System Description		**Site Description**		
Skylight unit size (ft2)	107.2	Climate Location	Buffalo, NY	
Number of Skylights	6	Climate Zone	ASHRAE B-17	
Total Skylight Area (ft2)	643	Building Type	Class, University	
Skylight to Floor Ratio (SFR)	10.3%	Building Area	6,273	(ft2)
Effective Aperture	4.7%			
Floor Area per Skylight	1,046	**Elecric Lighting System Description**		
Skylight U-value	0.280	Lighting Type	Lensed fluorescent	
Skylight SHGC	38%	Lighting Control	On/Off	
Skylight Tvis	70%	Light Level Setpoint	10	fc
Well Efficiency (WF)	82%	Lighting Density	0.50	W/ft2
Dirt and Screen Factor	80%	Connected Load	3.1	kW
Overall Skylight System Tvis	46%	Fraction Controlled	70%	
Skylight CU	52%			

SCENARIO 2

DISCUSSION:

The existing skylighting design provides up to 4,243 hours/year of full daylighting (according to SkyCalc). While this is greater than a design composed of less glazing area, the tradeoffs between energy consumption prove to be more economical for a smaller glazing area. Scenario two combined with automatic lighting control is the only condition in this study to provide net positive annual cost savings, and it is only when automatic lighting control is incorporated that any kind of positive savings is achieved.

LED LUMINAIRE OPTIONS (HONORS BREADTH)

The following section considers the viability of LED options for general illumination within the building's interior. A background of existing technical characteristics and considerations is presented, followed by a study specific to the building conducted in AGI32.

LED luminaires are quickly gaining momentum as marketable lighting solutions. They are seeing great demand in exterior and accent lighting due to their excellent capacity for colored and dynamic illumination. However, there is great concern among industry professionals about their proper integration within the lighting market, specifically with regards to designs that account for the unique characteristics associated with LED sources. These trends of research and development are comparable to the shift within lighting technology that occurred in the mid-20th century with the implementation of fluorescent sources. There is a great sense of urgency to implement the technology where possible because substantial energy savings and long life are advertised. Yet it should be recognized, that "LEDs still face difficult competition for general illumination because success is defined by correctly matching a technology with the needs of the application" [4].

The considerations for LED product selection should mimic those of any other source, but the designer must be cognizant of the limitations and performance of the source especially within the context of the application. There are numerous characteristics and metrics that need to be considered, including but not limited to: power supply, maintenance, thermal management, economics, and performance.

Performance encompasses numerous properties and characteristics associated with a lighting fixture including photometrics, color rendering, efficiency, and life/reliability. LEDs have the flexibility to accommodate numerous lighting tasks with proper optical design. However, they are also currently associated with issues of glare because of their intense point source. Color quality, rendering, and matching is a major issue associated with white LEDs. While RGB LEDs can be controlled to create a vivid spectrum of colors, binning and color rendering metrics create complications for standard white LED lighting. The CIE is presently developing a new standard for color comparison, because the existing CRI technique does not provide sufficient comparison among different sources. The R_a value does not provide an accurate representation for LEDs because their spectra possess sharp peaks and valleys atypical of other lighting sources whose broader spectra were used as the basis for the development of CRI [5, 6]. Reliability and length of life are perhaps the most marketable traits of an LED, yet they are still being tested. While many manufacturers claim lumen maintenance (of 70%) can be forecast to 60,000 hours, accelerated studies by the Lighting Research Center (LRC) at Rensselaer Polytechnic Institute and others provide evidence this is not the case for all LEDs.

LED performance is inversely proportional to driving current and operating temperatures; as temperature and/or current decrease the lifetime of an LED increases. Since a lifetime of 60,000 hours is difficult to test in a lab, the LRC performed studies to extrapolate data from testing conditions of 6,000 hours. These preliminary studies conducted with phosphor-converted LEDs indicated that an LED downlight operating in open air conditions at 95°C can reach a lumen depreciation of 30% after approximately 5,000 hours [7]. Additionally, the study exhibited high levels of color shift in the test LEDs. The Department of Energy has also collected data on reliability testing via the CALiPER program which includes trends for a larger pool of test sources. A graph of the trends of lumen maintenance for 26 test sources is provided in Figure 30, and includes sources in addition to the phosphor-converted white LEDs of the LRC study [8]. While these studies rely on extrapolated data, they convincingly prove that not all LEDs and LED luminaire combinations existing today maintain lumen output greater than 70% until a operation of 50,000 hours.

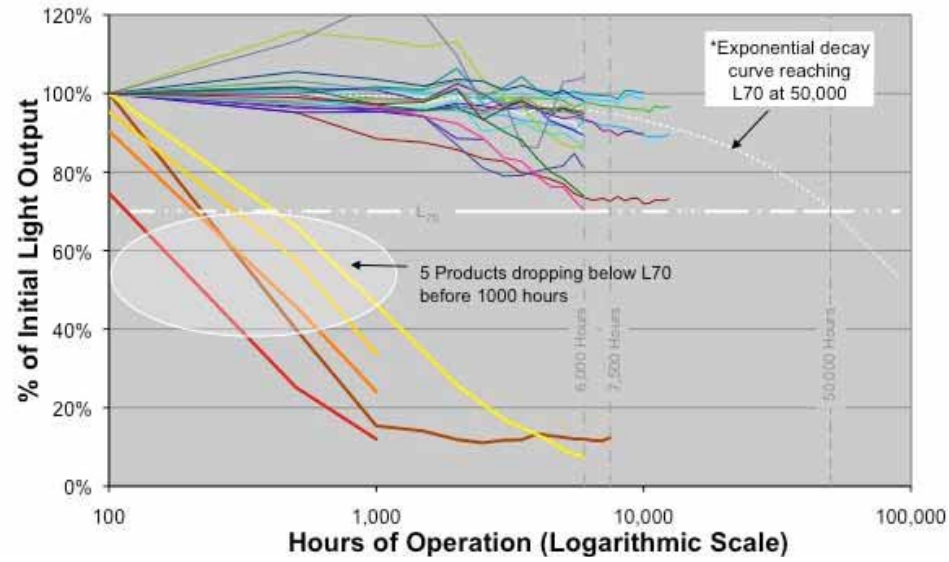


FIGURE 30 – FROM DOE CALIPER STUDY [8]

Finally, but not of least importance, the issue of economics must be considered with LED luminaire specification. While there are methods of computing energy savings and simple payback, there has yet to be a documented demonstration that LED lighting systems provide a total lower cost compared to standard lighting systems [4]. This is due to the fact that the incorporation of LED architectural lighting technology is so new, and LED luminaire production has not yet reached a point in development where it can take advantage of economies of scale.

While research and development are ongoing, marketable products are likewise growing in number. As mentioned previously, most existing LED solutions serve specific lighting applications such as display cases, signs, signal lighting, automotive lighting, task lighting, and accent lighting. The exterior design for the Science Building presented in previous sections already implements LED fixtures in exterior applications, where they have proven to provide light at a fraction of the energy consumption in comparison to an alternative source such as metal halide. This study investigates the options for general overhead illumination within commercial or institutional spaces, and presents an evaluation of performance in AGI32 and a simple payback study.

Research of available general illumination products yielded two opportunities for linear downlighting through manufacturers Albeo Technologies and Lunera. Lunera was chosen as the object for further study based on luminaire housing and optics, which are designed to provide a more evenly distributed light and easily fill in for standard four feet, linear luminaires. Based on product literature for the Lunera 6400 luminaire (available in Appendix A), it has an integrated power supply unit that supplies its strips of RGB white LEDs. It provides 1700 lumens at an input power of 30 watts, and can receive source voltage of 120/277 VAC.

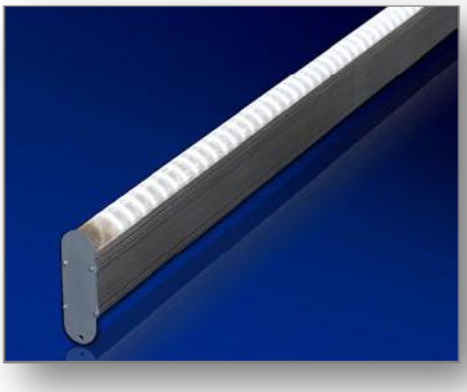


FIGURE 31 – ALBEO LUMINAIRE

FIGURE 32– LUNERA 6400

The space chosen for the study is the genetics teaching lab, of which there occur a total of 10 identical spaces throughout the building. At an area of roughly 1,160 ft^2 the total illuminated area for this suggested design would be 11,600 ft^3. Two scenarios were simulated in AGI32 for:

1. 21 luminaires arranged perpendicular to lab table orientation
2. 16 luminaires parallel and in between lab tables

SCENARIO 1

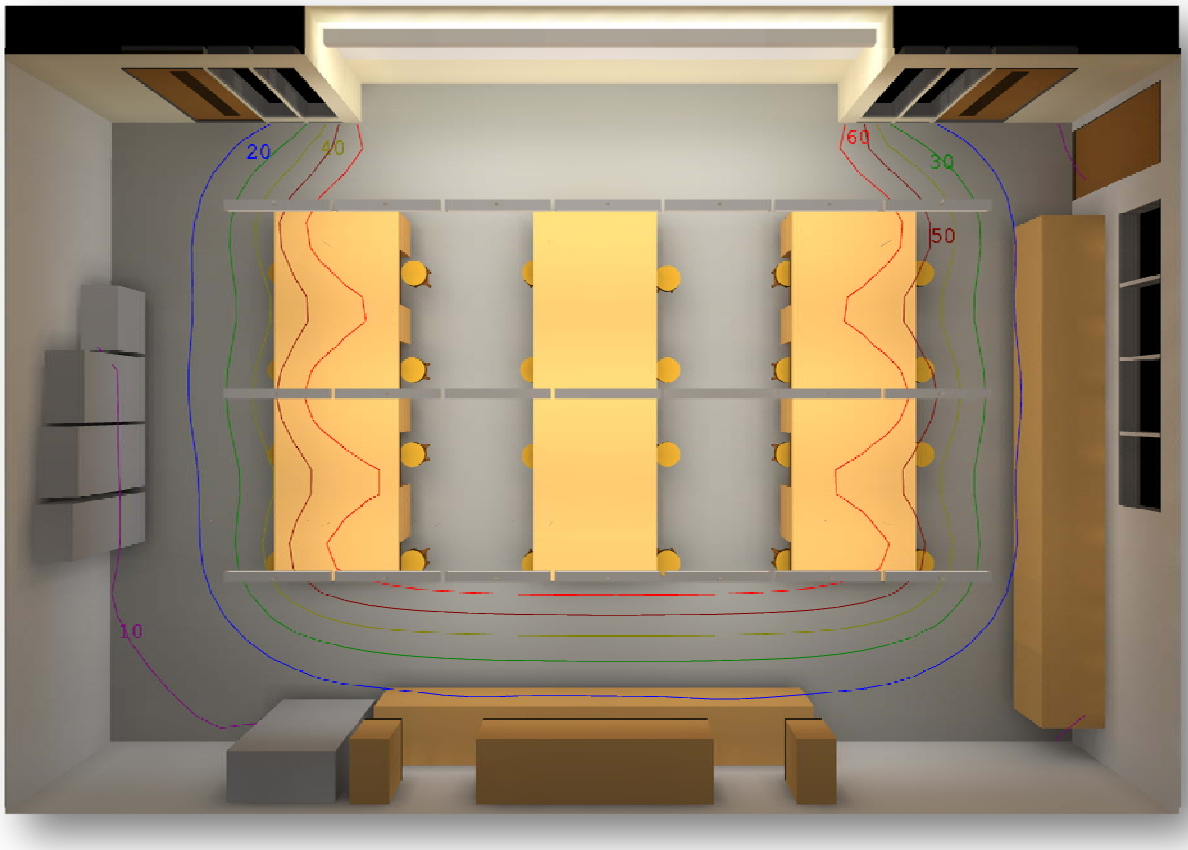


FIGURE 33 - SCENARIO 1

Results Scenario 1:

Average Illuminance = 44.4 fc

LPD = 0.681 W/ft^2

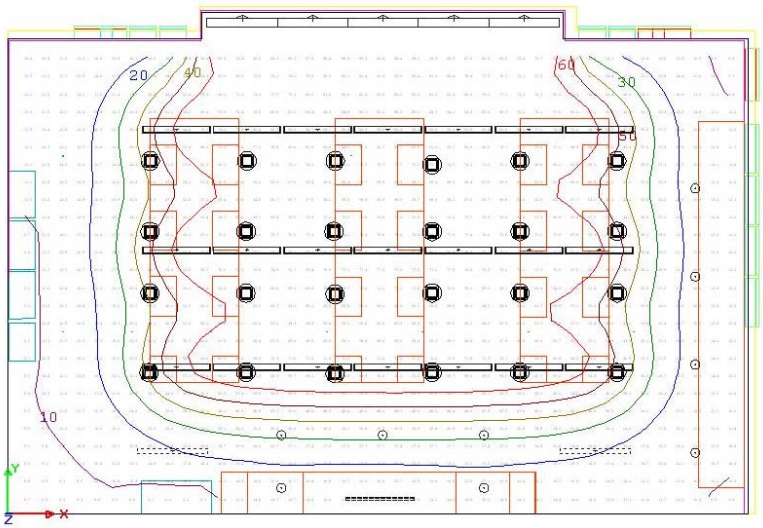


FIGURE 34 - SCENARIO 1 ISOLINES

SCENARIO 2

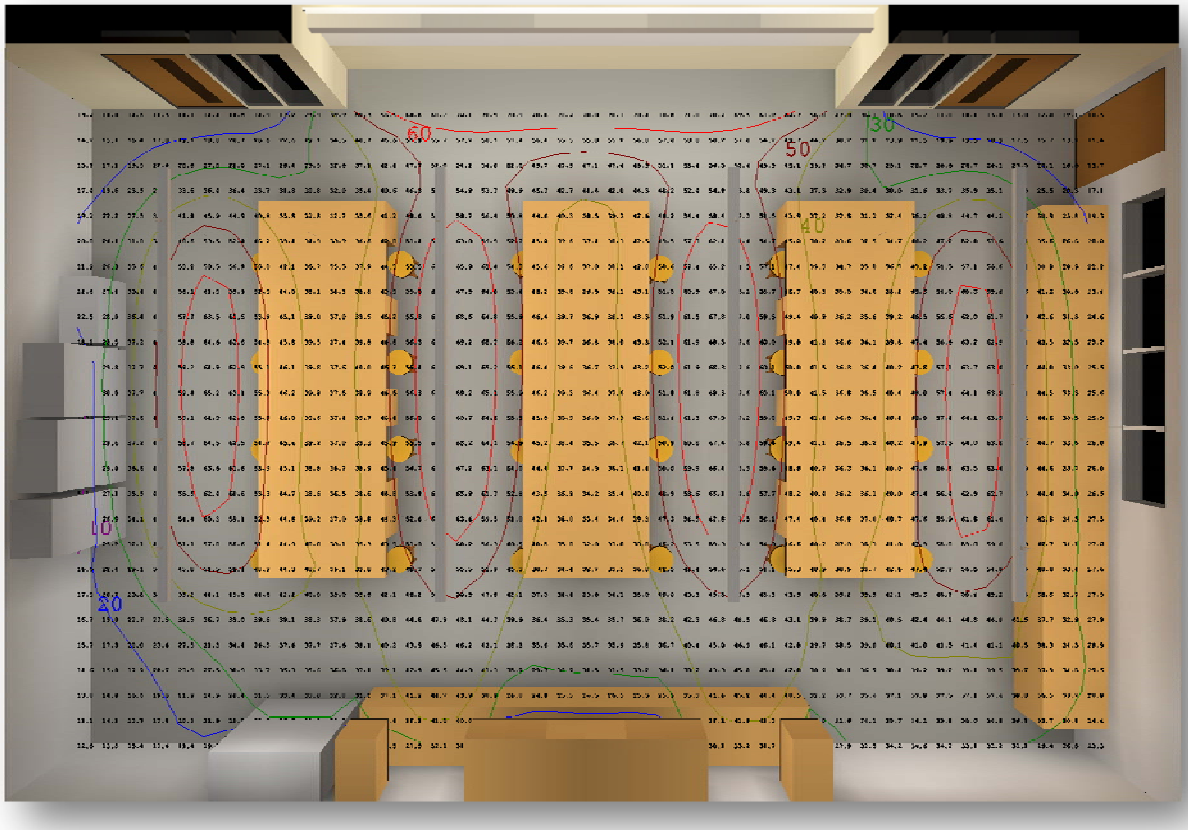


FIGURE 35 - SCENARIO 2

Results Scenario 2:

Average Illuminance = 41.5 fc

LPD = 0.753 W/ft^2

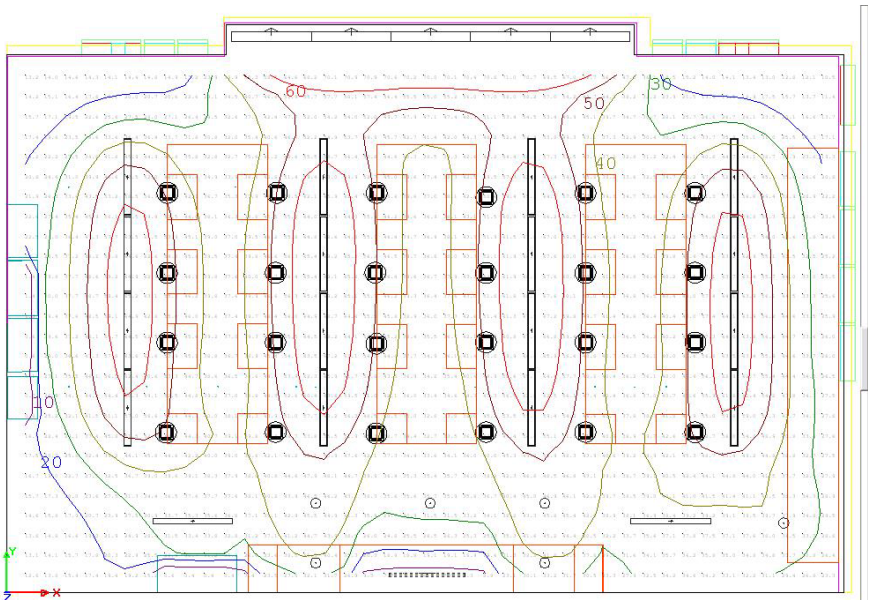


FIGURE 36 - SCENARIO 2 ISOLINES

Individual luminaire price data could not be obtained from Lunera, but their Web site (www.lunera.com) provides a payback calculator tool. Using the tool and applying the settings for a school project at 10,000 ft^2 in New York yields an estimated 1.9 years payback period. A payback period between one and two years can be a substantial incentive for a designer to employ a new system, however, the results from the rough estimates provided are significantly higher.

The calculations provided below indicate initial costs for the proposed scenarios at roughly half and one-third, respectively, of the price of the fluorescent system. However, the calculated payback period based on lighting energy savings is upwards of 16 years. If the LED system were run for 3,500 hours for 14 years it would reach the estimated 50,000 hour life. Since, the period of payback is greater than the potential luminaire life it would be disqualified as a potential solution. Even at a payback period of seven years, it would not be reasonable to utilize the LED design.

				Input Power		Annual Power Cons.	Annual Energy Costs	Annual Cash Flow	Payback Period	Initial System Cost		
	Existing	Luminaires	Total #	W	kW	kWh				Luminaires	Lamps	Ballasts
		LSB-2	140	8680	8.68	30,918	$ 3,091.82			24,500.00	103.25	4,200.00
1	Proposed	Lunera 6400	210	6300	6.3	22,441	$ 2,244.06	$ 847.76	16	13,597.50		
2	Proposed	Lunera 6400	160	4800	4.8	17,098	$ 1,709.76	$ 1,382.06	7	10,360.00		

Assumptions:

- Cost data for the fluorescent luminaires was obtained through distributor R.D. Wright. Estimate values/luminaire = $175. Ballast prices assumed $30/ballast (based on Lunera calculator assumptions). Lamp cost data taken from Grainger Supply: $14.75/lamp.

- Estimated initial costs for Lunera fixtures obtained from applying cost savings presented by Lunera (37% of fluorescent light cost).
- Energy costs assumed: $0.10/kWh
- Total annual operation hours: 3,562

DISCUSSION

The estimated and manufacturer generated payback periods vary too greatly to be effective in an economic analysis. The large difference in results is most likely the result of inconsistent assumptions between the two methods. If the payback period of 1.9 years could be confirmed, then the system could more reasonably be considered based on economics.

The proposed systems perform reasonably well in supplying the required illuminance levels at the task surfaces. While Scenario 1 performs better quantitatively, Scenario 2 would likely reduce direct and veiling glare since the luminaires are not located directly over the task areas. Scenario one and two both provide net savings in energy costs associated with lighting at 27% and 45% respectively.

CONCLUSIONS

While this system provides energy savings, it would not be a good investment for the building at this time. In addition to unconfirmed payback data, the color quality and reliability of the fixture is not provided. This leaves too many performance issues inadequately addressed. Furthermore, the direct, diffusing lens has the potential to create more issues of glare that could easily be avoided with a parabolic troffer or indirect fixture. It could perform well for a generic classroom, but since these classrooms also house lab activities, this could be a potential issue for the occupants.

ACOUSTICAL BREADTH

The atrium designed for the building serves primarily as a circulation space and a link between the existing building and the new addition. However, since it is a major open space within the academic core of the Buffalo State College campus, it also has the potential to serve as an event or gathering space for university functions such as workshops or information sessions. Therefore the nature and size of the space require an acoustical environment that provides proper reverberation time for speech.

There are numerous architectural characteristics to be considered for the acoustical performance of a space, such as finishes, layout, and dimensions. The volume of a space directly affects the average length of sound reflections, or mean free path. The existing design of the atrium accounts for the large volume and hard surfaces by providing acoustical panel treatments on the wall and suspended from the ceiling. This study evaluates the performance of the existing acoustical treatment for a target reverberation time (T) range of 1.3-1.9 seconds and compares the results with a proposed scenario implementing a more absorptive, carpet floor.

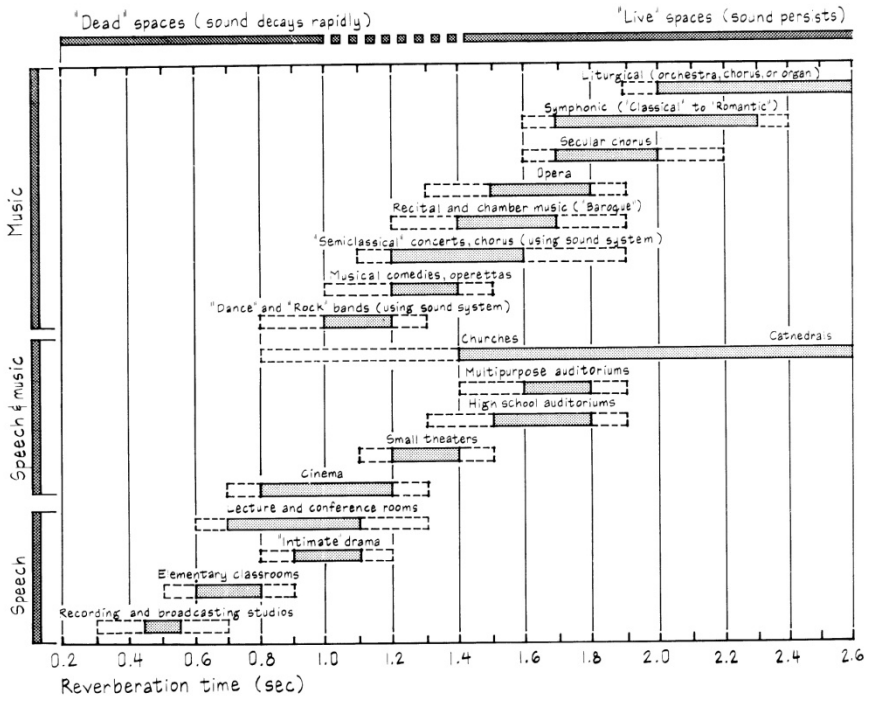
PROCEDURE:

The target T range of 1.3-1.9 seconds was selected based on optimal reverberation times for speech and music in a space [3] as presented in the figure below. In order to quantitatively evaluate the performance, the sound absorption coefficients (α) were first gathered for all the surface materials within the atrium. Then, using the surface area data and absorption coefficients, total room absorption, “a”, was calculated to be applied in Sabine’s

Formula. Note, in this study "a" is modified to account for the long shape of the atrium with a_{air}, which is equivalent to 8 sabins/1,000 ft^3.

$$a = \sum S\alpha + a_{air}$$

$$Sabine's\ Formula: \qquad T = 0.05 * \frac{V}{a}$$



OPTIMUM REVERBERATION TIMES ACCORDING TO SPACE AND AUDIO NEEDS

The calculations for T at 1,000 Hz are summarized in the tables below

Scenario 1	Existing Conditions

Location	Material	Absorption Coefficient	Surface Area	Sα
Floor	Tile	0.01	10881	108.81
Walls	Brick	0.04	5912	236.48
	Gyp Board	0.04	10795	431.8
	AWP	0.82	3082	2527.24
	Tile	0.01	1242.6	12.426
	Glass	0.12	550	66
Ceiling	Gyp Board	0.04	6568	262.72
	ACP	0.82	2166	1776.12
	Glass	0.03	1280	38.4
	Concrete	0.02	3843	76.86

ΣSα = a	5,537
Air Absorption	2,158
Adjusted a*	7,695
Atrium Volume	269,739

Reverberation Time
T = 0.05*(V/a)

T = 1.75

Satisfactory for Range of 1.3 - 1.9 Sec

Scenario 2	Replacing Level One Floor with Carpet

Location	Material	Absorption Coefficient	Surface Area	Sα
Floor	Tile	0.01	4608	46.08
	Carpet	0.37	6273	2321.01
Walls	Brick	0.04	5912	236.48
	Gyp Board	0.04	10795	431.8
	AWP	0.82	3082	2527.24
	Tile	0.01	1242.6	12.426
	Glass	0.12	550	66
Ceiling	Gyp Board	0.04	6568	262.72
	ACP	0.82	2166	1776.12
	Glass	0.03	1280	38.4
	Concrete	0.02	3843	76.86

ΣSα = a	7,795
Air Absorption	2,158
Adjusted a*	9,953
Atrium Volume	269,739

Reverberation Time
T = 0.05*(V/a)

T = 1.36

Significant Improvement
Satisfactory for Range of 1.3 - 1.9 Sec

Scenario 3	Replacing All Floors with Carpet

Location	Material	Absorption Coefficient	Surface Area	Sα
Floor				
	Carpet	0.37	10881	4025.97
Walls	Brick	0.04	5912	236.48
	Gyp Board	0.04	10795	431.8
	AWP	0.82	3082	2527.24
	Tile	0.01	1242.6	12.426
	Glass	0.12	550	66
Ceiling	Gyp Board	0.04	6568	262.72
	ACP	0.82	2166	1776.12
	Glass	0.03	1280	38.4
	Concrete	0.02	3843	76.86

ΣSα = a	9,454
Air Absorption	2,158
Adjusted a*	11,612
Atrium Volume	269739

Reverberation Time
T = 0.05*(V/a)

T = 1.16

Significant Improvement
< 1.3 - 1.9; comparable to cinema, lecture/conference room

RESULTS:

As indicated from the calculations above, all three scenarios fall within the range of 1.3 to 1.9 seconds, though the performance from scenario three is the best, as is to be expected. Additionally, the difference in noise levels (Noise Reduction) between the existing and second and third scenarios is calculated by:

$$NR = 10\ x\ log\frac{a_1}{a_2}$$

NR	dB
1:2	1.1
1:3	1.8

Again, these results indicate that scenario three performs the best. However, the noise reduction levels are too small to have a dramatic impact on the performance of the space. Human hearing can perceive changes in loudness beginning at 3 dB. Therefore, it is recommended that the initial design be maintained.

SUMMARY + CONCLUSIONS

The senior thesis project provided a unique experience for learning more about the performance and integration of systems within a building. The underlying goal of the work in these studies was to be comprehensive about the redesign and to incorporate as much of my existing knowledge and skills of building systems. As a result, daylighting, mechanical, and acoustical analyses were incorporated in the atrium space. The existing skylight system performs well for daylighting purposes but would not provide any economic benefit to the owner if not incorporated with an automatic switched lighting control system. Additionally, the current acoustical considerations for the atrium satisfy reverberation time requirements of speech. While carpeting would further improve these conditions, it is not necessary and could even conflict with the aesthetics and maintenance of the space. The study for the viability of LED luminaires for interior general illumination proves that existing technologies are not suitable for this classification of application at the present time.

Many of the existing systems perform well, and even above current standards or codes. However, the lighting levels within the existing design of the classrooms far exceed minimum requirements of the IESNA. Additionally, the electrical distribution system that supports the building has been engineered well and is prepared to cover all future loads for the second phase of the project. The proposed design of a MCC would just prove to be too difficult and expensive for this type of application.

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- Tony Borgesse

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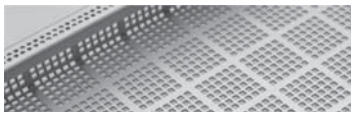
- Steven Shaffer – Manager, Design & Construction

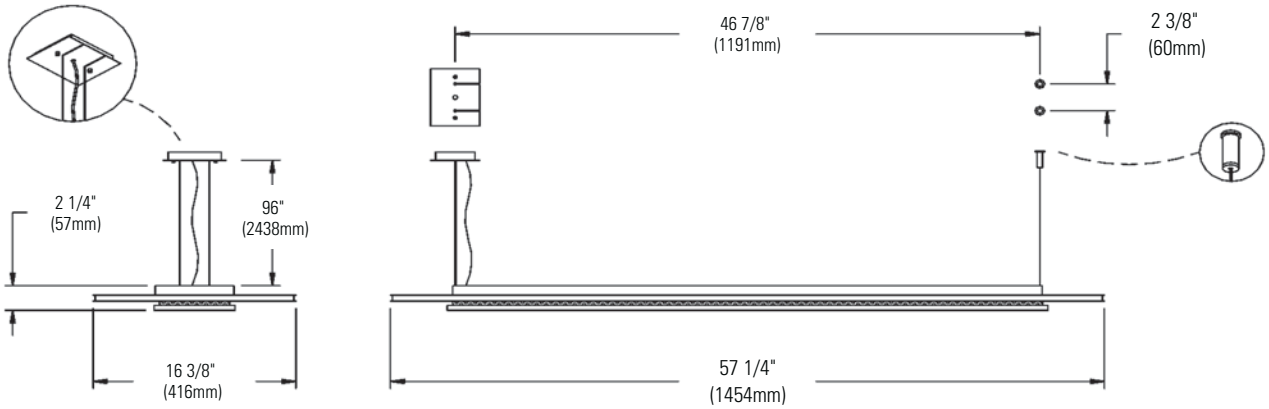
All of my classmates, friends, and family

APPENDIX A

Spectral Architectural Lighting **SL103A**

UltraFlat 1 Flat Forms 2-28W/54W T5





Ordering Guide (complete unit only)

Cat. No.	Lamp (linear)	Volt	Finish
SL103APIU	2-28W T5	120/277V	Textured Light Grey & Clear Acrylic with White Lacquer
SL103API3	2-28W T5	347V	Textured Light Grey & Clear Acrylic with White Lacquer
SL103BPIU	2-54W T5 High Output	120/277V	Textured Light Grey & Clear Acrylic with White Lacquer
SL103BPI3	2-54W T5 High Output	347V	Textured Light Grey & Clear Acrylic with White Lacquer

Features

1. **Form:** UltraFlat 1 features low profile 5/8" (16mm) and elegant detailing sought in architectural flat pendants. The perforated area presents a uniquely shaped square-in-square pattern designed to emulate the rectangular straight lines of the luminaire form. Mitred corner aluminum frame.
2. **Optical System:** Light is projected through the edge of the specially treated acrylic surface to give a uniform soft white glow. Direct light passes through a unique square in square pattern and indirect light is controlled by a wide spacing optic.
3. **Acrylic Element:** A cast acrylic element with polished edges and a specially treated surface to create a soft even glow.
4. **Perforated Element:** A square in square pattern creates a small downlight component and a soft balanced glow.
5. **Slim Profile:** Slim T5 luminaire design profile with matching contoured forms.
6. **Light Distribution:** Direct / Indirect light distribution.
7. **Central Ballast Channel:** Balanced design central ballast channel accepts all T5 ballasts and emergency options.
8. **Suspension:** Two 3/64" (1.2mm) steel cables with glider adjusting hardware for leveling.

Mounting

Dual Mount Canopy: Dual cable Spectral canopy suitable for mounting on standard octagonal box for plaster ceiling, exposed ceiling or T-Bar ceiling mounts.

Twin Adjustable Cable: Twin steel cables adjust for height leveling.

Mounting Height: Luminaire comes standard with 8' (2.4 meters) of mounting steel cables and electrical wires.

Luminaire Weight: 24 lbs.

Electrical

Ballast: Electronic Program Rapid Start slim profile 2-lamp T5 linear ballast. Universal voltage "U" ballasts automatically detect 120 volts or 277 volts operation.

Lampholder: G5 AirPass Rotor base, miniature Bi-pin.

Cord: Lightolier cords 300 volts for 120/277 volts operation or 600 volts for 120/277/347 volts operation. 18AWG AWM leads, 10 Amps maximum. White color.

Wiring: Luminaires come prewired. No need to open luminaire for wiring.

Options and Accessories

Dimming: Full range of analog or digital T5 dimming ballast option. Use Lightolier fluorescent ballast designations.*

Emergency: Bodine emergency battery pack. The emergency ballast senses the power failure and immediately switches to the emergency mode illuminate one lamp at a reduced lumen output for a minimum 90 min. The battery fully recharges within 24 hours. Add code (-EM).

Fuse: 2 Amps internal fusing.*
Add code (-F1) for 120 volts, (-F2) for 277 volts or (-F3) for 347 volts.

DALI Interface: Digital Addressable Lighting Interface available upon request for individual luminaire addressable control.*

Color End Luminious Element: Available in blue and green.

Radio Interference Filter: Inductive capacitor circuit designed interference from line radiation or feedback. Add code (-RFI).

Finish

All painted parts are with powder coat paint process.

Labels

UL "c/us" Listed. Suitable for damp locations.

* Consult your Lightolier representative for more information.

Job Information **Type:** F1

Job Name: BSC New Science Building

Cat. No.: SL103BPIU

Lamp(s): 2 54WT5HO

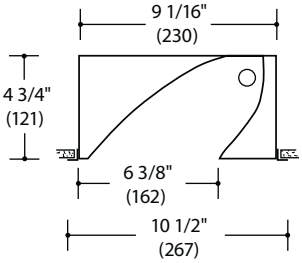
Notes:

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

LIGHTOLIER®

LITECONTROL

Fixture Type: F2
Project name: BSC New Science Building



U.S. Patent No. D351,481

Recessed Wall/Wash™

G-D-1000

Asymmetric Recessed Direct

Product Description

Recessed Direct fixture used for wall/washing applications. UL LIsted. This fixture is Cradle to Cradle Silver Certified[CM] by MBDC.

Ordering Guide

Product, lamping, & length						Options			
G -	**D -**	**10**	1	4	**T8 -**	**CWM -**	ELB10		277
Mounting	Distribution	Series	Lamp Count	Nominal Length(ft)	Lamp Type	Finish	Ballast	Other Options	Volts
G Recessed (exposed grid ceiling)*	**D** Direct	**10**	**1, 2 →**	**2 →**	**T8**	**CWM** (matte white) is standard	**ELB10** is standard	**F**	**120**
			1, 2 →	**4 →**				**CCEA**	**277**
			1 →	**2 →**	**BX40**		**DA/MK7**	**EF**	
			2 →	**4 →**	**BX50**		**DL/ECO**	**T2M**	
			see **notes**				**DO/HEL**	**T2S**	
							see **Ballast Options**	see **Other Options**	

notes:
Lamp count = total number of lamps in the fixture
Row mounting is not available.
For ordering guide information in shaded areas, choose selection by reading ACROSS the shaded areas for correct specifications.

*A conversion kit is available for installation in drywall ceiling.

G-D-1014T8-CWM-ELB10-F-120 is a typical catalog number for a 1-lamp (1 lamp in cross-section), 4-foot long T8 fixture, matte white finish, electronic ballast, fuse, 120 volts.

Cross-section lamping

Ballast Options

Specify in place of **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
EF Emergency Fluorescent Ballast. Battery-powered ballast from a UL Listed manufacturer will operate one T8 lamp for 1 1/2 hours.
T2M, T2S Master/slave ballasting. For energy considerations combine **T2M** (Master) with **T2S** (Slave).
T2M - Fixture contains one two-lamp ballast.
T2S - Fixture does not contain a ballast.

Questions to Ask

1. Ceiling type?
2. Other options? **3.** 120 or 277 volt?

Click on **Quick Find 10**
litecontrol.com

revised 07/21/2009

PORTFOLIO™ energy solutions

DESCRIPTION

A low brightness 7-3/8" aperture adjustable accent fixture for use with a 26W, 32W or 42W Triple Twin Tube lamp. Optics allow the lamp axis to pivot about the center of the aperture at the ceiling line, allowing maximum light output with no flashback. 20° truncated cone allows full range and flexibility of aiming.

Catalog #	CA7042ECP	Type
Project	Buffalo State CollegeNew Science Building	F3
Comments		Date
Prepared by	Marie Ostrowski	02/12/2010

SPECIFICATION FEATURES

A ... Reflector
Spun 0.040" aluminum. Available in a variety of Alzak® finishes. Upper reflector is specular clear for maximum light output. Torsion springs pull trim tight to ceiling. Reflector is keyed to prevent improper orientation relative to adjustment. Compact fluorescent lamps can be removed through the reflector.

B ... Trim Ring
Self flanged or molded white trim ring. Rimless or metal trim ring accessories available.

C ... Aiming Mechanism
Stable lamp aiming and locking mechanism allows smooth 365° rotation and 30° elevation adjustment. Lamp aiming scale enables consistent setting across multiple fixtures.

D ... Housing
One piece die cast 1-1/2" deep collar. Housing is painted optical matte black to eliminate stray light.

E ... Universal Mounting
Accepts 1/2" EMT, C Channel, T bar fasteners and hanger bars. Provides 5" total adjustment.

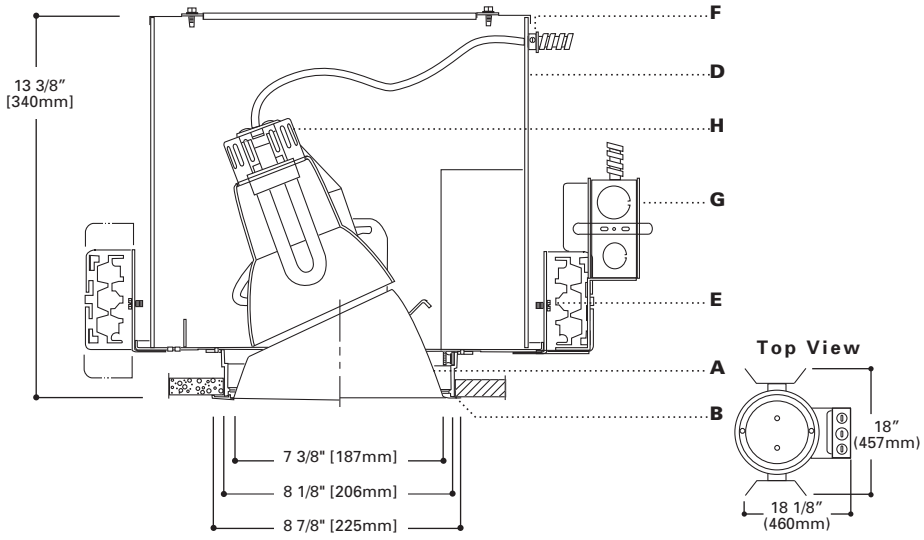
F ... Conduit Fittings
Die-cast screw tight connectors.

G ... Junction Box
Listed for eight #12g (four in, four out) 90°C conductors feed through branch wiring. Pry-outs for four 1/2" and two 3/4" conduits. Access to junction box through panel in side of housing.

H ... Socket
4-pin GX24q3/4 base with fatigue free stainless steel lamp spring ensures positive lamp retention.

Labels
cULus listed, C.S.A. certified, damp location, IBEW union made.

Options & Accessories
TRM=Metal Trim Rings to replace molded trim ring
TRR=Rimless Trim Rings for minimal flange appearance in plaster ceilings



CA7042 7471/70

26W, 32W, 42W TTT
Compact Fluorescent

7-3/8" ADJUSTABLE

26W Triple 4-pin
Ballast: Electronic
120V Input Watts: 29, Line Amps: 0.25
277 Input Watts: 26, Line Amps: 0.09
Power Factor: >.99, THD: <10%
Min. Starting Temp: -10°C (15°F)
Sound Rating: A

32W Triple 4-pin
Ballast: Electronic
120V Input Watts: 34.5, Line Amps: 0.30
277 Input Watts: 34.5, Line Amps: 0.13
Power Factor: >.99, THD: <10%
Min. Starting Temp: -10°C (15°F)
Sound Rating: A

32W Triple 4-pin
Ballast: Dimming
120V Input Watts: 39, Line Amps: 0.33
277 Input Watts: 37, Line Amps: 0.13
Power Factor: >.95, THD: <20%
Min. Starting Temp: 10°C (50°F)
Sound Rating: A

NOTES:
Accessories should be ordered separately. For additional options please consult your Cooper Lighting Representative. Alzak is a registered trademark of Aluminum Company of America. Hi-Lume is a registered trademark of Lutron Co. Inc.

ORDERING INFORMATION

CA7042ECP

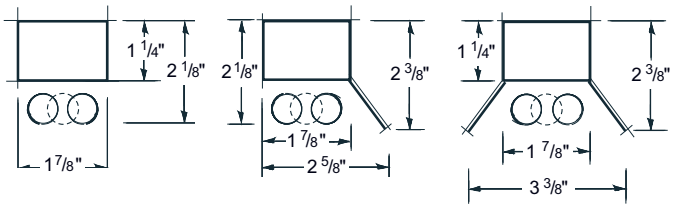
CA70	42	E	CP

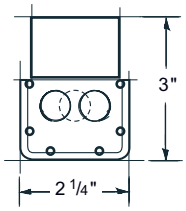
Housing
CA70: 7" Adjustable

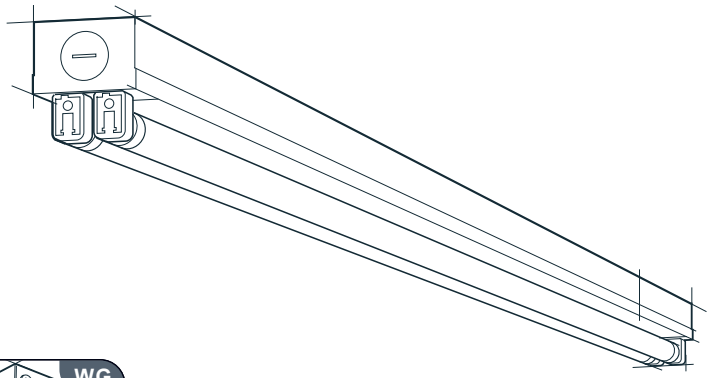
Wattage
42: (1) 26W, 32W, or 42W TTT Lamp

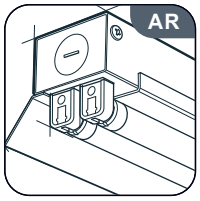
Ballast
E: 120/277V 50/60 Hz Electronic

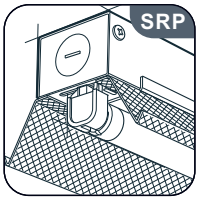
Options
CP: Chicago Plenum

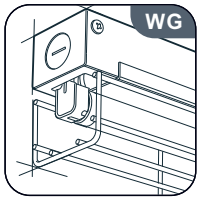












ordering

series	body style	lamp rows	nominal length	color/finish	voltage	options
P-T5	STD	1T5	02	BWE	277	
	STD standard	1T5	02'	BWE* white enamel	120	AL
	AR asymmetric reflector	2T5	03'	YGW gloss white	277	EML*
	ARP asymmetric reflector perforated	1T5HO	04'	Y__ premium color	347*	EMH*
	SR symmetric reflector	2T5HO	06'	CC custom color	120-277	DM
	SRP symmetric reflector perforated		08'	GLV galvanized	*T5HO only	B__
	WG wire guard		R__*	*standard		FH
			*row length			*consult factory for fixture lengths < 4'

Applications Concealed coves, small offices, retail, healthcare, schools, small profile spaces.

Features A compact T5/HO strip light with integral ballast in 1- or 2-lamp profiles. Options include perforated or solid, symmetric and asymmetric reflectors, and a rugged, zinc-coated wire guard (natural finish). Dimming ballasts and emergency batteries are also available.

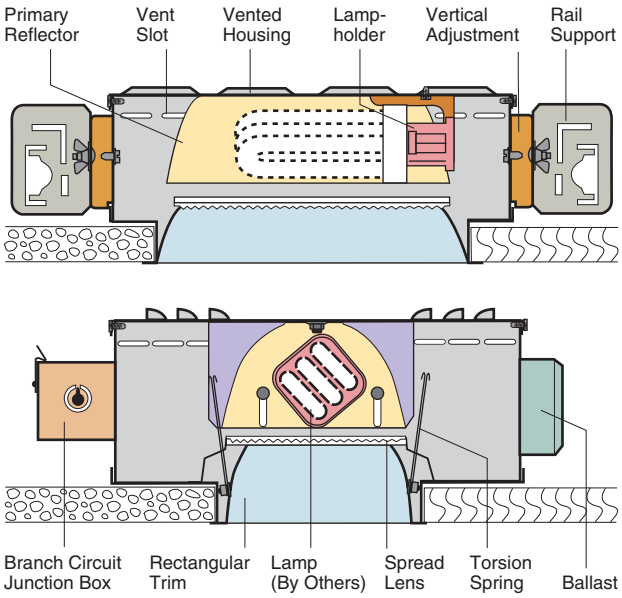
Construction The housing, available in 2-, 3-, 4-, 6- or 8-foot standard lengths, is made of die-formed, 20-gauge steel.

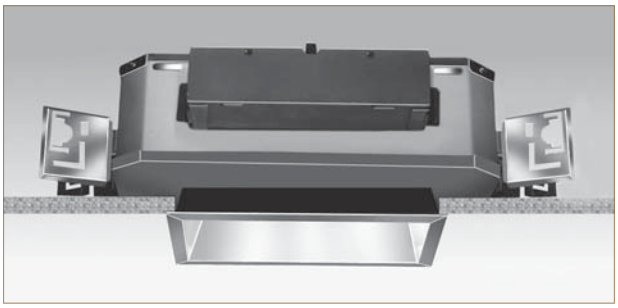
Finish The standard exterior body color is white enamel (BWE). Refer to ordering matrix for optional metal finishes or refer to **Defining Section** for optional paint colors.

Electrical T5/HO fixtures have programmed-start electronic ballasts with less than 10% THD. Fixtures are U.L. Damp labeled (non-emergency) and I.B.E.W. manufactured. Maximum ballast size available: 1 5/8" width x 1 1/4" height.

Mounting Fixture is to be surface-mounted.

Options **AL:** aluminum body; **EML:** emergency battery (T5/HO=600-700 lumens); **EMH:** emergency battery (T5/HO=1100-1400 lumens); **DM:** dimming (consult factory); **B_:** specific ballast, specify manufacturer and catalog number (consult factory); **FH:** fixture fusing (slow blow).





T4142

Rectangular Parabolic Splay Trim
One 26-32-42W Triple Tube Lamp
4 1/2" x 8 1/2" Apertures

Optics and Applications
The hydroformed specular primary reflector creates a slightly asymmetric pattern depending upon measurement parallel or perpendicular to the lamps. A microprism spread lens is supplied as standard for brightness control.

Design Features
A rigid housing protects all fixture parts. Air flow design assures a cool lamp chamber. The parabolic splay trim is held by a constant tension torsion spring assembly. Maximum ceiling thickness 7/8". Top or bottom service.

Finish
Housing and structural parts are painted matte black. The aperture trim is Softglow® clear. Special finishes, textures and colors are available. See Accessories.

Trim Textures
A selection of textured trims creates an interesting architectural dimension on the ceiling plane. All textures are available in anodic special colors.

Ballast
Fully electronic, microprocessor controlled with variable starting current for inrush protection to assure rated lamp life. Input voltage ranges from 120V through 277V. Operates 26W, 32W or 42W triple tube lamps interchangeably. Power factor .98, starting temperature 0° F (-18° C), THD < 10%. Pre-heat start < 1.0 second. End of lamp life protection. Rated for > 50,000 starts.

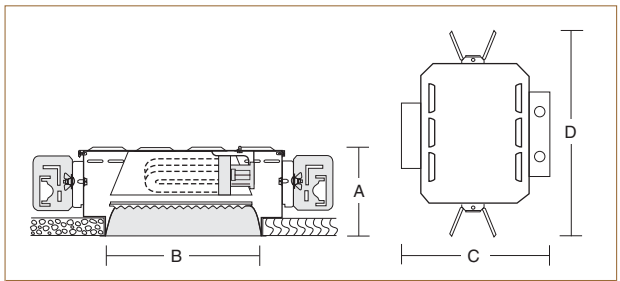
General
Fixtures are pre-wired, UL and C-UL listed for eight wire 75°C branch circuit wiring. All products are union made IBEW. Luminaire Efficiency Rating (LER) data is in the photometric directory located in Section Z.

Accessories

R2	26" support rails.	WT	White trim flange.
R5	52" support rails.	WHT	White complete trim.
SB	Softglow black trim.	BP	Ball Peen texture.*
SG	Softglow gold trim.	CG	Corrugated texture.
SH	Softglow mocha trim.	DS	Distressed texture.
SP	Softglow graphite trim.	WV	Woven texture.
ST	Softglow titanium trim.	BR	Bright trim finish.
SW	Softglow wheat trim.	LL	Linear lens.
SY	Softglow pewter trim.	LP	Large prism lens.
SZ	Softglow bronze trim.	FR	Frosting on lens.
V347	347 volt ballast.	F	Ballast fuse.

TC Single cross blade for two cell trim.*
FC Two cross blades for four cell trim.*
DM Dimming ballast. Specify watts and volts.
EM Emergency power includes integral charger light and test switch visible through aperture. Single lamp operation for 90 minutes. Specify volts.
WRL Wattage restriction label, specify wattage.
*Baffles TC and FC not available with Ball Peen texture.

Dimensions and Lamps



Number	A Depth	B Aperture	C Width	D Length	Lamp
T4142	5 1/2" 140mm	4 1/2" x 8 1/2" 114mm x 216mm	13 1/2" 343mm	18 3/4" 476mm	One 26-32-42W Triple Tube

Matching Rectangular Units

PAR lamp directional downlight	Page T1
Tungsten halogen downlight	Page T2
Low voltage directional downlights	Page T3
Metal halide downlights	Pages T5, T6
PAR lamp wall washers	Page T21
Tungsten halogen wall washers	Page T22
Compact fluorescent wall washers	Page T23
Metal halide wall washers	Page T24

** Click for link to pages in blue.

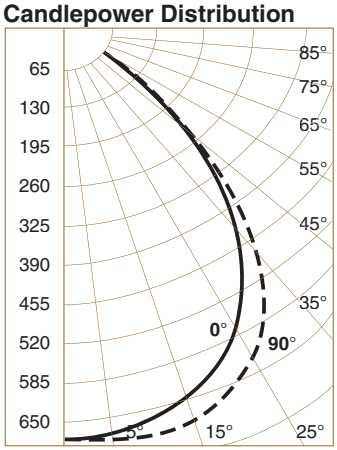
T4 T4142

Performance Datachart

Single Unit Initial Footcandles, 30" Work Plane							Ceiling to Floor	Multiple Units Initial Footcandles, 30" Work Plane			
T4142 One 32W Philips Triple Tube Read Top Data T4142 One 42W Philips Triple Tube Read Bottom Data								Ceiling 80% Walls 50% Floor 20%			
Nadir	10°		20°		30°			Spacing is Maximum Over Work Plane			
FC	FC	Diam	FC	Diam	FC	Diam		Spacing	RCR 1	RCR 3	RCR 8
23 29	22 28	2' 2'	18 23	4' 4'	12 15	6' 6'	8'	6' 6'	30 39	25 32	16 21
16 21	15 20	2' 2'	13 17	5' 5'	8 11	8' 8'	9'	8' 8'	22 28	18 23	11 15
12 16	12 15	3' 3'	10 13	5' 5'	6 8	9' 9'	10'	9' 9'	16 21	13 17	9 11
9 12	9 12	3' 3'	7 10	6' 6'	5 6	10' 10'	11'	10' 10'	13 17	10 14	7 9
8 10	7 9	3' 3'	6 8	7' 7'	4 5	11' 11'	12'	11' 11'	10 13	8 11	5 7

For 26W use 32W data x .75

Candlepower Distribution

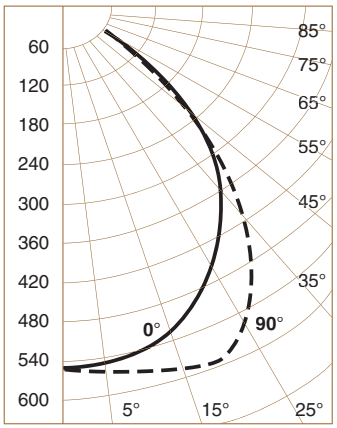


T4142 32W Triple Tube Philips
Eff. 47% S/M 0° 1.13 90° 1.19

Candelas

o	0°	90°
	2400*	2400*
0	686	686
5	686	686
10	673	689
15	656	687
20	621	671
25	574	629
30	515	559
35	435	475
40	345	368
45	243	234
50	156	131
55	93	68
60	54	31
65	30	13
70	16	10
75	11	6
80	0	0
85	0	0
90	0	0

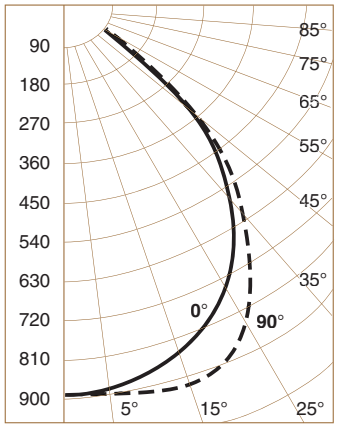
o Vertical Angles
* Initial Lamp Lumens



T4142 32W Triple Tube Osram
Eff. 41% S/M 0° 1.14 90° 1.27

o	0°	90°
	2400*	2400*
0	552	552
5	551	561
10	543	570
15	528	588
20	502	591
25	467	563
30	420	503
35	363	418
40	297	318
45	223	209
50	141	119
55	87	63
60	54	30
65	29	11
70	16	8
75	7	3
80	2	0
85	0	0
90	0	0

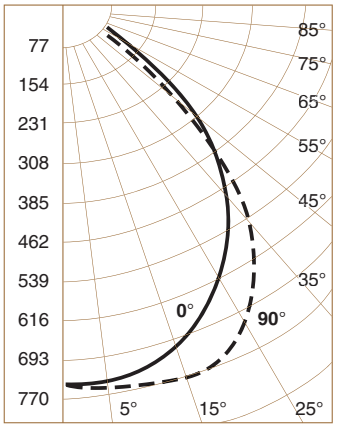
o Vertical Angles
* Initial Lamp Lumens



T4142 42W Triple Tube Philips
Eff. 47% S/M 0° 1.13 90° 1.20

o	0°	90°
	3200*	3200*
0	891	891
5	891	898
10	870	914
15	840	918
20	798	905
25	746	843
30	669	735
35	572	612
40	463	474
45	348	335
50	215	194
55	127	103
60	78	50
65	43	17
70	20	13
75	12	8
80	9	5
85	0	0
90	0	0

o Vertical Angles
* Initial Lamp Lumens



T4142 42W Triple Tube Osram
Eff. 39% S/M 0° 1.12 90° 1.24

o	0°	90°
	3200*	3200*
0	744	744
5	746	754
10	736	763
15	710	776
20	668	773
25	620	725
30	552	649
35	476	545
40	379	401
45	277	253
50	177	147
55	107	74
60	62	32
65	35	13
70	18	9
75	9	6
80	0	0
85	0	0
90	0	0

o Vertical Angles
* Initial Lamp Lumens

Coefficients of Utilization

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

T4142 One 32W Triple Tube Philips
T4142 One 42W Triple Tube Philips
T4142 One 32W Triple Tube Osram x .88
T4142 One 42W Triple Tube Osram x .85

Notes

1 All data with standard Softglow® clear trim.

2 Single unit Datachart pattern diameters are determined by the number of degrees from each side of nadir. Therefore a 20° diameter represents a total 40° pattern width at the work plane 30" above the floor. Footcandle values are at the edge of that diameter.

3 Datachart spacing is rounded off to the nearest foot.

4 Data by IES methods. Compact fluorescent data vary due to lamp lumen differences, power input, burning position, ambient temperature and ballast characteristics. A modification factor should be applied.

sconce

softlite™ VI

FOCAL POINT®

features

ADA compliant wall sconce that compliments entire Softlite™ family.

1', 2' and 4' nominal lengths provide endless design capabilities.

Detachable perforated lamp shield allows for quick cleaning and re-lamping.

Softlite™ Sconce makes an exceptional aesthetic statement in corridors, conference rooms, private or open offices, reception areas or other high-end applications.

companion luminaire

recessed

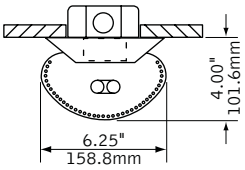
recessed

linear

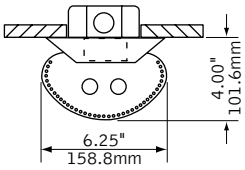
WMR
Designed for
MRI use

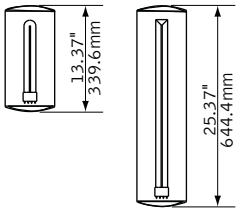
dimensional data

1' & 2' fixtures



4' fixture





lamping options

1' fixture

18W BIAX LAMP

2' fixture

40W BIAX LAMP

T5/T5HO LAMP

T8 LAMP

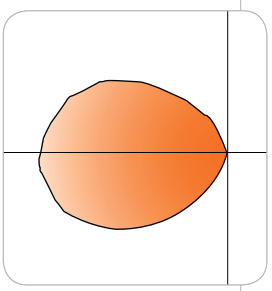
4' fixture

T5/T5HO LAMP

T8 LAMP

performance

1–Lamp 18W Biax
74% Efficiency
180 cd @ 85°



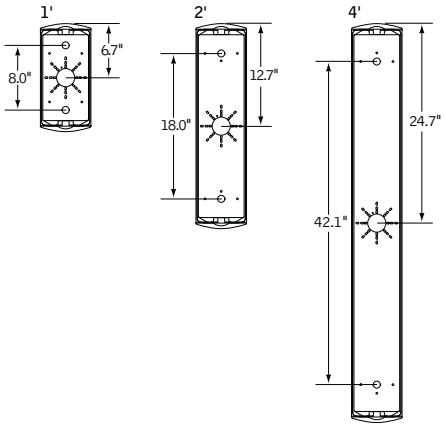
Visit focalpointlights.com for complete photometric data.

february 4 2010 B

fixture:

project:

mounting information



specifications

construction

20 Ga. Steel housing/reflector.

Lamps are shielded by detachable 22 Ga. steel perforated lamp shield with acrylic lens insert.

Die-cast aluminum end caps complete shield assembly.

1' unit weight:	4 lbs.
2' unit weight:	7 lbs.
4' unit weight:	12 lbs.

optic

20 Ga. C.R.S. reflector finished in High Reflectance White powder coat.

electrical

Luminaires are pre–wired for specified circuits, with thermally protected Class "P" electronic ballasts.

Optional dimming ballasts available.

Consult factory for specifications and availability.

UL and cUL listed.

finish

Polyester powder coat applied over a 5-stage pre–treatment.

ordering

luminaire series		FS6
Softlite Sconce	FS6	
profile		1
1' Length (120V. only)	1	
2' Length	2	
4' Length	4	
lamping		1BX18
1' Length Only		
1 Lamp 18 Watt Biax	1BX18	
2' Length Only		
1 Lamp 40 Watt Biax	1BX40	
1 Lamp T5	1T5	
2 Lamp T5	2T5	
1 Lamp T5HO	1T5HO	
2 Lamp T5HO	2T5HO	
1 Lamp T8	1T8	
2 Lamp T8	2T8	
4' Length Only		
1 Lamp T5	1T5	
2 Lamp T5	2T5	
1 Lamp T5HO	1T5HO	
2 Lamp T5HO	2T5HO	
1 Lamp T8	1T8	
2 Lamp T8	2T8	
circuit		1C
Single Circuit	1C	
voltage		
120 Volt	120	
277 Volt	277	
347 Volt (Consult factory for availability) (277V. & 347V. not available on 1' luminaire)	347	
ballast		
Electronic Instant Start <20% THD (T8 & 40W Biax only)	E	
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast* (Available on 2' and 4' units only)	D	
mounting		WM
Wall Mount	WM	
factory options		
Emergency Battery Pack* (2' & 4' units only)	EM	
HLR/GLR Fuse	FU	
Include 3000K Lamp	L830	
Include 3500K Lamp	L835	
Include 4100K Lamp	L841	
finish		WH
Matte Satin White	WH	

* for more information see Reference section.

Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | T: 773.247.9494 | F: 773.247.8484 | info@focalpointlights.com | www.focalpointlights.com.

28W/835 Min Bipin T5 HE ALTO UNP

Product family description

High efficiency, environmentally responsible, ultra-slim lamps.

Features/Benefits

- Slim profile lamp and ballast.
- Better for the environment.
- Operates on programmed start ballasts.
- Fail-safe operation at end of life.
- Design flexibility.
- Improved optical control.
- Fixtures can be 40% smaller than T8 systems.
- Better fit in 2 x 2 and 2 x 4 grid ceilings.
- Low mercury (14W, 21W and 28W.)
- Energy efficient.
- Less material for less waste.

Applications

- Ideal for general, decorative and architectural lighting in offices, retail stores, hotels, schools and hospitals.

Notes

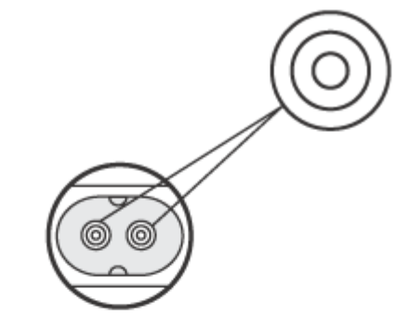
- Silhouette™ T5 nominal lamp lengths are shorter than standard sizes. See dimension chart for details.

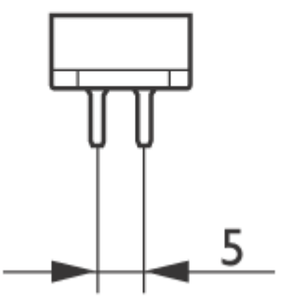
Product data	
Product Number	230854
Full product name	28W/835 Min Bipin T5 HE ALTO UNP
Ordering Code	230854
Pack type	Unpacked
Pieces per Sku	1
Skus/Case	40
Pack UPC	046677230852
EAN2US	
Case Bar Code	50046677230857
Successor Product number	
System Description	High Efficiency
Base	Miniature Bipin
Base Information	Green [Green Base]
Bulb	T5 [16 mm]

PHILIPS

Product data	
Packing Type	UNP [Unpacked]
Packing Configuration	40
Rated Avg. Life	24000 hr
Type	na
Feature	na [Not Applicable]
Ordering Code	F28T5/835/ALTO
Pack UPC	046677230852
Case Bar Code	50046677230857
Watts	28W
Dimmable	Yes
Color Code	835 [CCT of 3500K]
Color Rendering Index	85 Ra8
Color Designation	White
Color Description	835 White
Color Temperature	3500 K
Initial Lumens	- Lm
Overall Length C	1163.2 mm
Diameter D	17 mm
Special packing	ALTO
Product Number	230854

TL5 HE





Base Miniature Bipin

PHILIPS

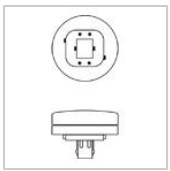
Presented By:	**Marie Ostrowski**		
Contact Phone:		Customer Name:	Buffalo State College
Contact E-mail:	mso139@psu.edu	Project Name:	New Science Building
		Fixture Type:	D Recessed Downlight

GE Lighting

97631 - F32TBX/835/A/ECO

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

High Color Rendering
Energy Savings

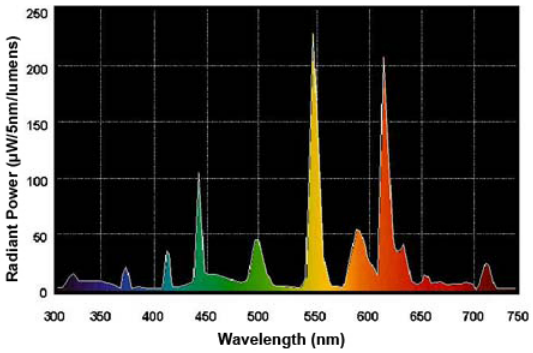

CAUTIONS & WARNINGS

Caution

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

GRAPHS & CHARTS

Spectral Power Distribution



GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24q-3
Wattage	32
Voltage	120/100
Rated Life	12000 hrs
Starting Temperature	0 K (32 °F)
Cathode Resistance	2.7 Ohm
LEED-EB MR Credit	123 picograms Hg per mean lumen hour
Rated Life (rapid start) @ Time	12000.0 @ 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	2400
Mean Lumens	2040
Nominal Initial Lumens per Watt	75
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

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)	5.5 cm
Nominal Length	5.5 cm
Base Face to Top of Lamp	4.9 cm

PRODUCT INFORMATION

Product Code	97631
Description	F32TBX/835/A/ECO
ANSI Code	60901-IEC-7432-2
Standard Package	Case
Standard Package GTIN	10043168976319
Standard Package Quantity	10
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168976312

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

24W/835 Min Bipin T5 HO ALTO UNP

Product family description

Environmentally responsible, ultra-slim lamps with extraordinary light output.

Features/Benefits

- Increased light output.
- Slim profile lamp and ballast.
- Better for the environment.
- Operates on programmed start ballasts.
- Fail-safe operation at end of life.
- Up to 70% more lumens than standard Silhouette™ T5 lamps.
- Design flexibility.
- Improved optical control.
- Low mercury (24W and 39W.)
- Energy efficient.
- Less material for less waste.

Applications

- Ideal for medium and high-bay retail and industrial applications.

Note

- Philips Lighting warrants T5 HO lamps when used with ballasts that are designed to meet the proposed IEC (International Electrotechnical Commission) dimming requirements and all other industry standards (i.e., NEC, UL, IEC and ANSI.) Please work with your Philips representative to get dimming approval before installation.
- Silhouette T5 nominal lamp lengths are shorter than standard sizes. See dimension chart for details.

Product data	
Product Number	290205
Full product name	24W/835 Min Bipin T5 HO ALTO UNP
Ordering Code	290205
Pack type	Unpacked
Pieces per Sku	1

PHILIPS

Product data	
Skus/Case	40
Pack UPC	046677290207
EAN2US	
Case Bar Code	50046677290202
Successor Product number	
System Description	High Output
Base	Miniature Bipin
Base Information	Green [Green Base]
Bulb	T5 [16 mm]
Packing Type	UNP [Unpacked]
Packing Configuration	40
Rated Avg. Life	24000 hr
Type	na
Feature	na [Not Applicable]
Ordering Code	F24T5/835/HO/ALTO
Pack UPC	046677290207
Case Bar Code	50046677290202
Watts	24W
Dimmable	Yes
Mercury (Hg) Content	
Color Code	835 [CCT of 3500K]
Color Rendering Index	85 Ra8
Color Designation	White
Color Description	835 White
Color Temperature	3500 K
Initial Lumens	2000 Lm
Overall Length C	563.2 mm
Diameter D	17 mm
Special packing	ALTO
Product Number	290205

PHILIPS

54W/835 Min Bipin T5 HO ALTO UNP

Product family description

Environmentally responsible, ultra-slim lamps with extraordinary light output.

Features/Benefits

- Increased light output.
- Slim profile lamp and ballast.
- Better for the environment.
- Operates on programmed start ballasts.
- Fail-safe operation at end of life.
- Up to 70% more lumens than standard Silhouette™ T5 lamps.
- Design flexibility.
- Improved optical control.
- Low mercury (24W and 39W.)
- Energy efficient.
- Less material for less waste.

Applications

- Ideal for medium and high-bay retail and industrial applications.

Note

- Philips Lighting warrants T5 HO lamps when used with ballasts that are designed to meet the proposed IEC (International Electrotechnical Commission) dimming requirements and all other industry standards (i.e., NEC, UL, IEC and ANSI.) Please work with your Philips representative to get dimming approval before installation.
- Silhouette T5 nominal lamp lengths are shorter than standard sizes. See dimension chart for details.

Product data	
Product Number	290288
Full product name	54W/835 Min Bipin T5 HO ALTO UNP
Ordering Code	290288
Pack type	Unpacked
Pieces per Sku	1

PHILIPS

Product data	
Skus/Case	40
Pack UPC	046677290283
EAN2US	
Case Bar Code	50046677290288
Successor Product number	
System Description	High Output
Base	Miniature Bipin
Base Information	Green [Green Base]
Bulb	T5 [16 mm]
Packing Type	UNP [Unpacked]
Packing Configuration	40
Rated Avg. Life	24000 hr
Type	na
Feature	na [Not Applicable]
Ordering Code	F54T5/835/HO/ALTO
Pack UPC	046677290283
Case Bar Code	50046677290288
Watts	54W
Dimmable	Yes
Mercury (Hg) Content	
Color Code	835 [CCT of 3500K]
Color Rendering Index	85 Ra8
Color Designation	White
Color Description	835 White
Color Temperature	3500 K
Initial Lumens	5000 Lm
Overall Length C	1163.2 mm
Diameter D	17 mm
Special packing	ALTO
Product Number	290288

PHILIPS

	A	A	B	B	B	B
Full product name	Max	Max	Min	Min	Max	Max
Bipin T5 HO ALTO UNP						

	C	C	D	D
Full product name	Max	Max	Max	Max
54W/835 Min Bipin T5 HO ALTO UNP	1163.2	1163.2	17	17

Presented By:
Contact Phone:
Contact E-mail:

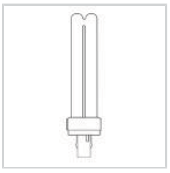
Customer Name:
Project Name: BSC New Science Building
Fixture Type: F6 - WALL SCONCE

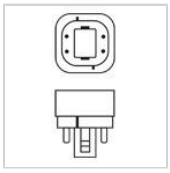
GE Lighting

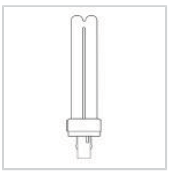
97600 - F18DBX/835/ECO4P

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

High Color Rendering
Energy Savings







GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	G24q-2
Wattage	18
Voltage	100
Rated Life	12000 hrs
Starting Temperature	0 °C (32 °F)
Cathode Resistance	6.05 Ohm
LEED-EB MR Credit	344 picograms Hg per mean lumen hour
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	1200
Mean Lumens	970
Nominal Initial Lumens per Watt	66
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.25 A
Open Circuit Voltage (after preheating)	220 V
Open Circuit Voltage Across Starter	198 V
Lamp Current	0.22 A
Preheat Voltage	4.25 V
Current Crest Factor	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	5.8000 in(147.3 mm)
Nominal Length	5.800 in(147.3 mm)
Base Face to Top of Lamp	5.200 in(132.1 mm)

PRODUCT INFORMATION

Product Code	97600
Description	F18DBX/835/ECO4P
ANSI Code	60501-IEC-2518-2
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	043168976008

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

Date: _____ Type: _____

Firm Name: _____

Project: _____

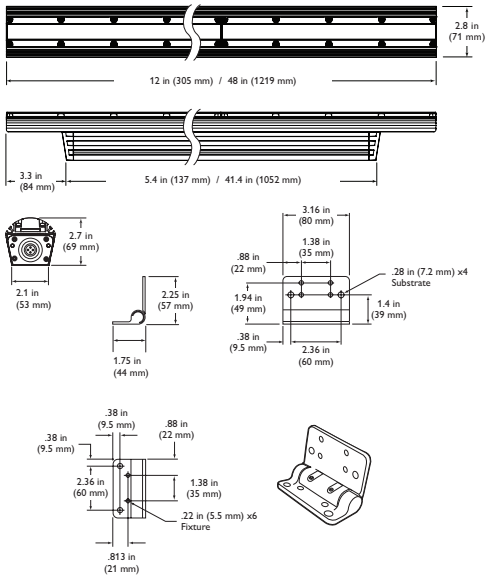
eW Graze Powercore

4000 K, 10° x 60° Lens

Linear LED surface light for wall washing and grazing

eW® Graze Powercore is a linear lighting fixture optimized for surface grazing and wall-washing applications requiring high-quality white or solid color light. Featuring Powercore® technology, eW Graze Powercore processes power directly from line voltage, eliminating the need for low-voltage, external power supplies. Fixtures are available in eight color temperatures, ranging from a warm 2700 K to a cool 6500 K, and five solid colors. eW Graze Powercore offers superior illumination quality and dramatic energy savings for new installations and retrofit upgrades. A space-efficient, low-profile aluminum housing and flexible mounting options allow discrete placement within a wide range of compact architectural details

- Tailor light output to specific applications — eW Graze Powercore is available in standard 1 ft and 4 ft exterior-rated housings, and standard 10° x 60° and 30° x 60° beam angles.
- High-performance illumination and beam quality — eW Graze Powercore offers superior beam quality for striation-free saturation as close as 6 in (152 mm) from fixture placement. eW Graze Powercore accommodates end-to-end or incremental placement without visible light scalloping between fixtures.
- Supports new applications for white light— Long-life LEDs (50,000 hours at 70% lumen maintenance) significantly reduce or eliminate maintenance problems, allowing the use of white or solid color lighting in spaces where bulb maintenance may be limited or unfeasible.
- Universal power input range — eW Graze Powercore accepts line voltage input of 100, 120, 220 – 240, and 277 VAC.
- Versatile installation options — Constant torque locking hinges offer simple position control from various angles without special tools. The low-profile extruded aluminum housing accommodates installation within architectural niches of many different shapes and sizes.



- Wide range of build-to-order configurations — Additional fixture lengths, beam angles, color temperatures up to 6500 K, and solid colors (Royal Blue, Blue, Green. Amber, and Red) are available as build-to-order configurations. See the eW Graze Powercore Ordering Information sheet for complete details.
- "Cool lighting" functionality — eW Graze Powercore fixtures do not heat illuminated surfaces, discharge infrared radiation or emit ultraviolet light.
- Dimming capable — Patented DIMand™ technology offers smooth dimming capability with many ELV-type dimmers.
- Trouble-free, code-compliant installation — IP66, UL wet location ratings. UL / cUL, CE, FCC, RoHS, WEEE certified.

For detailed product information, please refer to the eW Graze Powercore Product Guide at www.colorkinetics.com/ls/essentialwhite/ewgraze/

A Green Flagship Product

Our Green Flagship Products offer significantly improved environmental performance in two or more of the following Green Focal Areas: weight, energy consumption, hazardous substances, packaging, recycling, disposal, and lifetime reliability.

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	1 ft (305 mm)	4 ft (1.2 m)
Output	Beam Angle	10° x 60°	
	Color Temperature	4000 K (+400 / -500)	
	Lumens†	477	1908
	Efficacy (Lm/W)	31.8	
	Mixing Distance	6 in (152 mm) to uniform beam saturation	
	Lumen Maintenance‡	100,000+ hours L_{70} @ 25° C 50,000 hours L_{70} @ 50° C	
Electrical	Input Voltage	100 / 120 / 220 – 240 / 277 VAC, 50 / 60 Hz	
	Power Consumption	15 W maximum at full output, steady state	60 W maximum at full output, steady state
Control		Commercially available ELV control dimmers	
Physical	Dimensions *(Height x Width x Depth)*	2.7 x 12 x 2.8 in (69 x 305 x 71 mm)	2.7 x 48 x 2.8 in (69 x 1219 x 71 mm)
	Weight	2.7 lb (1.2 kg)	10.8 lb (4.9 kg)
	Housing	Extruded anodized aluminum	
	Lens	Clear polycarbonate	
	Fixture Connectors	Integral male / female waterproof connectors	
	Mounting	Multi-positional, constant torque locking hinges	
	Temperature	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup	
	Humidity	0 – 95%, non-condensing	
	Fixture Run Lengths*	88 @ 110 VAC 97 @ 120 VAC 180 @ 220 VAC 197 @ 240 VAC	*Configuration:* *1 ft (305 mm) fixtures installed end-to-end, 20 A circuit, standard 50 ft (15.2 m) Leader Cable*
Certification and Safety	Certification	UL / cUL, FCC Class A, CE, RoHS, WEEE	
	LED Class	Class 2 LED product	
	Environment	Dry / Damp / Wet Location, IP66	

† Lumen measurement complies with IES LM-79-08.

‡ L_{70} = 70% maintenance of lumen output. (When light output drops below 70% of initial output.)

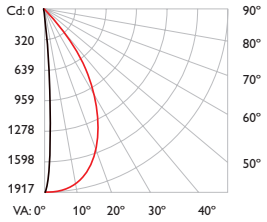
*These figures, provided as a guideline, are accurate for this configuration only. Changing the configuration can affect the fixture run lengths.

OPTIBIN® CK TECHNOLOGY | POWERCORE® CK TECHNOLOGY | DIMAND® CK TECHNOLOGY

Photometrics

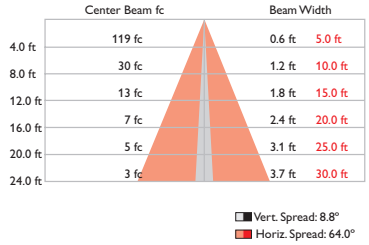
4000 K, 1 ft, 10° x 60° lens

Polar Candela Distribution



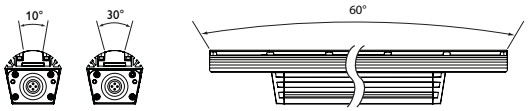
	0	22.5	44	67.5	90
0	1902	1902	1902	1902	1902
5	782	870	1135	1596	1896
15	98	107	156	570	1734
25	45	51	73	160	1356
35	25	29	42	76	774
45	12	14	25	47	261
55	4	6	13	29	66
65	1	2	6	14	26
75	0	0	1	5	10
85	0	0	0	0	1
90	0	0	0	0	0

Illuminance at Distance



For lux multiply fc by 10.7

Power Consumption	15 W
Lumens	477
Efficacy	31.8 Lm/W



Fixtures

Item	Beam Angle	Voltage	Size	Item Number	Philips 12NC
eW Graze Powercore 4000 K	10° x 60°	120 VAC	1 ft	523-000030-01	910503700277
			4 ft	523-000030-03	910503700279
		277 VAC	1 ft	523-000030-09	910503700285
			4 ft	523-000030-11	910503700287
		220 – 240 VAC	1 ft	523-000030-17	910503700293
			4 ft	523-000030-19	910503700295
		100 VAC	1 ft	523-000030-25	910503700301
			4 ft	523-000030-27	910503700303

Use Item Number when ordering in North America.

Accessories

Item	Type	Size	Item Number	Philips 12NC
Leader Cable	UL / cUL	50 ft (15.2 m)	108-000041-00	910503700320
	CE		108-000041-01	910503700320
Jumper Cable	UL / cUL	End-to-End	108-000039-00	910503700314
		1 ft (305 mm)	108-000039-01	910503700315
		5 ft (1.5 m)	108-000039-02	910503700316
	CE	End-to-End	108-000040-00	910503700317
		1 ft (305 mm)	108-000040-01	910503700318
		5 ft (1.5 m)	108-000040-02	910503700319
Glare Shield		1 ft (305 mm)	120-000081-00	910503700745
		2 ft (610 mm)	120-000081-01	910503700746
		3 ft (914 mm)	120-000081-02	910503700747
		4 ft (1.2 m)	120-000081-03	910503700748

Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.colorkinetics.com

DAS-000009-02 R04 07-09

1300 Industrial Road, Unit #19
San Carlos, CA 94070
Tel: 1-(650)-595-LUMA(5862)
Fax: 1-(650)-595-5820
Email: info@lumascape.com
FREE CALL 1-866-695-LUMA(5862) US & Canada

LUMASCAPE USA INC.

LS482 Balitza

Bollard & Pathway

Refer to Symbol Index on page 2 for explanation

humantouch™ electropolish+™

IP66 c UL us

Specifications

Lamp source	13W	CFL / TC-TEL *(GX24-q1)*
	18W	CFL / TC-TEL *(GX24-q2)*
	26W	CFL / TC-TEL *(GX24-q3)*
	50W max	HAL Bi-pin / QT12 *(G6.35)*
	60W	A19 Type *(E26 Medium) 120V only*
	23W	CFL / SB *(E26 Medium) 120V only*
UL classification	Suitable for wet locations	
IP rating	IP66	
Construction	316 marine grade stainless steel	
Installation types	Surface mount plate Discreet mount	
Standard inclusion	Thermal cutout	
Ambient operating temperature	-4°F to 122°F (-20°C to +50°C)	
Warranty	10 year structural, 1 year electrical	
Photometrics	Refer to www.lumascape.com	
Surface temperature	**HumanTouch™** compliant ≤149°F (≤65°C)	
	13W - 26W	CFL / TC-TEL
	50W	max HAL Bi-pin / QT12

Any luminaire can become hot - take care with appropriate use and placement

LS482 Balitza

LS482 → [ ] → [ ] → [ ] → [ ] → [ ]

LAMP	WATTAGE	BASE	Code
CFL / TC-TEL 4 pin ECG*	13W	GX24-q1	267
CFL / TC-TEL 4 pin ECG*	18W	GX24-q2	266
CFL / TC-TEL 4 pin ECG*	26W	GX24-q3	262
HAL Bi-pin / QT12 *12V*	50W (max)	G6.35	293
A19 Type *120V only*	60W	E26 med.	291
CFL / SB *120V only*	23W (max)	E26 med.	291

** ECG - **E**lectronic **C**ontrol **G**ear*

HEAD	Code
Apex	H
Armored apex	B
Level	F
Armored level	I

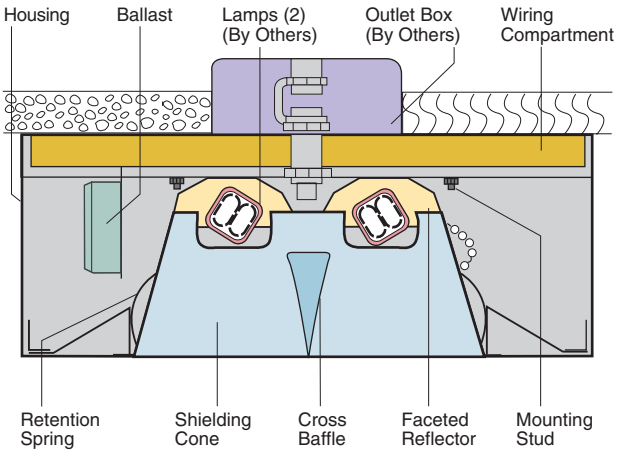
MOUNTING	HEIGHT	Code
Surface mount plate	23.6in (600mm)	A2
Surface mount plate	35.4in (900mm)	A3
Discreet mount	23.6in (600mm)	C1

CONTROL GEAR	ENTRY	Code
Integral	Bottom	Q
Remote	Bottom	R

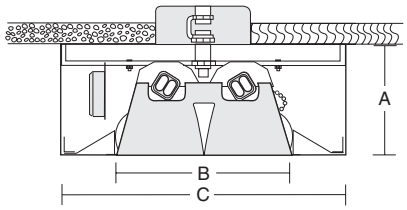
VOLTAGE	Code
120V 60Hz	4
277V 60Hz *Not suitable for SB or A19 or Halogen line voltage*	9

P639CB

Surface Mount Cylinder
Two 26W Quad Tube Lamps
8 3/8" Cross Baffled Aperture



Dimensions and Lamps



Number	A Depth	B Aperture	C Diameter	Lamps*
P639CB	6" 153mm	8 3/8" 213mm	13" 330mm	Two 26W Quad Tube

*For 18W lamps, add W18 to catalog number.

Optics and Applications

This cylinder features use a two reflector system. The primary linear reflector is formed and faceted. The cross baffles are parabolic. The pattern is slightly asymmetric depending upon measurement parallel or perpendicular to the lamps. Use in corridors, transit areas, open spaces, foyers, restrooms, etc.

Design Features

Cross baffles are supported at the top for rigidity to insure the pre-set parabolic curve is maintained for predictable brightness control.

Finish

A specular clear Alzak cone is standard. Optional colors and Softglow® finishes are available. Interior finish is matte black, the cylindrical housing exterior is satin brushed, then painted matte white baked enamel.

Ballast

Fully electronic, microprocessor controlled with variable starting current for inrush protection to assure rated lamp life. Input voltage range from 120V through 277V. Power factor .98, starting temperature 0°F (-18°C), THD < 10%. Pre-heat start < 1.0 second. End of lamp life protection. Rated for > 50,000 starts.

General

Fixtures are UL and C-UL listed for thermal and electrical safety. Union made IBEW. Luminaire Efficiency Rating (LER) data is in the photometric directory located in Section Z.

Accessories

BA	Brushed aluminum.	WT	White trim flange.
G	Gold cone.	WHT	White complete trim.
H	Mocha cone.	CC	Custom color.
P	Graphite cone.	LS	Lamp shield, acrylic.
T	Titanium cone.	LP	Prism lens, acrylic.
W	Wheat cone.	P5	Pendant adaptor, 21" length.
Y	Pewter cone.	ES	Extra stem length, specify length.
Z	Bronze cone.		

S Softglow® finishes: add S before color letters. e.g. SW for Softglow® wheat cone, SC for Softglow® clear cone.
V347 347 volt ballast.
DM Dimming ballast, contact the factory.
EM Emergency power. Includes battery pack, charger light, test switch and single lamp operation for 90 minutes. Components are remote from fixture. Specify volts.

Matching Units

Recessed CB downlights Page P22
Recessed wall washers Page P33

** Click for link to pages in blue.

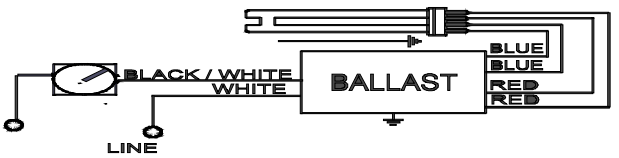
PHILIPS ADVANCE

VEZ-1T42-M2-LD	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
CFQ26W/G24Q	1	26	50/10	0.11	08/31	0.05/1.00	10	0.98	1.6	3.23
CFTR26W/GX24Q	1	26	50/10	0.11	08/31	0.05/1.00	10	0.98	1.6	3.23
CFTR32W/GX24Q	1	32	50/10	0.14	09/38	0.05/1.00	10	0.98	1.6	2.63
* CFTR42W/GX24Q	1	42	50/10	0.18	10/49	0.05/1.00	10	0.99	1.6	2.04

Wiring Diagram

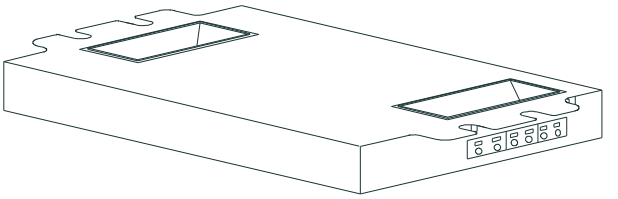


Diag. 134

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	3.00 "	1.29 "	4.60 "
4 49/50	3	1 29/100	4 3/5
12.6 cm	7.6 cm	3.3 cm	11.7 cm

Revised 08/17/2006

Data is based upon tests performed by Philips Lighting Electronics N.A. 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.

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PHILIPS
ADVANCE

VEZ-1T42-M2-LD	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 at maximum light output and 0.05 at minimum light output for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% at maximum light output when operated at nominal line voltage with primary lamp. Total Harmonic Current (THC) at minimum light output shall not exceed THC at maximum light output.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, and CFL lamps.

2.12 Ballast shall control lamp light output from 100% - 5% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.13 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

2.14 Ballast shall tolerate sustained open circuit and short circuit output conditions.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a ____ warranty from date of manufacture against defects in material or workmanship for operation at a maximum case temperature of ____ (Go to our web site for up to date warranty information: www.philips.com/advancewarranty.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be controlled by a compatible Mark 10 Powerline two-wire dimmer.

4.5 Ballast shall be Philips Advance part # _____ or approved equal.

Revised 08/17/2006

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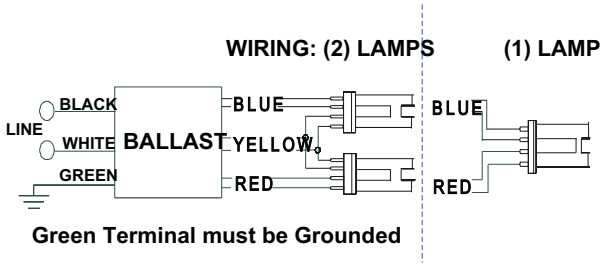
PHILIPS ADVANCE

ICF-2S26-H1-LD@277	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
* CFM26W/GX24Q	1	26	0/-18	0.11	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.20	54	1.00	10	0.99	1.5	1.85
CFM32W/GX24q	1	32	0/-18	0.13	36	0.98	10	0.98	1.5	2.72
CFM42W/GX24q	1	42	0/-18	0.17	46	0.98	10	0.98	1.5	2.13
CFQ26W/G24q	1	26	0/-18	0.10	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.19	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.18	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.18	48	0.93	10	0.99	1.5	1.94

Wiring Diagram



Green Terminal must be Grounded

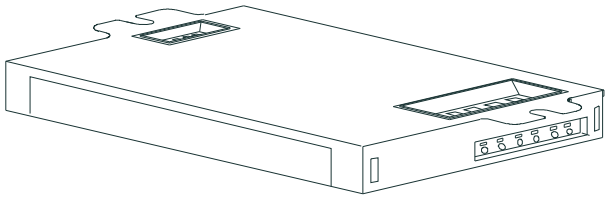
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

Data is based upon tests performed by Philips Lighting Electronics N.A. 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.

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PHILIPS ADVANCE

ICF-2S26-H1-LD@277	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start except for ballasts with -QS suffix, which shall be Rapid Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for primary lamp. Ballasts for PL-H lamps shall have a minimum starting temperature of -30C (-20F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall be rated for use in air-handling spaces.

3.4 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.5 Ballast shall comply with ANSI C82.11 where applicable.

3.6 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.7 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C and three-years for a maximum case temperature of 85C (90C three-year warranty for ICF-1H120-M4-XX, ICF-2S42-90C-M2-XX and ICF-2S70-M4-XX models).

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

Revised 09/02/2004

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PL-T 42W/835/4P 1CT

Product family description

Product data	
Product Number	268755
Full product name	PL-T 42W/835/4P 1CT
Ordering Code	268755
Pack type	1 Lamp in a Folding Carton
Pieces per Sku	1
Skus/Case	12
Pack UPC	046677268756
EAN2US	
Case Bar Code	50046677268751
Successor Product number	
Base	GX24q-4
Base Information	4P
Execution	/4P [4 Pins]
Packing Type	1CT [1 Lamp in a Folding Carton]
Packing Configuration	12
Avg. Hrs. Life	16000 hr
Ordering Code	PL-T 42W/835/4P/ALTO
Pack UPC	046677268756
Case Bar Code	50046677268751
Watts	42W
Lamp Wattage EL	43.0 W
Lamp Voltage	- V
Dimmable	Yes
Color Code	835 [CCT of 3500K]
Color Rendering Index	82 Ra8
Color Designation	White
Color Description	835 White
Color Temperature	3500 K
Initial Lumens	- Lm
Initial Lumens	3200 Lm
Overall Length C	158.4 mm
Diameter D	39.85 mm
Diameter D1	39.65 mm
Product Number	268755

PHILIPS

PL-C ALTO 26W/835/2P 1CT

Product family description

Product data	
ProNumUS	383232
Full product name	PL-C ALTO 26W/835/2P 1CT
OrdCodUS	383232
Pack type	1 Lamp in a Folding Carton
Pieces per Sku	1
Skus/Case	10
EAN1US	
EAN2US	
EAN3US	
Successor Product number	
Base	G24d-3
Base Information	2P
Execution	/2P [2 Pins]
Packing Type	1CT [1 Lamp in a Folding Carton]
Packing Configuration	10
Avg. Life	10000 hr
Watts	26W
Lamp Voltage	100 V
Dimmable	No
Mercury (Hg) Content	
Color Code	835 [CCT of 3500K]
Color Rendering Index	82 Ra8
Color Designation	White
Color Description	835 White
Color Temperature	3500 K
Initial Lumens	1760 Lm
Overall Length C	171.4 mm
Diameter D	27.1 mm
Diameter D1	27.1 mm

PHILIPS

Presented By:
Contact Phone:
Contact E-mail:

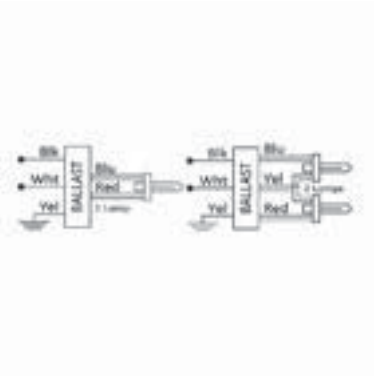
Customer Name:
Project Name: BSC New Science Building
Fixture Type: F6

GE Lighting

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 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)
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

Revised: 3/4/2009

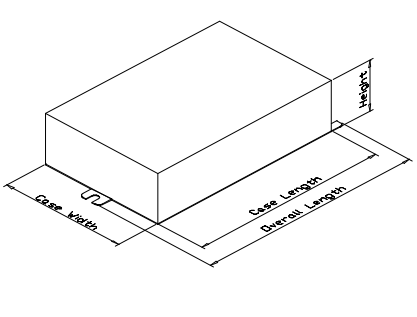
PHILIPS ADVANCE

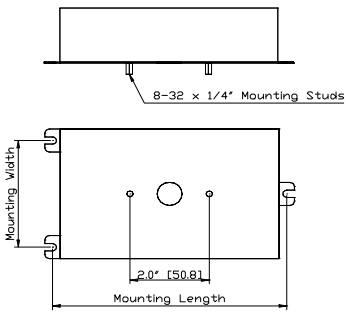
e-Vision® Electronic Ballast for Metal Halide Lamps

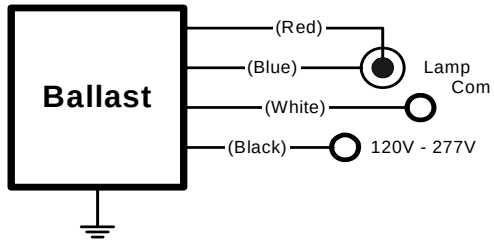
Catalog Number: IMH-150-H
For 150W Metal Halide Lamps
ANSI M102 or M142
120-277V 50/60Hz Electronic
Status: RELEASED

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)
150 Watt Lamp, ANSI Code M102 or M142 Minimum Starting Temp -30°C/-20°F										
1	150	120	IMH-150-H-XXX	1.4	165	1	3	H	1.9	5
		277		0.6	161					



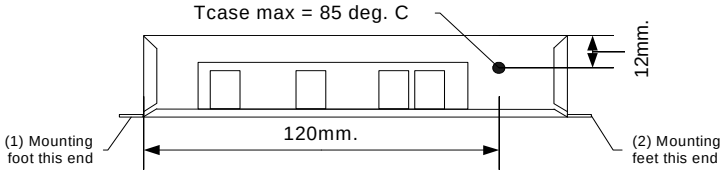




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
H	161mm [6.3"]	144mm [5.7"]	92mm [3.6"]	38mm [1.5"]	152mm [6.0"]	73mm [2.9"]



Case Temperature Measurement Location

EISA Compliant

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 85°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 12 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 terminal 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

Presented By:
Contact Phone:
Contact E-mail:

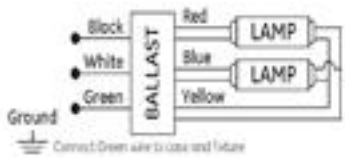
Customer Name:
Project Name: BSC New Science Building
Fixture Type: F10

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

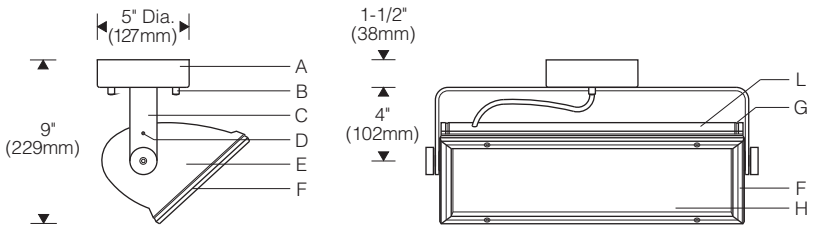
SAFETY & PERFORMANCE

- 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

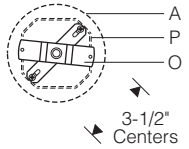
SPECIFICATIONS BY LAMP & WATTAGE

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

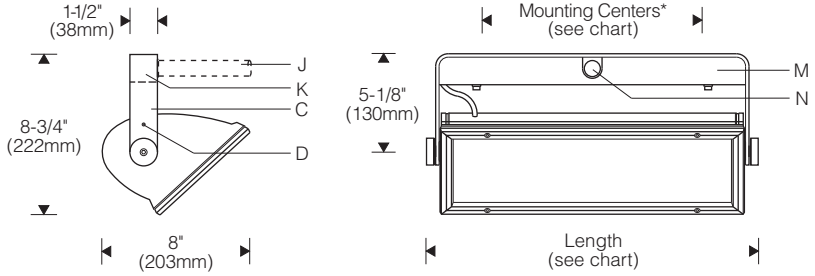
E Mount 1:10 Scale



Canopy (E mount)



Y Mount 1:10 Scale



Wattage	*Source*	*Length*	*Mounting**
300-500	Halogen	12-1/16" (306mm)	8-7/8" (225mm)
150	MH		
210-400	MH	17-13/16" (452mm)	14-5/8" (370mm)
900-1000	Halogen	24-7/8" (632mm)	21-11/16" (550mm)

* Dimension for **Y** mount only.

Specifications

- **A** Aluminum canopy (**E** mount)
- **B** Chrome cap nuts
- **C** Aluminum yoke
- **D** Locking set screw
- **E** Die-cast end plates
- **F** Mitred extruded aluminum door frame with silicone gasket
- **G** Aluminum reveal plates (black)
- **H** Micro-prismatic tempered glass lens
- **J** Conduit (by others)
- **K** Integral splice compartment
- **L** Specular extruded aluminum reflector
- **M** Aluminum splice cover
- **N** Conduit entry
- **O** Pivoting hanger bar
- **P** Outlet box (by others)

Finish:
Style 103 fluted – bright clear anodized aluminum housing and door frame. Painted end plates, yoke and canopy in choice of silver or semi-gloss black.

Style 104 smooth – semi-gloss white exterior, door frame, end plates, yoke and canopy.

Painted surfaces – 6 stage pretreatment and electrostatically applied thermoset powder coat for stable, long lasting and corrosion resistant finish.

Reflector and internal end plates – extruded high purity aluminum with clear anodized specular finish. All luminaire hardware – stainless steel. All mounting hardware – zinc or cadmium plated.

Mounting:
E mount – canopy mounts over recessed outlet box.

Y mount – surface mounted yoke attaches with 1/4 inch fasteners (by others) concealed under splice cover.

Pendant or cantilever mounting assembly ordered separately; specify **X** mount.

Track mounting available for tungsten halogen up to 500W; specify **K** mount. **Consult factory**.

REV. 8/08

Electrical:
Use 90°C wire for supply connections.

Y mount – integral splice compartment with one 7/8" diameter entry for exposed raceway/conduit (by others). Entry can be reversed in field to opposite side of yoke.

Tungsten halogen – recessed single contact (RSC) lampholders in patented clamping supports for maximum heat dissipation.

Metal halide – remote encapsulated constant wattage autotransformer (CWA) or electronic ballast. Mogul lampholder is pulse rated for use with either horizontal or universal position reduced envelope pulse start lamps. End-of-lamp aligner ensures consistent optical performance.

For complete ballast specifications, see Accessories Section.

Standard:
UL listed or CSA certified for damp locations (Style 104 painted model recommended for damp locations). Where pendant or cantilever may be exposed to wind, consult factory.

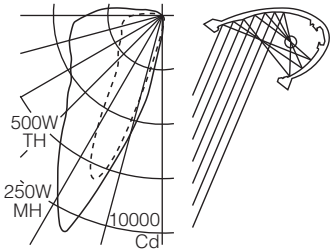
Features

- *Die-cast end plates join at articulated black reveals; machined aluminum knobs – no exposed fasteners*
- *Precured silicone gaskets – keep dirt and moisture out*
- *Lamp support on mogul base lamps ensures arc tube is in optical center*
- *Yoke set screw – securely locks aiming*

W 33.0

Performance

Two parabolic reflector sections drive light to the bottom of the wall. An elliptical section shields the lamp from normal viewing angles and redirects its light to a parabola. Glare is minimized and asymmetry of the beam is maximized resulting in high beam efficiency and superior surface uniformity.



For complete photometrics, see www.elliptipar.com.

elliptipar

To form a Catalog Number

1	104	-	150G	-	X	-	01	-	2	-	00	0
1	2		3		4		5		6		7	8

1 Source

M = Metal halide
T = Tungsten halogen

2 Style

103 = Large fluted surface, **remote** ballast
104 = Large smooth surface, **remote** ballast
Note: for damp locations, Style 104 is recommended.

3 Lamp

Lamp Code	*Watt-age*	*Lamp Number*	*Volt-ages*	*Remote Distance*
Ceramic Arc Tube Pulse Start Metal Halide (90+ CRI)				
210C	210	CDM210/T9/930/U/E	**2, U**	30' (9m)
315C	315	CDM315/T9/930/U/E	**2, U**	30' (9m)
Ceramic Arc Tube Pulse Start Metal Halide (80+ CRI)*				
150G	150	CDM150/T6/830	**1, 2**	15' (4.5m)
			T, U	5' (1.5m)
250C	250	CMH250/U/830/R	**A, B**	50' (15m)
400C	400	CMH400/U/830/R	**A, B**	50' (15m)
Quartz Arc Tube Pulse Start Metal Halide (68 CRI)*				
250P	250	MS 250W/H75/ T15/PS/740	**A, B**	50' (15m)
			2, U	16' (4.8m)
320P	320	MS 320W/H75/ T15/S/PS/740	**A, B**	50' (15m)
			2, U	16' (4.8m)
350P	350	MS 350W/H75/ T15/PS/740	**A, B**	50' (15m)
			2, U	16' (4.8m)
Tungsten Halogen				
0300	300	Q300T3	**A**	
0350	350	Q350T3/CL/HIR	**A**	
0500	500	Q500T3	**A**	
0900	900	Q900T3/CL/HIR	**B, G**	
1000	1000	Q1000T3	**A, F, G**	

For complete lamp and ballast information, see Accessories Section.
* Use only clear metal halide horizontal or universal position lamp with compact envelope. Standard lamp colors are 3000K for Ceramic Arc Tube Pulse Start lamps and 4000K for Quartz Arc Tube Pulse Metal Halide lamps.

W 33.1

Project: **BSC New Science Building**

Type: **M1**

4 Mounting

E = External yoke on ceiling canopy
Y = Yoke with integral splice compartment
X = External yoke for use with accessory cantilever or pendant mounting assembly (order separately) For use in natatorium (pool), consult factory.
K = Track mounted (300 - 500W halogen only) **Note: Consult factory for available track manufacturers and types.**

5 Finish

Style 103 Fluted
01 = Bright aluminum housing and door frame with silver end plates, yoke and canopy
81 = Bright aluminum housing and door frame with semi-gloss black end plates, yoke and canopy

Style 104 Smooth
02 = Semi-gloss white housing, end plates, door frame, yoke and canopy
99 = Custom RAL or computer matched color to be specified, consult sales representative

6 Voltage

Electronic (Metal Halide only):
1 = 120V
2 = 277V
T = 120V dim*
U = 208-277V dim*

Magnetic and Tungsten Halogen:
A = 120V
B = 277V
F = 220V
G = 240V

*100-50% dimming, 0-10V compatible controls by others. Consult factory for dimming the 210W lamp.

7 Option (See Accessories Section for specifications)

00 = No options
0M = MRI medical facility use (halogen E or Y mount only)
0P = Natatorium (pool) use, tungsten halogen or metal halide unit with remote ballast located outside the pool environment (Style 104 smooth painted model only)
0Q = Natatorium (pool) use, metal halide with remote ballast suitable for use in the pool environment (Style 104 smooth painted model only)
0R = Halogen standby lamp with relay field connected at remote ballast. 100W maximum (lamp included).
XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Standard

0 = UL, Underwriters Laboratories
J = CSA, Canadian Standards Association

Accessories

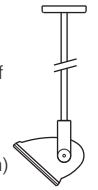
Order separately. See Accessories Section for specifications.

VC [ ] [ ] **36** [ ] = **Cantilever**, 36" (915mm) setback
- [ ] = **0** = UL, **J** = CSA
- [ ] = **02** = semi-gloss white, **07** = silver, **08** = semi-gloss black
- [ ] = **L** = 300-500W TH, 150-400W MH; **X** = 900-1000W TH

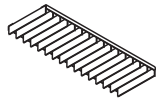
Consult factory for use in natatorium (pool).

VP [ ] [ ] [ ] [ ] = Wallwash **pendant**
- [ ] = **0** = UL, **J** = CSA
- [ ] = **Length** in inches (48" (1.2m) max. for TH, 60" (1.5m) max. for MH)
- [ ] = **02** = semi-gloss white, **07** = silver, **08** = semi-gloss black
- [ ] = **L** = straight, 300-500W TH, 150-400W MH; **E** = swivel (up to 45°), 300-500W TH, 150-400W MH; **X** = straight, 900-1000W TH (2 stems)

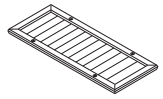
Length ceiling to top of yoke 6-1/2" (165mm)



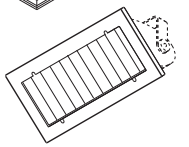
AE [ ] **V** [ ] **000** = External vertical blade **baffle**, black (not for use with 500W halogen units)
- [ ] = **2** = 25° shielding, **4** = 45°
- [ ] = **C** = 300-350W TH, 150W MH; **D** = 210-400W MH; **F** = 900-1000W TH



ACF = Stripped glass **color filter**, integral to door frame.



AXF = Interchangeable **color filter** assembly, exchangeable frame with stripped color glass.



Note: **Color filters not suitable for all lamp wattages.** Consult factory for complete specifications and ordering information.

AFK000X [ ] = Ballast **fuse** kit
- **0** = UL
- **J** = CSA

The external shapes of the asymmetric reflectors are trademarks of ***elliptipar****. Certain products illustrated may be covered by applicable patents and patents pending. For a list of patents, see Contents pages. These specifications supersede all prior publications and are subject to change without notice.*

elliptipar
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • **www.elliptipar.com**

DESCRIPTION

The 101-P Fabrique Rectilinear Pendants feature eleven standard fabrics, multiple mounting options and a Shade-in-a-Shade option.

Catalog #	101-P-38-T52-21-SWH	Type
Project	BSC Science	F8
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Material/Mounting
Cold-rolled steel frame and aluminum wirebody, painted matte white. Matte white acrylic bottom diffuser with two finials, standard. Optional matte white acrylic top cover. Double Stem (2S) (Standard): 13" x 5" rectilinear canopy plate. Two 1/2" stems with a standard hang height of 24" (OA), minimum 18" (OA). Maximum overall hang height for one piece stem assembly is 8' (OA). 9' to 25' (OA) is supplied with a Collector Body (CB). Contact Factory for lengths greater than 25'. Specify SCA for sloped ceilings up to 45 degrees, for horizontal mounting only to ceiling plane. Contact factory for SCA, vertical applications.

Fabric Shades
Solid cold-rolled steel construction. Fabric on heavy translucent white styrene. Shantung White (SWH), delicate linear weave with random "slubs"; Shantung Eggshell (SEG), delicate linear weave with random "slubs"; Chintz Chocolate (CCT), small weave without "slubs"; Chintz Onyx (CXH), small weave without "slubs"; Linen Brussels White (LBW), textured open weave; Shantung Beige (SBG), delicate linear weave with random "slubs"; Cinnamon Stick (CNK), cinnamon & olive tight weave, slight sheen with raised decorative bars; Apex (APX), formal tight weave, slight sheen with raised stitched "X" pattern; Criss Cross (CCS), milk chocolate slightly textured tight weave with chocolate and wine colored raised diagonal decorative bars; Glasgow Flax (GFX), off-white, tight weave background with a random beige horizontal/vertical pattern. Many additional stock fabrics are available as a MOD, contact the factory for details. Optional Shade-in-a-Shade (SIS): Solid cold-rolled steel construction with exposed metal painted white, silver or gold to match specified fabric. Fabric on heavy clear vinyl backing. Earth Dust (EDT), slight metallic weave, bronze shear organza; White Mist (WMT), slight metallic weave, white shear organza; or Silver Moon (SMO), slight metallic weave, silver shear organza. SIS is available in pendant version only.

Suspension Options
Aircraft Cable with White SJ Cord (SJWAC): 3/32" cables wth a standard height of 24" (OA), minimum 20" (OA). Maximum overall hang height is 25' (OA). Contact factory for lengths greater than 25'. Optional Clear SJ Cord (SJCAC). Note: 5-wire SJ supplied for non-DM and 7-wire supplied for DM.

Finish (Stem, canopy and finials)
Standard: Natural Aluminum (NA) [Sustainable Design].
Premium: Matte White (MW), Lacquered Satin Aluminum (SAL), Satin Brass (SB), Polished Brass (PB), Oxidized Brass (OBRS), Satin Chrome (SC), Polished Chrome (PC), Satin Copper (SCP), Polished Copper (PCP), Oxidized Copper (OCP), Satin Nickel (SN), Polished Nickel (PN), Gun Metal (GNM) or Custom Color (CC). Contact Factory for multi-finishes (i.e. MW finial with SC stems/canopy).

Fabric
Standard: Shantung White (SWH)
Premium: Shantung Eggshell (SEG), Chintz Chocolate (CCT), Chintz Onyx (CXH), Linen Brussels White (LBW), Shantung Beige (SBG), Glasgow Flax (GFX), Cinnamon Stick (CNK), Apex (APX), Criss Cross (CCS) or Customer Supplied Fabric (CSCC)*.
Many additional stock fabrics are available as a MOD, contact the factory for details. *Shaper can accommodate "Customer Supplied Fabric" (CSCC) orders. Please contact your representative for details and minimum quantities. Natural materials and textiles are subject to inconsistency on color/pattern, texture, shape and may vary from dye lots. They may also change in appearance over time. Optional Shade-in-a-Shade (SIS): Earth Dust (EDT), White Mist (WMT) or Silver Moon (SMO); [SIS available in 101-P only].

Optics
Refer to www.shaperlighting.com for complete photometrics.

Ballast
Integral electronic HPF, 120/277V (347V Canada), thermally protected with end-of-life circuitry to accommodate the specified lamp wattage 120/277V IEM & DM only. Contact factory for 347V DM.

Lamp/Socket
38": Two (2) 21WT5 linear fluorescent lamps or three (3) 60W T-10 frosted lamps.
48": Two (2) 28WT5 linear fluorescent lamps or four (4) 60WT-10 frosted lamps.
Note: When specifying the Advance dimming option, only Advance Mark 10 is available and the (2) 54WT5HO (101-P-48") lamping must be specified.
Fluorescent socket injection molded plastic. Lamps furnished by others.

Installation
Supplied with a universal integral mounting strap for a standard 4" J-box or plaster ring. Contractor to provide appropriate structural support for fixture weight. Shaper luminaires are designed for interior installations only.
Cleaning recommendation: Use a soft clothes brush or a vacuum brush to dust the outside of the lamp shade and a clean soft white flannel cloth for the inside of the lamp shade.

Options
FLT5 Dimming Ballast: Advance Mark 10 (DMA10) - Available in (2) 54WT5HO (101-P-48") only or Lutron (DML). White SJ Cord (SJWAC), Clear SJ Cord (SJCAC), Sloped Ceiling Adaptor - Horizontal Mount only (SCA), Slotted Matte White Acrylic Top Cover (TC), Integral Emergency Battery (IEM), Shade-in-a-Shade (SIS) with EDT, WMT or SMO outer fabric options. Contact factory for NFP701 Fire Resistent or Stain Guard fabric coatings.

Labels
U.L. and C.U.L. approved.

Modifications
Shaper's skilled craftspeople with their depth of experience offer the designer the flexibility to modify standard mini-fabric pendant luminaires for project specific solutions. Contact the factory regarding scale options, unique finishes, mounting, additional materials/colors, or decorative detailing.

101-P SERIES

Pendant Luminaire
Fabrique
Fabric Rectilinear

Fabrique

Fabrique

Shaper now offers a wide variety of architectural fabric luminaires. All of the shades have been designed to have minimal or no visible hardware or structural trim, and are available with the latest in lamp and ballast technology (T5/CFL with dimming ballasts).

SUSTAINABLE DESIGN

Shaper has a long-standing history of offering environmentally-friendly fixtures. The copper and bronze alloys used in our exterior luminaires feature up to 98% re-cycled content, contribute less undesirable air emissions compared to painted alumi-num and are easy to recycle.

Refer to the Icon Legend Link on shaperlighting.com.

Specifications and dimensions subject to change without notice.
Consult your representative for additional options and finishes.

ORDERING INFORMATION

Sample Number: 101-P-38-T5/2/21-120V-NA-SBG-24

101-P	38	T5/2/21	277	NA	SWH	SJCAC	300

Series
101-P = Fabric Rectilinear Pendant

Size
38"
48"

Lamp
T5/2/21 [1]
T5/2/39HO [1]
T5/2/28 [2]
T5/2/54HO [2]
INC/3/60 [1]
INC/4/60 [2]

Voltage
120V
277V [3]
347V [3]

Finish
Standard
NA = Natural Aluminum
Premium
CC = Custom Color
GNM = Gun Metal
MW = Matte White
OBRS = Oxidized Brass
OCP = Oxidized Copper
PB = Polished Brass
SC = Satin Chrome
PC = Polished Chrome
PCP = Polished Copper
PN = Polished Nickel
SAL = Lacquered Satin Aluminum
SB = Satin Brass
SCP = Satin Copper
SN = Satin Nickel

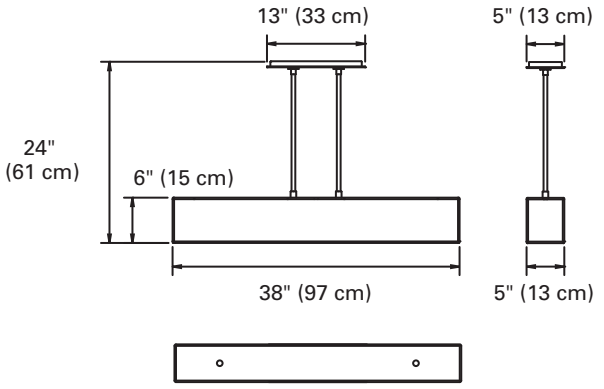
Fabric
Standard
SWH = Shantung White
Premium
SEG = Shantung Eggshell
CCT = Chintz Chocolate
CXH = Chintz Onyx
LBW = Linen Brussels White
SBG = Shantung Beige
GFX = Glasgow Flax
CNK = Cinnamon Stick
APX = Apex
CCS = Criss Cross
CSCC = Customer Supplied Custom Color [4]

Options
SJWAC = Aircraft Cable with White SJ Cord
SJCAC = Aircraft Cable with Clear SJ Cord
DML = Dimming Ballast (Lutron)
DMA10 = Dimming Ballast (Advance 10) [5]
IEM = Integral Emergency Ballast [3]
SCA = Sloped Ceiling Adapter [6]
TC = Matte White Acrylic Top Cover
SIS-EDIT = Shade-in-Shade, Earth Dust
SIS-WMT = Shade-in-Shade, White Mist
SIS-SMO = Shade-in-Shade, Silver Moon

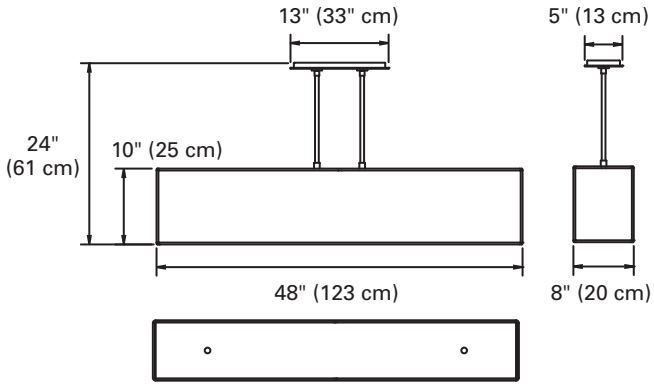
Suspension Height
24"
or specify

Notes:
[1] Available in 38".
[2] Available in 48".
[3] Available with T5 only.
[4] Shaper can accommodate Customer Supplied Fabric" orders. Please contact your representative for details and minimum quantities.
[5] Available in T5/2/54HO (101-P-48) lamping only.
[6] Specify up to 45° (Horizontal Mount only).

DIMENSIONS

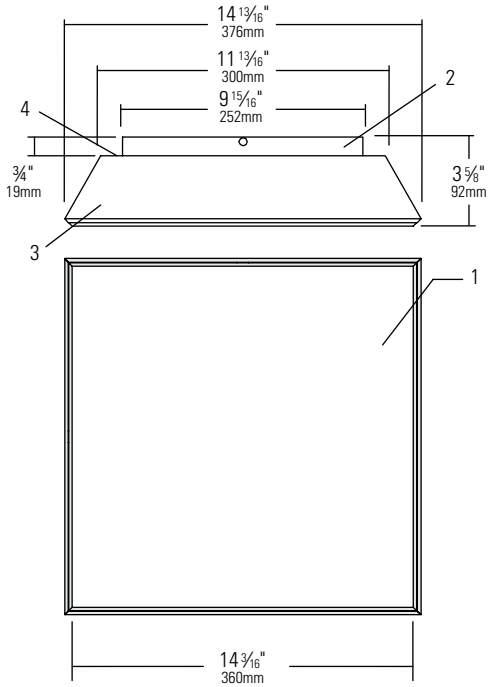


101-P-38" STANDARD



101-P-48" STANDARD

Specifications and dimensions subject to change without notice.
Consult your representative for additional options and finishes.



Fixture Ordering Information

Diffuser Catalog No.	Backplate	Wattage	Volts	Lamp
ST12AL	S122U	22W	120V/277V	(1) T5 Circular
	S213U	13W	120V/277V	(2) Twin Tube

Features

1. **Diffuser:** Injection molded, Impact and UV resistant Polycarbonate
2. **Backplate:** Stamped 20ga.(0.036") C.R.S., Gloss White Powder Coat Finish
3. **Housing:** Extruded Aluminum
4. **Back Light:** Opal Acrylic, 2mm Thick

Electrical

Ballast-Electronic 120-277v

S122U		
Voltage	120V	277V
Total Input Watts	25W	25W
Max. Line Current (Amps)	0.21A	0.09A
Ballast Factor	1	1
THD	15%	15%
Min. Starting Temp	0°F (-18°C)	0°F (-18°C)

Lamping

56949	22W	3000K	Circline
56951	22W	3500K	Circline

Lamping (by others)

Lamp	Philips	General Electric	Osram/Sylvania
22W T5 CIRCULAR	TL5C 22W/*	--	FPC22/*
*Manufactures Color Temperature Designation			

Mechanical

Diffuser assembly fastens securely to backplate using springcup and countersunk screw

Finish

Brushed and Clear Lacquered Aluminium

Accessories

Color Insert Kit SACC12. Citrine, Garnet and Sapphire

Labels

cULus listed, suitable for damp locations. ULus listed.

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®

LITECONTROL

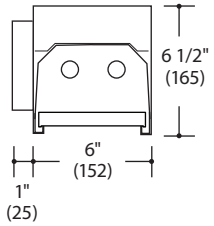
Type:
Project:

Mod-66™

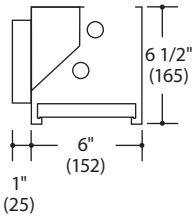
W-D-66N, W-ID-66N,
W-ADW-66N (chalkboard)
Wall-Mounted

Specifications

W-D-66N



W-ID-66N



HOUSING. Die-formed and welded steel, with 3/8" regression at housing bottom for rigidity and appearance, furnished with 6" long, 20-gauge steel splines for precise alignment at each joint. End headers have clearance holes for easy row installation and are notched under lamps for more even diffuser luminance and continuous baffle appearance. W-ID-66N. Three-inch wide opening in housing top provides 36-50% uplight ceiling and wall illumination.
END CAPS. Steel, 14-gauge, with no holes or knockouts, finished to match housing. Four fasteners on each end cap allow tight attachment to ends of individual fixtures and ends of rows.
REFLECTOR. W-D-66N. Standard: Die-formed steel with high-reflectance white finish. Parabolic Reflector/Baffle (**PARSS**): Die-formed semi-specular anodized aluminum reflector and baffle assembly. W-ID-66N. Die-formed steel with high-reflectance white finish. W-ADW-66N. Die-formed semi-specular aluminum (on lamp side) and die-formed steel with high-reflectance white finish.
LAMPING. Available in one- and two-lamp T8.
BALLAST. Electronic Ballast (**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.
TANDEM WIRING. When selected from Ordering guide below, fixtures wired to switch in-line lamps separately, providing two levels of light (two-lamp cross-section fixtures only).
SYSTEM CONNECTORS. Corners and straight extensions available. Die-formed steel. Bottom and exposed sides to be smooth with no exposed fasteners or knockouts. See Field Measurement Procedure for instructions.
MOUNTING. Provided with two wall-mounting brackets measuring 4 1/2" square x 1" deep. Finish is CBC (Camera Black). W-ADW-66N. Provided with two wall-mounting brackets (**WCB**) measuring 4 1/2" x 6" deep, finished to match housing.
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. (UL LISTED)

Note: Litecontrol reserves the right to change specifications without notice for product development and improvement.

Ordering guide

Product, lamping, & length

W -	D -	66N	2	4	T8 -
Mounting	Distribution	Series	Lamp Count	Nominal Length(ft)	Lamp Type
W Wall-Mounted	**D** Direct **ID** Indirect/Direct **ADW *** Asymmetric Direct	**66N**	**1, 2 →** **1, 2 →** **1, 2 →** **2, 4 →** **2, 4 →** see **notes**	**2** **3** **4** **6** **8**	**T8**

Cross-section lamping

W-D-66N			W-ID-66N		W-ADW-66N
					
1-T8	**1-T8** **PARSS**	**2-T8**	**1-T8**	**2-T8**	**1-T8**

Options

BW -	CWM -	- -	ELB -	-	EF -	120
Diffuser	Finish	Tandem Wiring	Ballast	Bracket	Other options	Volts
BW **PBSS** **PWA** **PAT.12 (XA)** **PAT.19** **FP** **PARSS** *(1-lamp D only)* **6044** *(ADW only)* see **Diffusers**	**CWM** (Matte White) is standard see *LiteColors*™ in Product Guide for other finishes	**--** **TW** see **notes**	**ELB** is standard **DA/ELB** **HEL/ELB** **ECO/ELB** see **Ballast options**	**WCB** *(ADW only)*	**EF** **F** see **Other options**	**120** **277**

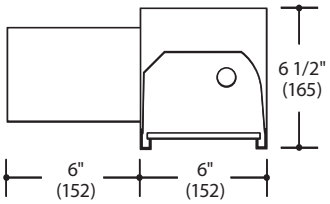
notes:
Lamp Count = total number of lamps in the fixture
Tandem Wiring not available for one-lamp cross-section fixtures
*W-ADW-66N available in one-lamp cross-section only
For Ordering guide information in shaded areas, choose selection by reading ACROSS the shaded areas for correct specifications.

W-D-66N24T8-BW-CWM-ELB-EF-120 is a typical catalog number for a 2-lamp (2 lamps in cross-section) , 4-foot long T8 fixture with white blade baffle, Matte White finish, electronic ballast, emergency fluorescent ballast, 120 volts.
W-ADW-66N14T8-6044-CWM-ELB-WCB-EF-120 is a typical catalog number for a 1-lamp (1-lamp in cross-section), 4-foot long T8 fixture with a 6044 lens, Matte White finish, electronic ballast, chalkboard mounting brackets, emergency fluorescent ballast, 120 volts.

Questions to Ask
1. 120 or 277 volt? **2.** Row information, including desired fixture lengths?
3. Diffuser type? **4.** White, *LiteColor*, or special color? **5.** Tandem wiring?
6. Other options?

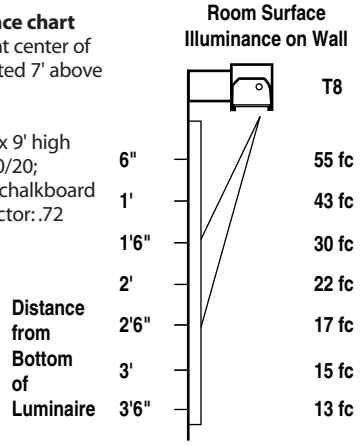
Chalkboard fixture

W-ADW-66N



Vertical illuminance chart
Values calculated at center of 12-foot row mounted 7' above the floor.

Room size: 8' x 12' x 9' high
Reflectances: 80/70/20;
30% chalkboard
Total Light Loss Factor: .72



Diffusers (W-D-66N & W-ID-66N only)

BW Blade Baffle, White. 3/4" high x 3/4" OC, 20-gauge steel, regressed.
PBSS Parabolic Baffle. Semi-specular anodized aluminum, 1.4" high x 2" OC. (Used with standard reflector.)
PWA Louver. Parabolic specular aluminum, acrylic 1/2" cube, regressed.
PAT.12(XA) Lens. Diagonal 3/16" conical prisms, .100" thick extruded acrylic, regressed.
PAT.19 Lens. 3/16" square prisms, .156" thick extruded acrylic, regressed.
FP Lens. White acrylic, .100" thick, regressed.
PARSS Parabolic Reflector/Baffle. Semi-specular anodized aluminum, parabolic reflector with 1.4" high x 2" OC parabolic baffles. **One-lamp cross-section W-D-66N only**
6044 Asymmetric Lens. 210" thick acrylic asymmetric lens (6044) to direct light towards wall. **W-ADW-66N only**

Ballast options

Specify in place of **ELB**, contact factory for availability/compatibility with lamping:
DA/ELB Advance Mark VII Dimming Ballast.
HEL/ELB Osram Sylvania Dimming Ballast.
ECO/ELB Lutron ECO-10 Dimming Ballast.

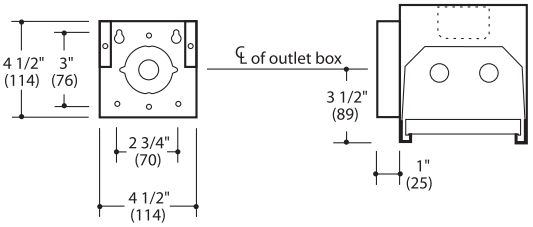
Other options

EF Emergency Fluorescent Ballast. Battery-powered ballast from a UL Listed manufacturer will operate one T8 lamp for 1 1/2 hours.
F Fuse. Slow or fast low, determined by Litecontrol.

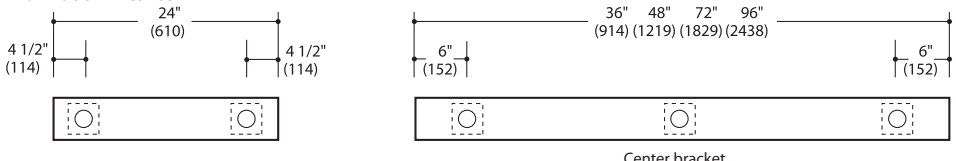
Planning for installation

For special system connectors needed to exactly fill a wall or follow a perimeter, field-measured dimensions may be required from the job site. Minimum SE length is 3.25". Please refer to Field Measurement Procedure for instructions.

Wall bracket



Individual fixtures

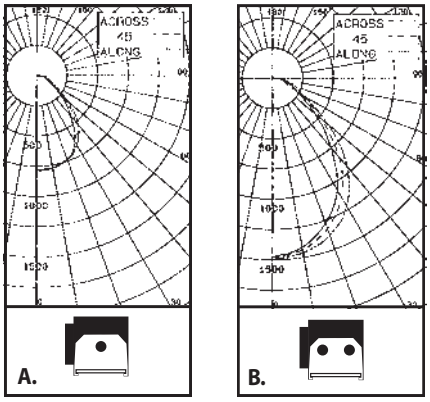


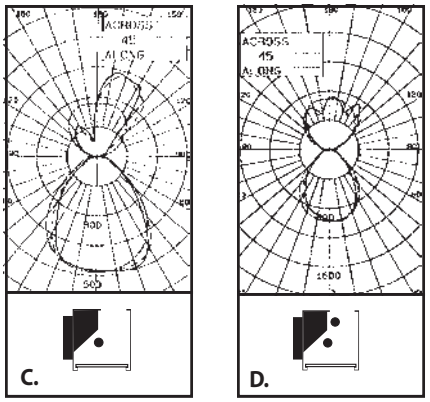
Indicates wall mounting bracket location

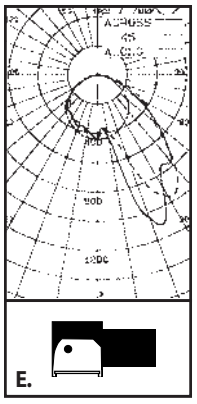
○ 2 1/2" diameter knockout (in fixture)

Center bracket
for W-ID-66N 6' and 8' only

Photometric data







A. W-D-66N14T8-XA 58.2% Efficiency
Litecontrol Certified Test Report #12111010

B. W-D-66N24T8-XA 51.1% Efficiency
Litecontrol Certified Test Report #12121010

C. W-ID-66N14T8-XA 69.4% Efficiency
Litecontrol Certified Test Report #10411010

D. W-ID-66N24T8-XA 67.2% Efficiency
Litecontrol Certified Test Report #10421010

E. W-ADW-66N14T8-6044 55.7% Efficiency
Litecontrol Certified Test Report #17811070

For complete photometric information, see website.

Click on **Quick Find** **66wd 66wid 66adw**
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PHOTOMETRIC DATA

W-ADW-66N14T8-6044 55.7% Efficiency
Litecontrol Certified Test Report #17811070

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	.66	.66	.66	.66	.65	.65	.65	.65	.62	.62	.62	.59	.59	.59	.57	.57	.57	.56
1	.61	.59	.57	.55	.60	.58	.56	.54	.55	.54	.52	.53	.52	.51	.51	.50	.49	.48
2	.56	.52	.49	.46	.55	.51	.48	.45	.49	.46	.44	.47	.45	.43	.46	.44	.42	.41
3	.52	.46	.42	.39	.50	.45	.41	.38	.44	.40	.38	.42	.39	.37	.41	.38	.36	.35
4	.47	.41	.36	.33	.46	.40	.36	.33	.39	.35	.32	.38	.34	.32	.36	.34	.31	.30
5	.43	.36	.31	.28	.42	.36	.31	.28	.34	.30	.27	.33	.30	.27	.32	.29	.27	.26
6	.40	.32	.28	.24	.39	.32	.27	.24	.31	.27	.24	.30	.26	.23	.29	.26	.23	.22
7	.36	.29	.24	.21	.36	.29	.24	.21	.28	.23	.21	.27	.23	.20	.26	.23	.20	.19
8	.33	.26	.21	.18	.33	.25	.21	.18	.25	.21	.18	.24	.20	.17	.23	.20	.17	.16
9	.31	.23	.18	.15	.30	.23	.18	.15	.22	.18	.15	.21	.18	.15	.21	.17	.15	.14
10	.28	.21	.16	.13	.28	.21	.16	.13	.20	.16	.13	.19	.16	.13	.19	.15	.13	.12

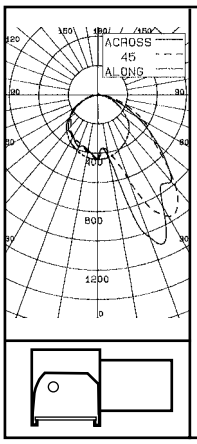
Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	0	0	0
90-0°	1615	55.72	100
180-0°	1615	55.72	100

LUMINANCE SUMMARY (fL)

ANGLE	0°	45°	90°	135°	180°
45°	623	578	664	1434	1477
55°	595	561	590	1178	1147
65°	532	478	513	1028	829
75°	330	356	457	784	571
85°	163	163	327	551	439



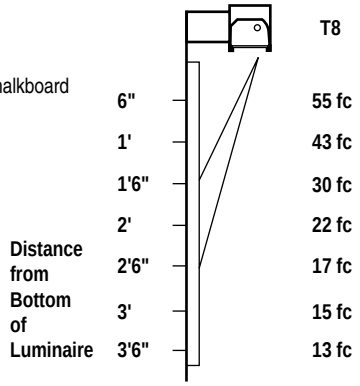
CANDLEPOWER SUMMARY

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
90	1	0	0	0	1	
85	9	9	18	30	24	23
80	27	33	46	73	54	
75	54	59	75	129	94	89
70	94	93	105	199	151	
65	143	128	138	276	222	179
60	189	166	174	358	311	
55	217	204	216	428	417	265
50	247	235	260	492	531	
45	280	259	299	643	662	321
40	311	285	328	820	773	
35	315	317	351	941	749	317
30	331	344	372	959	882	
25	360	346	389	858	1092	257
20	378	355	406	618	1036	
15	365	374	420	458	726	129
10	383	397	432	387	437	
5	410	419	438	370	365	40
0	438	438	438	438	438	

VERTICAL ILLUMINANCE CHART

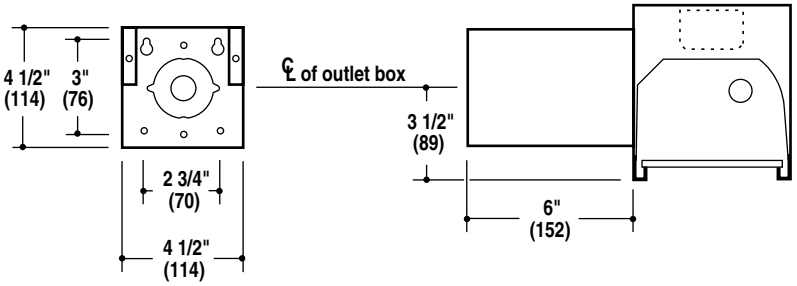
Values calculated at center of 12-foot row mounted 7' above the floor.
Room Size: 8' x 12' x 9' high.
Reflectances: 80/70/20; 30% chalkboard
Total Light Loss Factor: .72

Room Surface Illuminance on Wall



PLANNING FOR INSTALLATION

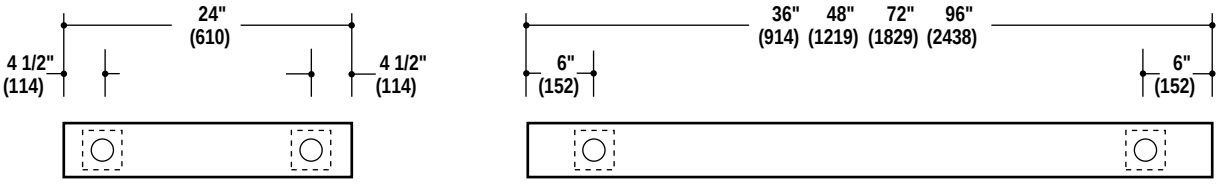
WALL BRACKET



QUESTIONS TO ASK:

1. 120 or 277 volt?
2. Row information, including desired fixture lengths?
3. White, LiteColor, or special color?
4. Verify 6044 Diffuser.
5. Other options?

INDIVIDUAL FIXTURES



Indicates wall mounting bracket location

○ 2 1/2" diameter knockout (in fixture)

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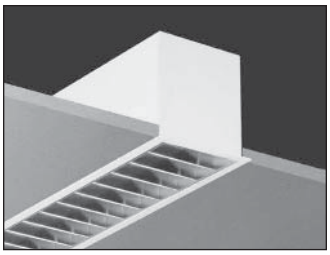
M100 Recessed Linear Fluorescent Flanged Extrusion

se'lux®



Project: BSC New Science Building **Type:** F16 **Qty:**

	–	1T5	–	MA	–		–	004	–	WH	–	277	–
Fixture Series		**Lamp Type**		**Shielding**		**Mounting**		**Nominal Length**		**Finish**		**Voltage**	

Options **(refer to separate data sheets for ordering codes and details)**

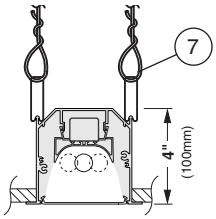
Fixture Series	Lamp Type	Shielding	Mounting	Nominal Length	Finish	Voltage	Options
M1R1 M100 Recessed Continuous Flange (Flanged Extrusion/ Flanged Endcaps) **M1R2** M100 Recessed Flush End (Flanged Extrusion/ Flangeless Endcaps)	**1T5** F28T5 **2T5** (2x)F28/T5 **1T5HO** F54T5HO **1T8** F032/T8	**SA** Specular Parabolic **MA** Matte Parabolic **MP** Silky Specular Parabolic **PL** Matte Perforated Parabolic **SD** Satine Lens **OD** Extra Diffuse Lens **X** None	**SH** Suspension Clips **TS** 1" Studs (factory installed) **RC** Rotating Crossbars **PM** Perimeter Mount	**004** 4 foot **008** 8 foot **012** 12 foot For actual lengths see following page. For other lengths, configurations indicate nominal length rounded to the next highest foot. Factory will supply layout drawings. Individual fixtures cannot be field joined.	**WH** White **BK** Black **SV** Silver **SP** Specify RAL#	**120** **277** **347**	**TB** Lengths to Fit 2' Grid T-Bar Ceiling System[1] **(qty.)EM** Stand-by Battery Pack[2] (prefix quantity, i.e. - **5EM**) **FS** Single Fusing **DM** Dimming[1] (specify system) **DMA** Digital Addressable Dimming[1] **SI** Satine Acrylic Inlay[3] **FW** Flex Whip (standard) **FW1** Flex Whip (dimming) **Track** Eutrac Standard[4] **DL** Suitable for Damp Locations **CCEA** Chicago Plenum **Downlights** (See MR16 spec sheets, pp.98-99)

[1]T5 & T5HO lamps only, consult factory for other lamps. [2]Must be low profile ballasts (1½" W x 1³/₁₆" H); consult factory for details. [3]SA, MA, MP & PL shieldings only. [4]Consult factory for details.

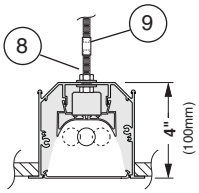
Mounting Diagrams

Scale = 1 : 8

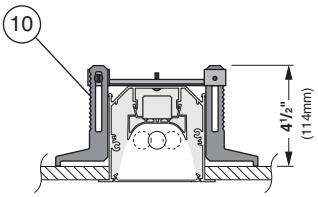
Suspension Clips (SH)



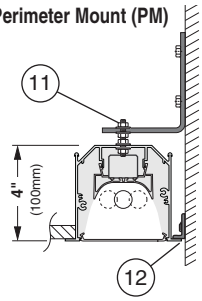
Pre-installed Rod (TS)



Rotating Crossbars (RC)

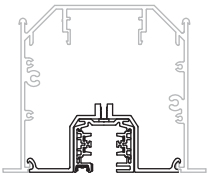


Perimeter Mount (PM)



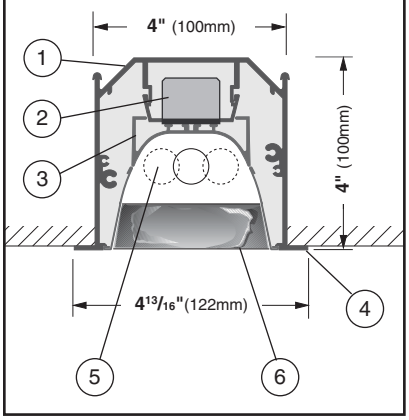
Track

Track insert including track available for all configurations, consult factory for details.



M1R1
M1R2

Scale = 1 : 4



1. Housing - Continuous, 6063-T5 extruded aluminum profile up to 16 feet long. Joined with Connector Plus Joining System for ease of installation and to assure a uniform appearance.

2. Ballast - Electronic, high power factor, class "P", type "A" sound rating. Specify 120v, 277v, or 347v. Ballast is factory pre-wired with leads to one end of fixture. Consult factory for ballast options.

3. Gear Tray - Extruded aluminum,with white painted finish. Gear tray installed as a complete electrical unit and is held in place with knurled dress nuts. It is fully accessible from below ceiling.

4. Flange - 1/2" (12mm) wide flange runs full lengths of both sides and is part of the main extruded body. Specify continuous flange (M1R1) or flush end (M1R2).

5. Lamps - As noted (by others). Other lamp lengths or wattages available, consult factory.

6. Shielding - Louvers offer excellent glare control in longitudinal, lateral, and all diagonal planes. High quality aluminum louvers and acrylic shielding allow true freedom of layout for today's modern spaces.

7. Spring Steel Suspension Clips - Supplied two places, located nominally every 4 ft. Support wires supplied and installed by others.

8. Pre-installed 1" 1/4-20 Studs - Attached to fixture 6" (152mm) from each end of fixture housing.

9. Coupling and Threaded Rod to Structure - Supplied and installed by others.

10. Rotating Crossbar - For inaccessible ceilings, adjustable for ceiling thicknesses from **1/4"** to **2"**. Supplied, (2) per fixture, locate 6" (152mm) from each end of fixture.

11. Steel Wall Bracket and 1/4-20 Rod - Supplied, (2) per fixture, rods are attached to fixture 6" (152mm) from each end of fixture housing. (Fasteners to wall and wall anchors by others.)

12. Aluminum Wallbracket - Secured to wall (fasteners and wall anchors by others) and runs entire length of fixture. Also supplied for width of fixtures when supplied with continuous flange. Allows for 1/8" gap between flange and wall to create shadow line allowing for unevenness of wall.

Interior Luminaire Finish - Standard interior colors are White (WH), Black (BK) and Silver (SV). RAL colors (SP) are available, please specify RAL#.

TEL: (845) 691-7723
FAX: (845) 691-6749
www.selux.com/usa
M1R1-01 (v5.1)

c UL US LISTED

Union Made Affiliated with **IBEW** *Local 363*

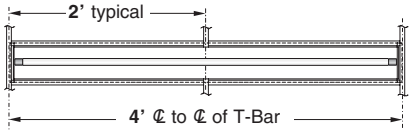
M100 Recessed Linear Fluorescent Flanged Extrusion

M1R1 and M1R2 Layout Dimensions

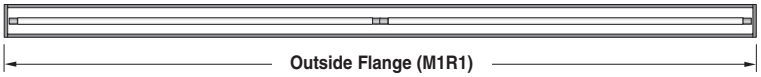
Specify T5 lamps when using in grid ceiling systems where 24" or 48" light openings are required.

M1R1 Recessed - nominal 4 foot individual

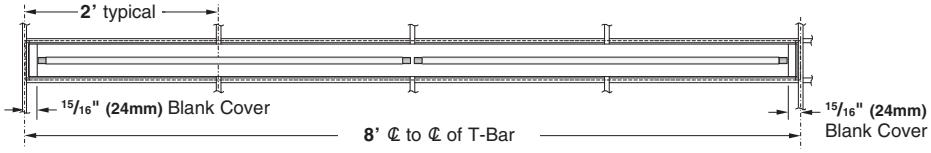
M1R1 Recessed - T-Bar Length - nominal 4 foot individual



M1R1 Recessed - nominal 8 foot individual

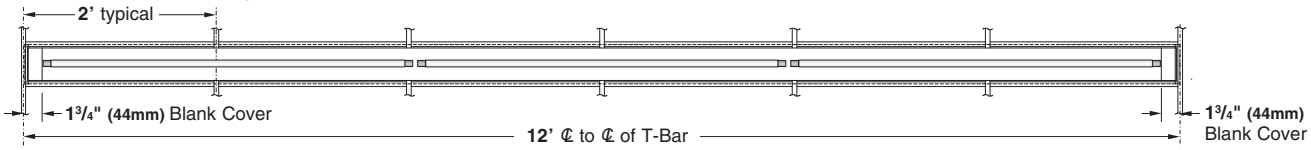


M1R1 Recessed - T-Bar Length - nominal 8 foot individual

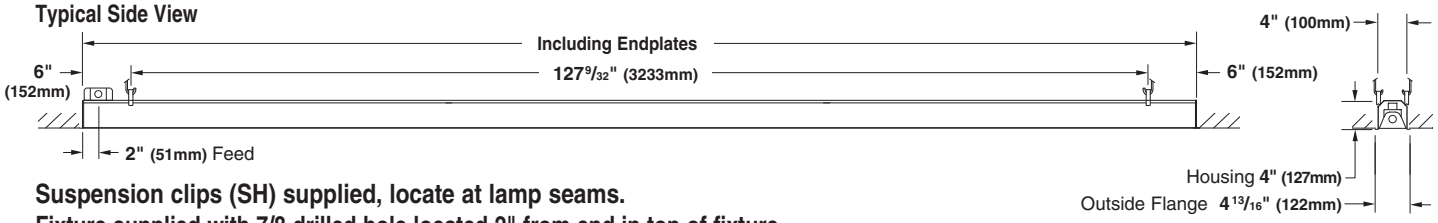


M1R1 Recessed - nominal 12 foot individual

M1R1 Recessed - T-Bar Length - nominal 12 foot individual



Typical Side View



Continuous Flange (M1R1)

Flush End (M1R2)

Suspension clips (SH) supplied, locate at lamp seams.
Fixture supplied with 7/8 drilled hole located 2" from end in top of fixture.

	T5 (1 or 2 lamp)				T8 (1 lamp)	
	M1R1/M1R2 Including Endplates	M1R1 Outside Flange	M1R1/M1R2 - TB Including Endplates	M1R1 - TB Outside Flange	M1R1/M1R2 Including Endplates	M1R1 Outside Flange
4 foot individual	46.78" (1188mm)	47.58" (1209mm)	47.03" (1195mm)	47.91" (1217mm)	48.33" (1228mm)	49.20" (1250mm)
8 foot individual	93.19" (2367mm)	94.00" (2388mm)	95.03" (2414mm)	95.91" (2436mm)	96.37" (2448mm)	97.24" (2470mm)
12 foot individual	139.59" (3546mm)	140.41" (3568mm)	143.03" (3633mm)	143.91" (3655mm)	144.41" (3668mm)	145.28" (3690mm)

For other lengths, lamping, continuous runs or configurations please specify overall length (in feet), accessories desired and sketch/drawing of configuration. SELUX will detail project drawings upon order and supply submittal drawings for approval. Individual fixtures cannot be field joined. If you have any questions please contact SELUX customer service or applications engineering for assistance (1-800-SELUX-CS).

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PO Box 1060, 5 Lumen Lane / Highland, NY 12528
TEL: (845) 691-7723 / FAX: (845) 691-6749
E-mail: seluxus@selux.com / Web Site: www.selux.com/usa
M1R1-02 (05/08)

LINCS®

1" Modular Task Light
T5/T5HO Fluorescent

LINCS100F Series

MODULARITY · LIFETIME WARRANTY · LAMPS INCLUDED · ECO-FRIENDLY

Project	Type
BSC New Science Building	
Project Location	
Buffalo, NY	
Catalog #	

Description

The Little Inch Connecting System (LINCS®) sets the standard for flexible, inconspicuous task lighting. LINCS® unique labor-saving plug-together design affords premium quality at a low installed cost. The attractive extruded aluminum design dissipates heat, is durable, lightweight and corrosion resistant. Lamp choices include T5, T5HO and preheat T5 fluorescent lamps to best suit your application requirements. The wide variety of finishes and wiring options make LINCS® a great choice for both residential and commercial applications.

Additional features:

- Miniature 1" profile
- LINCS® can be installed 4 times faster than conventional undercabinet task luminaires.
- Optional integral occupancy sensor automatically switches LINCS® on when the task area is occupied and off when vacant helping to maximize energy savings.
- Optional wiring module with master On/Off switch or duplex convenience outlet.
- Backed by a Lifetime Warranty.

Specifications

Construction .060" extruded aluminum housing with injection molded polycarbonate endcaps and covers.

Reflector & Lens All LINCS® lenses are extruded from Alkcorylic™ DR acrylic and are warranted against breakage or discoloration. The linear prism lens is standard. A white opal lens (WL) or an opaque front task lens (OF) are optional.

Finish LINCS® is available in a white or black polyester powder coat paint finish or a satin aluminum finish. White models have white endcaps. Black and satin aluminum models have black endcaps.

Lamps LINCS® is available with T5, T5HO or preheat T5 lamps. The T5/T5HO lamps have an average lamp life of 20,000 hours and are supplied with 3000K color temperature. 3500K and 4100K lamps can be requested. The preheat T5 lamps have an average lamp life of 7,500 hours and are supplied with a warm white lamp. Cool white or 3000K lamps available.

Listings UL & CUL Listed for direct-wired and portable installations. The luminaire is IBEW labeled.

Electrical The T5/T5HO models utilize an electronic ballast for 120 or 277 volt applications. The preheat T5 models have an electronic instant start ballast for 120 volt applications only. Ballasts are thermally protected, have a Class "A" sound rating and end-of-life protection. 347 volt not available. Optional passive infrared occupancy sensor control (OSC) available.

Installation Male and female grounded Molex™ connectors are built into each end for modular, plug-together electrical connection. LINCS® can also be connected with interconnect cords. A UL recognized 3/8" flexible metal conduit/non-metallic sheathed wiring connector is supplied for direct-wiring the power into back of housing or through adapter plate at the ends. All models (except for LINCS100F12) have a wiring access panel with a knockout to allow quick wiring without opening the wireway cover. The power cords plug directly into the end of the fixtures and provide an alternative method for wiring.

Warranty All luminaire components, except for lamps and transformers, are warranted against defects during the life of the original installation.

Ordering Information

Sample Catalog No: **LINCS100F35 - 120 - WHG - OSC** (Note: Separate multiple options with a comma.)

LINCS100FS46 — 277 — WHG — [ ]

NOM. LENGTH	Model Number	
	T5 Lamps	
23-7/8"	LINCS100FS23	(1) F14 T5 (Med. Bipin)
35-11/16"	LINCS100FS35	(1) F21 T5 (Med. Bipin)
47-1/2"	LINCS100FS46	(1) F28 T5 (Med. Bipin)
59-5/16"	LINCS100FS58	(1) F35 T5 (Med. Bipin)
	T5HO Lamps	
23-7/8"	LINCS100HO23	(1) F24 T5HO (Med. Bipin)
35-11/16"	LINCS100HO35	(1) F39 T5HO (Med. Bipin)
47-1/2"	LINCS100HO46	(1) F54 T5HO (Med. Bipin)
	Preheat T5 Lamps	
13-5/8"	LINCS100F12	(1) F12 T5 (Med. Bipin)
22-5/8"	LINCS100F21	(1) F13 T5 (Med. Bipin)
25-13/16"	LINCS100F24	(2) F8 T5 (Med. Bipin)
34-13/16"	LINCS100F33	(1) F8 T5 (Med. Bipin) (1) F13 T5 (Med. Bipin)
43-13/16"	LINCS100F42	(2) F13 T5 (Med. Bipin)

Voltage

120
277[1]

Finish

WHG White Glossy
MB Matte Black
SA Satin Aluminum

Specify Qty. of Connectors Needed	Options	
	CSJT-3	SJT cordset hard-wired into back of fixture. UL listed as a portable fixture for use in office workstations (120 volt only)
	DIM[2,3,5]	Dimming ballast for use with analog 0-10 volt fluorescent dimming control
	OF	Opaque front task lens
	WL	White opal diffuser
	OSC[4]	Integral occupancy sensor control
	RSW[5]	Rocker switch (on/off) (120 volt only)
	HLRSW[5]	3-position rocker switch (high/low/off)
	MSBRK	Mounting brackets for attachment to metal shelves (2 brackets)
	SBF	Slow blow fuse.
QTY:	**LINCS100-1/RSW**[6]	Wiring Module with Rocker Switch
QTY:	**LINCS100-2/CO**[6]	Wiring Module with Duplex Outlet
QTY:	**LINCS100PC3**[7]	3' Straight power cord
QTY:	**LINCS100PC6**[7]	6' Straight power cord
QTY:	**LINCS100PC10**[7]	10' Straight power cord
QTY:	**LINCS100PCF4**[7]	2'-4' Flexible coiled power cord
QTY:	**LINCS100ICS**[7]	6" Straight interconnect cord
QTY:	**LINCS100ICF**[7]	12"-36" Flexible coiled interconnect cord

1 277 volt not available with T5 preheat lamps.
2 Dimming control supplied by others
3 Dimming available for models: LINCS100FS35, FS46, FS58 and LINCS100HO46
4 OSC is not available with LINCS100F12
5 Not available when the OSC option is selected.
6 Specify a finish for these options.
7 To designate the cord color add a "W" for white or a "B" for black to the model number. (Example: LINCS100ICSW)

11500 Melrose Avenue Franklin Park, Illinois 60131
Phone: 847-451-0700 Toll-Free: 1-866-50ALKCO
Fax: 847-451-7512 www.alkco.com 12/09

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PHILIPS

LINCS®

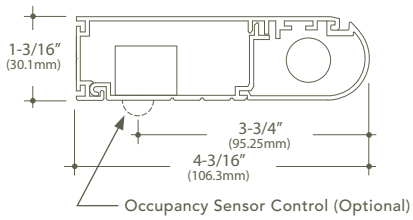
1" Modular Task Light
T5/T5HO Fluorescent

LINCS100F Series

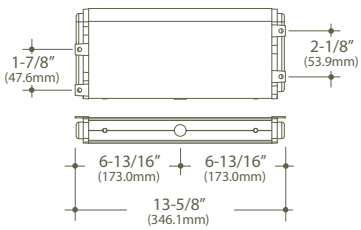
MODULARITY · LIFETIME WARRANTY · LAMPS INCLUDED · ECO-FRIENDLY

Project	Type
BSC New Science Building	

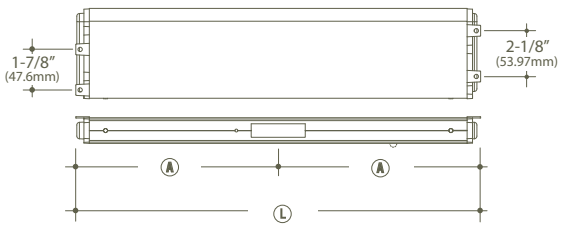
Dimensional Data



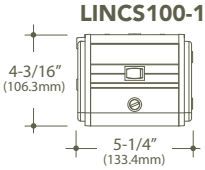
LINCS100F12



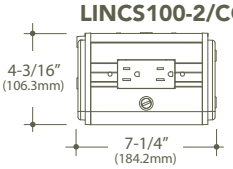
ALL OTHER MODELS



LINCS100-1/RSW



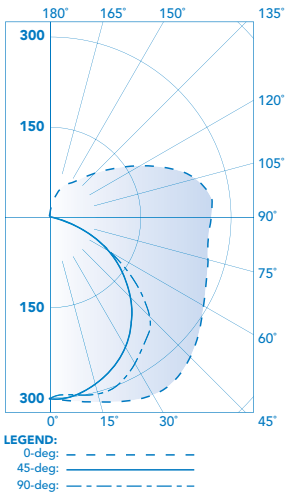
LINCS100-2/CO



DIMENSION	L	A	DIMENSION	L	A
LINCS100FS23	23-7/8" (606.4mm)	11-15/16" (303.2mm)	LINCS100HO46	47-1/2" (1206.5mm)	23-3/4" (603.3mm)
LINCS100FS35	35-11/16" (906.5mm)	17-7/8" (453.2mm)	LINCS100F21	22-5/8" (574.7mm)	11-5/16" (287.3mm)
LINCS100FS46	47-1/2" (1206.5mm)	23-3/4" (603.3mm)	LINCS100F24	25-13/16" (655.6mm)	12-15/16" (327.8mm)
LINCS100FS58	59-5/16" (1506.59mm)	29-11/16" (754.1mm)	LINCS100F33	34-13/16" (884.29mm)	17-7/16" (442.1mm)
LINCS100HO23	23-7/8" (606.4mm)	11-15/16" (303.2mm)	LINCS100F42	43-13/16" (1112.8mm)	21-15/16" (556.4mm)
LINCS100HO35	35-11/16" (906.5mm)	17-7/8" (453.2mm)			

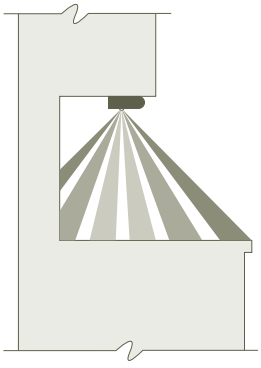
LINCSFS35

(1) 21W T5 Fluorescent - miniature bi-pin base
4450 lumens per lamp
Report No.: ITL52771
Efficiency: 67.3%



Integral occupancy sensor control (OSC)

The OSC also has a built-in photocell to prevent the luminaire from turning on when room has adequate illumination. Only the first luminaire in the interconnected row requires the OSC option.



ELECTRICAL DATA - T5HO

Lamp Wattage	24	39	54
Lamp Lumens*	1900	3325	4750
Input Watts	41	40	62
Max. Amps	.34	.34	.52
Power Factor	.98	.98	.96

ELECTRICAL DATA - T5

Lamp Wattage	14	21	28	35
Lamp Lumens*	1275	2000	2750	3450
Input Watts	18	25	33	40
Max. Amps	.15	.21	.28	.34
Power Factor	.98	.98	.98	.98

ELECTRICAL DATA - Preheat T5

Lamp Wattage	8	13	8/13	(2)8	(2)13
Lamp Lumens*	300	655	955	600	1310
Input Watts	10	14	23	19	28
Max. Amps	.08	.12	.20	.16	.24
Power Factor	.97	.97	.97	.98	.97

* Based on design lumens.

▶ Go to www.alkco.com for additional Photometric Data

(Hg) Some luminaires use fluorescent or high intensity discharge (HID) lamps that contain small amounts of mercury. Such lamps are labeled "Contains Mercury" and/or with the symbol "Hg". Lamps that contain mercury must be disposed of in accordance with local requirements. Information regarding lamp recycling and disposal can be found at www.lamprecycle.org

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Phone: 847-451-0700 Toll-Free: 1-866-50ALKCO
Fax: 847-451-7512 www.alkco.com 12/09

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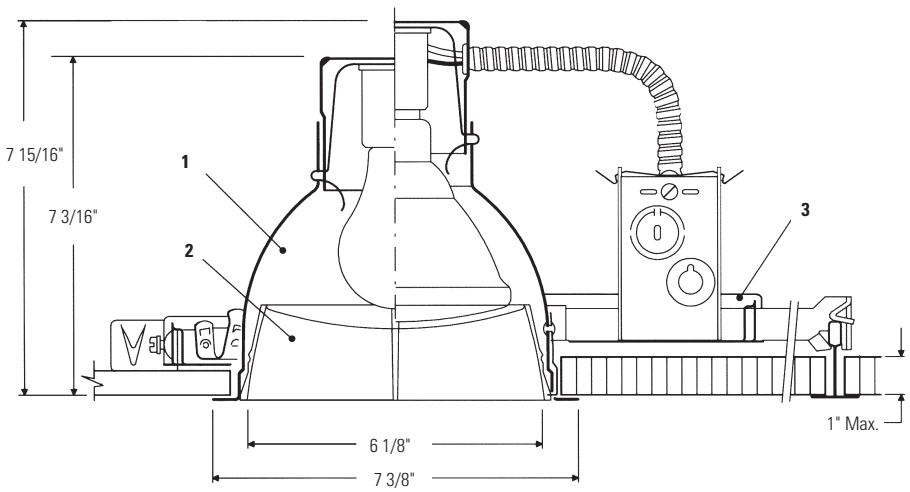
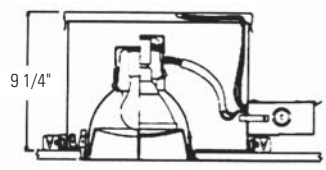
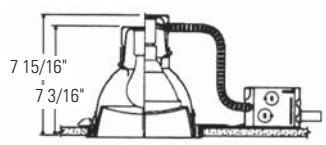


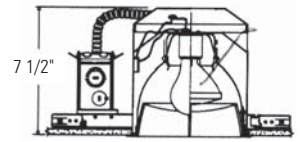
1132/1102P1 Series
Standard Incandescent



1132/1100
Deep IC Series
Incandescent
Insulated Ceiling



1132/1103R
Lyteming™
Non-IC
Remodeler Ring



1132/1104IC/N
Lyteming™
Convertible
IC/Non-IC

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

Reflector Trim	Frame-In Kit — See Individual Frame-In Kit Specification Sheets							
	Incandescent				Fluorescent			
	Frame-In Kit	Ceiling Type	Lamping	Height	Frame-In Kit	Ceiling Type	Lamping	Height
1132 Matte White	**1102P1** **1103R**	Non-IC Non-IC Remodeler	100W A19 150W PAR38	7 3/16", 7 15/16" 7 3/16", 7 15/16"	**1101F18U Series**	UniFrame™ Non-IC	(1) Triple 18W (GX24q-2)	7 1/16" max.
	1100IC **1100AICM**	IC AirSeal® IC	60W A19 75W PAR30	7 5/16" 7 5/16"				
	1100DICM **1100DAICM**	Deep IC Deep AirSeal® IC	60W A19 90W PAR38	9 1/4" 9 1/4"	**1100FTU Series**	Non-IC	(1) Triple 26/32W (GX24q-3)	6 3/4"
	1104ICX/N	AirSeal® IC	52W A19 75W PAR30	7 1/4"				
					1101F18ICU/N	Performance IC	(1) Triple 18W (GX24q-2)	7 1/4"
	1104IC/N **1104ICR**	AirSeal® IC IC Remodeler	40W A19 50W PAR30	7 1/2" 7 1/2"	**1104F13ES Series**	Airseal® IC	(1) Triple 13W (GX24q-1)	7 1/2"
	1104IC/N **1104ICR**	Non-IC Non-IC Remodeler	60W A19 75W PAR30	7 1/2" 7 1/2"	**1104F18ES Series**	Airseal® IC	(1) Triple 18W (GX24q-2)	7 1/2"
					1910XFH1	Conversion Kit	(1) Quad 13W (GX23-2)	7 3/16"
					1910XDH1	Conversion Kit	(2) Quad 13W (GX23-2)	6 3/4"

Features

1. **Reflector:** Hydroformed aluminum, 0.040" minimum thickness; Anobrite® (anodic-processed) semi-specular finish for permanent reflectivity; matte white trim flange.
2. **Cross Blade:** Die cast aluminum painted matte white or satin aluminum.
3. **Frame-In Kit:** (1102P1 standard frame shown.) Other frames listed above and shown around. See Frame-In Kit specification sheets for more details.

Options & Accessories

Retaining Clips: **1955 -** For installing in existing ceiling
Extra Wide Flange Trim Ring: **1957 -** 8 5/8" O.D.

Labels

UL (Suitable for Damp Locations), I.B.E.W.

US Patent Numbers: 4,313,154; 4,327,403; 4,751,624; 5,045,985
Other US & Foreign Patents Pending.

Job Information **Type:** F15

Job Name: BSC New Science Building

Cat. No.: 1132-1100FTU

Lamp(s): PL-T-26

Notes:

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

LUNERA 6400LED

6400 SERIES 4FT X 6.7IN SUSPENDED LED FIXTURE

Project	Catalog #	Type
Firm	Specifier	Qty

INTENDED USE

The 6400 Series is an LED luminaire for suspended applications. Designed as direct replacement for linear fluorescent fixtures, the Lunera 6400 Series is available in a variety of color temperatures, dimmable options and driven by a 30 watt power supply.

Lunera LED fixtures provide uniform soft light with an extended lifetime that delivers significant savings over typical linear fluorescent fixtures. The Lunera 6400 provides 25%-50% energy savings while meeting IESNA recommended illumination levels. Ideal for use in office, hospital, retail, educational and other commercial applications.

1,700 lumens

FEATURES

The 6400 is designed as a direct replacement for 4' fluorescents in commercial spaces.

- 1,700 lumens
- 30 watts
- .55 watts/sq. ft (typical)
- Smooth continuous dimming (0-10 volt)
- Multiple color temperatures up to 5000K
- 5 Year Warranty
- Easily remotable power supply up to 100'

30 watts

CONSTRUCTION

Solid design, precision tooling and exacting quality control create a commercial LED fixture that meets the industry's needs and requirements.

Anodized aluminum extrusion with acrylic layers, tested and proven LEDs and a solid state power supply.

ELECTRICAL SYSTEM

Standard driver is high efficiency, solid-state with smooth dimming available, 120V 50/60Hz or 277V 50/60Hz available.

ACCESSORIES

HANGING HARDWARE	BATTERY BACKUP
HS1: HANGNG HARDWARE (8 FT) NA: NONE	1BB: BATTERY BACKUP NA: NONE

ORDERING

PLATFORM	DIRECTIONAL	FRAME	CCT	POWER	WATTAGE	CONTROL	PSU
6400	DR				032		
6400	DR: DIRECT	S: SILVER C: CUSTOM	4000: 4000K 5000: 5000K	120V: 120 VOLTS 277V: 277 VOLTS 999M: MULTI VOLT	032: 32 WATTS	SS: STANDARD SWITCH DM: 0-10V DIM	IN: INTEGRATED RE: REMOTE

INSTALLATION INSTRUCTIONS, LM-79 TESTING, AND IES FILES AVAILABLE ONLINE AT WWW.LUNERA.COM

LUNERA 6400 SUSPENDED LED FIXTURE

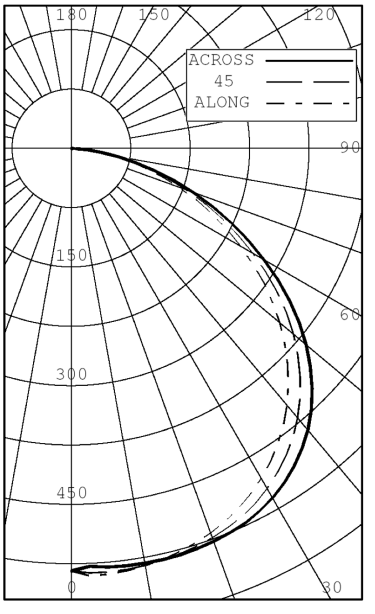
SPECIFICATIONS

Item	Specification	
Output	Lumen Maint (L70)	50,000 Hours
	Color Temperature	4000K, 5000K
	Lumens	1,700
	Efficacy (lm/w)	54
	Color Consistency	Proprietary Algorithm
	Power Factor	> 90%
Electrical	Input Voltage	120V 50/60 Hz or 277V 50/60 Hz
	Power Consumption	30W
Control		Dimming, 0-10 V
Physical	Dimensions (HxWXD)	48" x 6.7" x 1"
	Weight	11lbs
	Housing	Anodized Aluminum
	Optics	Acrylic
	Mounting	Fits standard size drop ceiling grid (15/16, 9/16, Chicago Plenum)
	Operating Temperature	-15°F to 115°+ dF (-26°C to 46°C)
	Humidity	20%-85% RH, non- condensing
	Fixture Run Lengths	15' nominal, 100' available
Certifica-tion & Safety	Certification	UL, CUL, ETL, FCC
	Material usage	No mercury or lead used, ROHS compliant
	Environment	Dry and Damp
	LED Class	L70 Rated to 50,000+ hrs @ T ≤ 130°C (266°F)

PHOTOMETRICS

ZONAL LUMEN SUMMARY

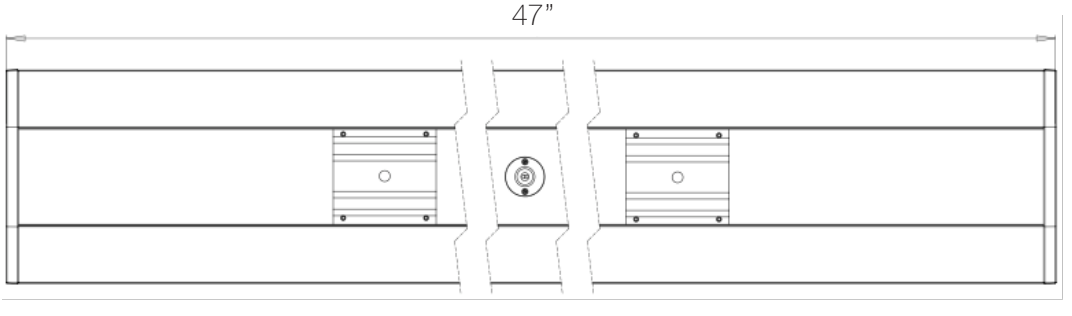
Zone	Lumens	% LAMP	% FIXT
0-30°	437	26.2	26.2
0-40°	732	43.8	43.8
0-60°	1327	79.5	79.5
0-90°	1668	100.0	100.0

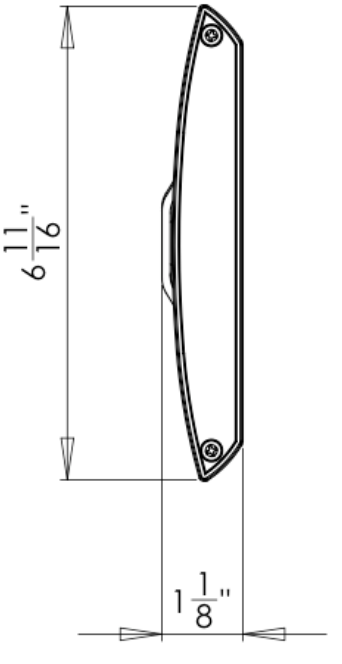


INTENSITY (CANDLEPOWER) SUMMARY

Angle	0°	45°
0°	534	534
5°	540	537
15°	528	531
25°	501	512
35°	454	473
45°	386	408
55°	296	317
65°	196	209
75°	97	103
85°	19	20
90°	0	0

DIMENSIONS & MOUNTING

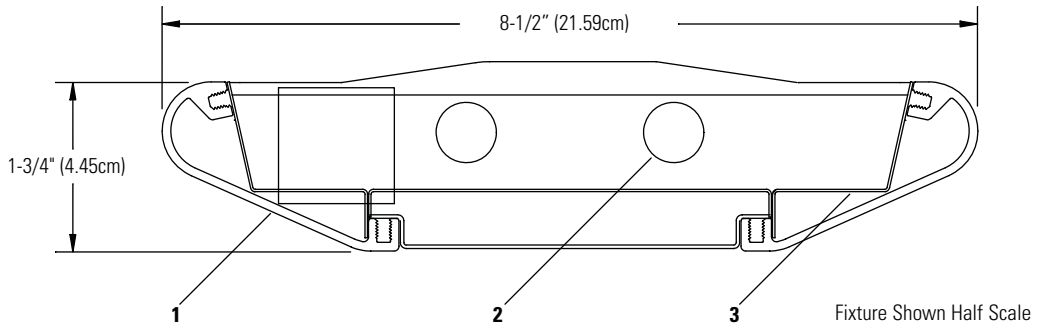




Lunera Lighting, Inc ™ | For more info, contact us at info@lunera.com | www.lunera.com |
T 650-241-3875 | F 650-362-1987 | 3696 Haven Avenue, Suite A, Redwood City, CA 94063

PID# 10-9.L3.DO2 REV B

Lytespread™ LSB Solid Indirect 2-Light T5 Per 4-Foot (Nominal) Section



Fixture Shown Half Scale

Ordering Information

Family	Lamps	Length	Shielding	Ballast	Voltage	Finish
LSB	**2**	4	**A**	28	277	WH
	2 = 2-Lamp T5	**4** = 4-Foot **8** = 8-Foot	**A** = Solid	**28** = 28W T5 **54** = 54W T5 **5E** = 54W T5 Emergency Pack **2E** = 28W T5 Emergency Pack **5D** = 54W T5 Dimming	**1** = 120 volt **2** = 277 volt	**AL** = Aluminum **WH** = White

Complete ordering instructions below.

Features

1. **Housing:** Extruded aluminum. Die-cast end cap mechanically attached with no exposed fasteners or hardware.
2. **Lamping:** Two T5, 28 or 54 watt (as specified) fluorescent lamps per 4-Foot nominal section. Provided by others.
3. **Reflector:** Precision die-formed semi-specular aluminum.

Electrical

Ballast is <10% THD, .98 ballast factor, pre-heat start. 18 gauge wire. Color-coded quick connectors allow ease of connection for joiner modules. Power feed is 18 gauge white SJT. For special circuiting consult factory. Factory installed ballast disconnect allows the ballast to be disconnected from and reconnected to incoming power under load without turning the entire circuit off.

Dimming: 120/277 VAC 1% dimming level, 4 wire feed required.

Emergency Battery Pack: 28 watt: 520 lumens @ 90 minutes, 54 watt: 700 lumens @ 90 minutes.

Mountings

Cable suspension (not shown) - 4-1/2" (11.43cm) diameter canopy finished white enamel, 1/16" (0.16cm) diameter stainless steel aircraft cable adjustable up to 36" (91.44cm). Dual-screw draw-tight connector to create hairline seam between joiner modules.

Finish

Powder coated baked white or aluminum finish. Custom colors available, consult factory.

Options and Accessories

Emergency circuiting; special circuiting; X, T & L joiner blocks - consult factory.

Labels

UL, cUL and I.B.E.W.

Ordering Instructions

Individual Fixtures:

1. Order number of MODULES required.
2. Order one POWER FEED END SET per MODULE.

Continuous Rows:

1. Determine run length.
2. Order the appropriate number of MODULES for the complete run.
3. Order one POWER FEED END SET per run.
4. Order one CABLE ASSEMBLY per MODULE minus one per run.
5. For runs that exceed amperage limits, order the appropriate number of CABLE/CORD ASSEMBLIES.

Job Information **Type:** F13

Job Name: BSC New Science Building

Cat. No.: LSB-24A-28-277-WH

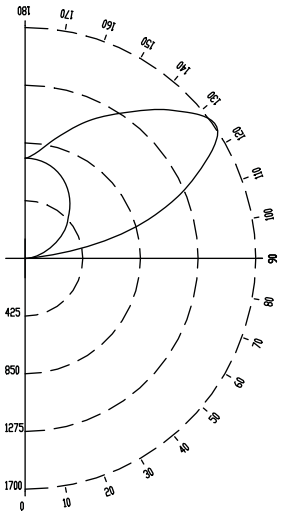
Lamp(s): 28WT5

Notes:

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

Performance

CANDLEPOWER CURVE



REPORT NO: LRL 300-1E
CAT NO: LSB24A28
LAMPS: 2 F28T5
LUMENS: 2900
EFFICIENCY: 86.1%

CANDLEPOWER

ZONE ➤ DEG. ▼	0	22	45	67	90
		CANDELAS			
180	738	738	738	738	738
175	736	743	753	772	771
165	707	768	833	914	923
155	652	779	914	1081	1120
145	567	772	991	1246	1313
135	454	728	1038	1433	1541
125	354	690	1165	1685	1715
115	227	649	1211	1357	1361
105	119	590	746	792	793
95	34	162	117	118	93
90	14	24	15	15	15
85	0	0	0	0	0
75	0	0	0	0	0
65	0	0	0	0	0
55	0	0	0	0	0
45	0	0	0	0	0
35	0	0	0	0	0
25	0	0	0	0	0
15	0	0	0	0	0
5	0	0	0	0	0
0	0	0	0	0	0

COEFFICIENTS OF UTILIZATION

% EFFECTIVE CEILING CAVITY REFLECTANCE

	80			70			50		
	WALL REFLECTANCE								
	70	50	30	70	50	30	50	30	10
0	82	82	82	70	70	70	48	48	48
1	75	71	68	64	61	58	42	40	39
2	68	62	57	58	53	49	36	34	32
3	62	54	49	53	47	42	32	29	27
4	56	48	42	48	41	36	28	25	23
5	51	42	36	44	36	31	25	22	19
6	47	38	31	40	32	27	22	19	16
7	43	34	27	37	29	27	20	17	14
8	40	30	24	34	26	21	18	15	12
9	37	27	21	31	24	19	16	13	11
10	34	25	19	29	21	17	15	12	10

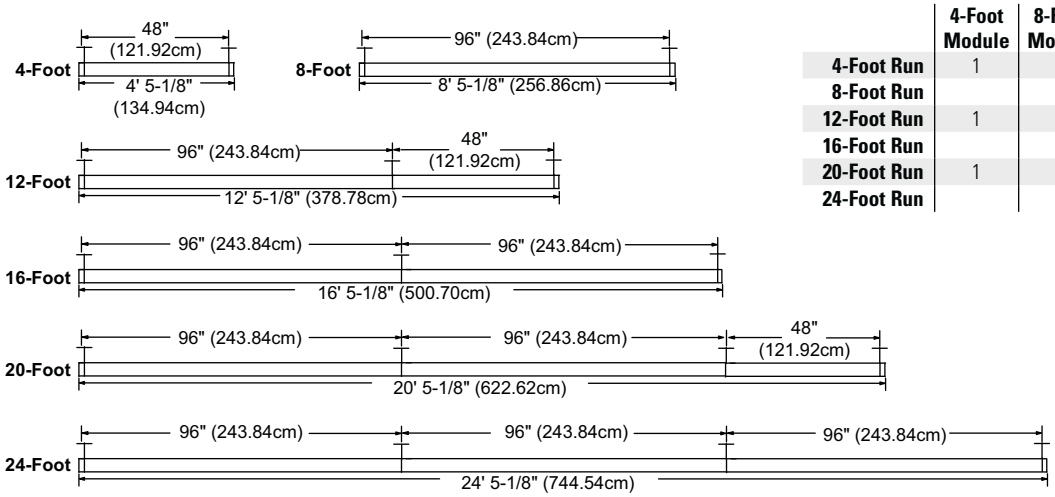
20% FLOOR CAVITY REFLECTANCE

DISTRIBUTION

Zone	Lumens	% Lamp	% Luminaire
0-90	0	0.0	0.0
90-180	4995	86.1	100.0
0-180	4995	86.1	100.0

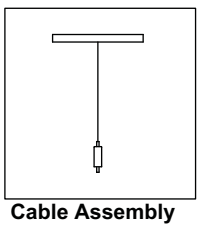
Calculations are for 28 watt T5 lamps, for 54 watt T5 lamps multiply by 1.7

Fixture Lengths & Mounting Locations

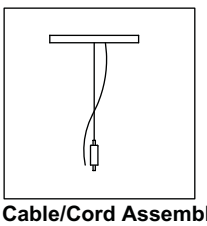


	4-Foot Module	8-Foot Module	Cable/ Assembly	Power Feed End Set
4-Foot Run	1			1
8-Foot Run		1		1
12-Foot Run	1	1	1	1
16-Foot Run		2	1	1
20-Foot Run	1	2	2	1
24-Foot Run		3	2	1

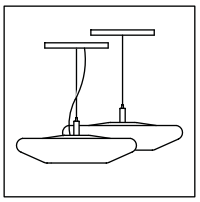
Mounting Accessories



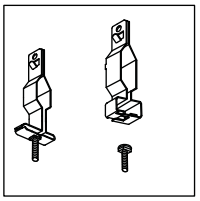
Cable Assembly
Single Cable: **LSBC36**



Cable/Cord Assembly
Single Cable & Cord: **LSBCC36**
Single Cable & 4 Wire Cord*: **LSBCC36X4**



Power Feed End Set
Straight Cord: **LSBEC36WH** (white)
LSBEC36AL (aluminum)
4 Wire Cord*: **LSBEC36WHX4** (white)
LSBEC36ALX4 (aluminum)



Ceiling Grid Kit
CGK
Includes both Standard 1" (2.54cm) Tee Bar Clip & Slot Tee Clip

***Use for dimming, switching, and emergency battery packs.**

Job Information **Type:** F13

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

PL-T 26W/835/4P ALTO ICT

Product family description

PL-T Triple 4pin Fluorescent Lamp with Amalgam.

Features/Benefits

- ALTO® Lamp Technology - Passes EPA's TCLP test for non-hazardous waste.
- Utilizes amalgam technology to provide > 90% of rated lumens in ambient temperatures from 23F to 130F.
- Triple tube design available in 18, 26, 32, and 42W.
- Excellent Color Rendering - 82 Color Rendering Index (CRI).
- Broad Range of Color Temperature - Available in 2700, 3000, 3500 and 4100K.
- Dimmable - PL-T 4-pin lamps may be used with electronic dimming ballasts.
- Long Life - 12,000 hours.
- Energy Saving - Designed for use with electronic ballasts for lower operating costs and flicker-free starting.

Applications

- Ideal for downlights and medium bay multi-lamp fixtures for general lighting.

Notes

- Rated average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently. (202)
- Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions. (203)
- Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions. (208)

PHILIPS

Product data	
Product Number	268243
Full product name	PL-T 26W/835/4P ALTO 1CT
Ordering Code	268243
Pack type	1 Lamp in a Folding Carton
Pieces per Sku	1
Skus/Case	12
Pack UPC	046677268244
EAN2US	
Case Bar Code	50046677268249
Successor Product number	
Base	GX24q-3
Base Information	4P
Execution	/4P [4 Pins]
Packing Type	1CT [1 Lamp in a Folding Carton]
Packing Configuration	12
Avg. Hrs. Life	16000 hr
Ordering Code	PL-T 26W/835/4P/ALTO
Pack UPC	046677268244
Case Bar Code	50046677268249
Watts	26W
Lamp Wattage EL	24.0 W
Lamp Voltage	80 V
Dimmable	Yes
Color Code	835 [CCT of 3500K]
Color Rendering Index	82 Ra8
Color Designation	White
Color Description	835 White
Color Temperature	3500 K
Initial Lumens	1800 Lm
Initial Lumens	1800 Lm
Overall Length C	126.4 mm
Diameter D	39.85 mm
Diameter D1	39.65 mm
Special Note	/ALTO
Product Number	268243

PHILIPS

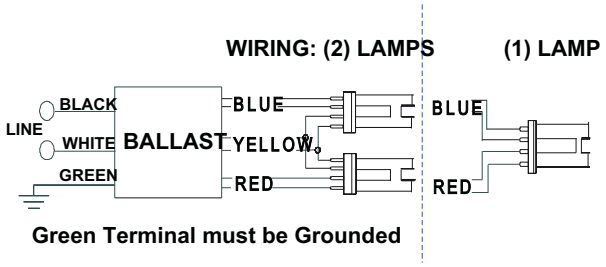
PHILIPS ADVANCE

ICF-2S26-H1-LD@277	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
* CFM26W/GX24Q	1	26	0/-18	0.11	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.20	54	1.00	10	0.99	1.5	1.85
CFM32W/GX24q	1	32	0/-18	0.13	36	0.98	10	0.98	1.5	2.72
CFM42W/GX24q	1	42	0/-18	0.17	46	0.98	10	0.98	1.5	2.13
CFQ26W/G24q	1	26	0/-18	0.10	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.19	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.18	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.18	48	0.93	10	0.99	1.5	1.94

Wiring Diagram



Green Terminal must be Grounded

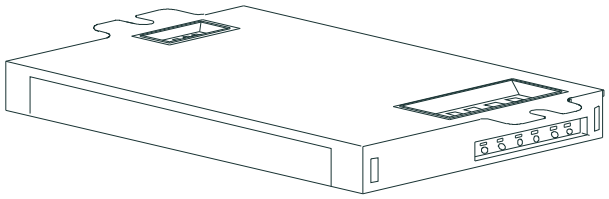
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

Data is based upon tests performed by Philips Lighting Electronics N.A. 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.

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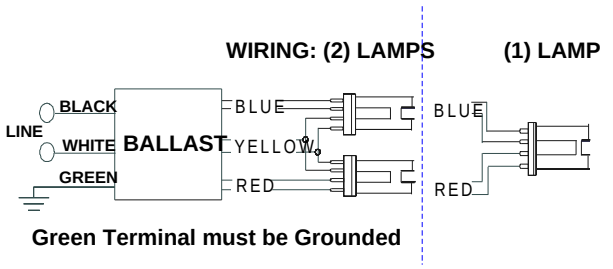
PHILIPS ADVANCE

ICF-2S26-M1-BS@277	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFM26W/GX24Q	1	26	0/-18	0.11	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.20	54	1.00	10	0.99	1.5	1.85
* CFM32W/GX24q	1	32	0/-18	0.13	36	0.98	10	0.98	1.5	2.72
CFM42W/GX24q	1	42	0/-18	0.17	46	0.98	10	0.98	1.5	2.13
CFQ26W/G24q	1	26	0/-18	0.10	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.19	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.18	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.18	48	0.93	15	0.99	1.5	1.94

Wiring Diagram



Green Terminal must be Grounded

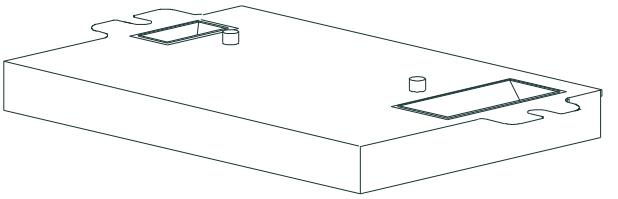
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.40 "	0.98 "	2.00 "
4 49/50	2 2/5	0 49/50	2
12.6 cm	6.1 cm	2.5 cm	5.1 cm

Revised 08/17/2006

Data is based upon tests performed by Philips Lighting Electronics N.A. 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.

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PHILIPS
ADVANCE

ICF-2S26-M1-BS@277	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start except for ballasts with -QS suffix, which shall be Rapid Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the IntelliVolt ballast. RCF models shall operate from 60 Hz input source of 120V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for primary lamp. Ballasts for PL-H lamps shall have a minimum starting temperature of -30C (-20F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall be rated for use in air-handling spaces.

3.4 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.5 Ballast shall comply with ANSI C82.11 where applicable.

3.6 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C and three-years for a maximum case temperature of 85C (90C 3year warranty for ICF1H120-M4-XX, ICF2S42-90C-M2-XX and ICF2S70-M4-XX modesls).

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

Revised 08/17/2006

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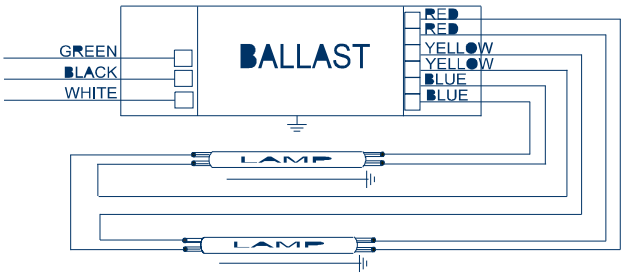
PHILIPS
ADVANCE

ICN-2S54-90C@277	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F54T5/HO	1	54	-20/-29	0.23	62	1.02	10	0.96	1.7	1.65
* F54T5/HO	2	54	-20/-29	0.43	117	1.00	10	0.98	1.7	0.85

Wiring Diagram



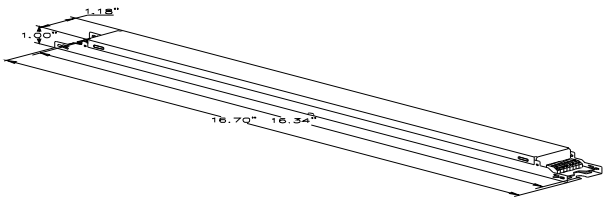
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	31	78.7
White	31	78.7
Blue	28	71.1
Red	28	71.1
Yellow	48	121.9
Gray	0	0
Violet	0	0

	in.	cm.
Yellow/Blue	0	0
Blue/White	0	0
Brown	0	0
Orange	0	0
Orange/Black	0	0
Black/White	0	0
Red/White	0	0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
16.70 "	1.18 "	1.00 "	16.34 "
16 7/10	1 9/50	1	16 17/50
42.4 cm	3 cm	2.5 cm	41.5 cm

Revised 03/11/2009

Data is based upon tests performed by Philips Lighting Electronics N.A. 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.

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10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

PHILIPS
ADVANCE

ICN-2S54-90C@277	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be provided with integral leads or poke-in wire trap connectors color-coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -28C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.

2.13 Four-lamp ballast shall have (semi-independent or independent) lamp operation.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with UL Type CC rating.

3.7 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

Revised 03/11/2009

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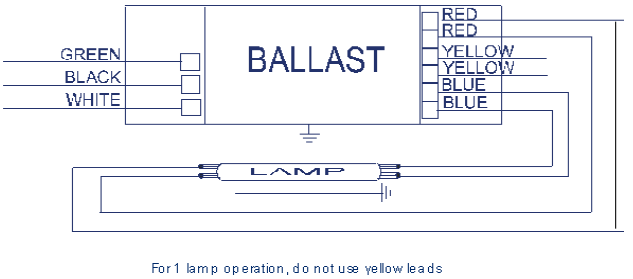
PHILIPS
ADVANCE

ICN4S5490C2LSG@277	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series/Parallel
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
* F54T5/HO	1	54	-20/-29	0.24	62	0.99	10	0.90	1.7	1.60
F54T5/HO	2	54	-20/-29	0.43	117	0.99	10	0.98	1.7	0.85
F54T5/HO	3	54	-20/-29	0.66	179	1.00	10	0.98	1.7	0.56
F54T5/HO	4	54	-20/-29	0.86	234	1.00	10	0.98	1.7	0.43

Wiring Diagram

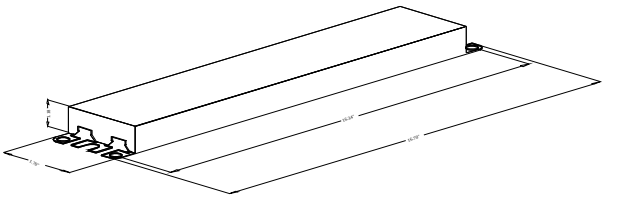


For 1 lamp operation, do not use yellow leads

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
16.7 "	1.7 "	1.18 "	16.34 "
16 7/10	1 7/10	1 9/50	16 17/50
42.4 cm	4.3 cm	3 cm	41.5 cm

Revised 07/31/2009

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PHILIPS
ADVANCE

ICN4S5490C2LSG@277	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series/Parallel
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be provided with integral leads or poke-in wire trap connectors color-coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -29C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

2.13 Ballast shall have a hi-low switching option when operating (4) F54T5/HO lamps to allow switching from 4-2 lamps, 3-2 lamps or 3-1 lamp.

2.14 Four-lamp ballast shall have semi-independent lamp operation.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with UL Type CC rating.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

Revised 07/31/2009

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Presented By:
Contact Phone:
Contact E-mail:

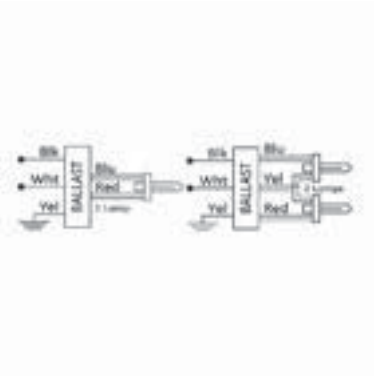
Customer Name:
Project Name: BSC New Science Building
Fixture Type: F6

GE Lighting

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 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)
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

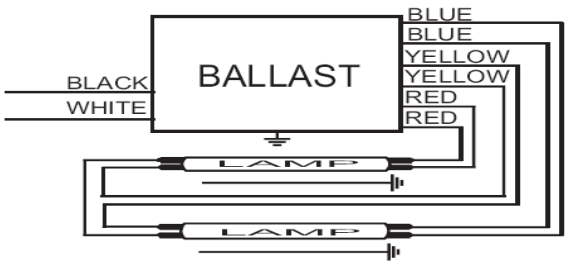
PHILIPS
ADVANCE

ICN-2S28-N@120	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F14T5	1	14	0/-18	0.14	17	1.07	10	0.98	1.7	6.29
F14T5	2	14	0/-18	0.28	33	1.04	10	0.98	1.7	3.15
F21T5	1	21	0/-18	0.22	25	1.06	10	0.98	1.7	4.24
F21T5	2	21	0/-18	0.39	49	1.02	10	0.98	1.7	2.08
F28T5	1	28	0/-18	0.29	31	1.05	10	0.98	1.7	3.39
* F28T5	2	28	0/-18	0.53	62	1.00	10	0.98	1.7	1.61

Wiring Diagram



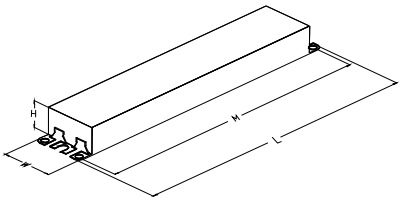
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	23	58.4
White	23	58.4
Blue	27	68.6
Red	27	68.6
Yellow	42	106.7
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White		0
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.5 "	1.3 "	1.0 "	8.9 "
9 1/2	1 3/10	1	8 9/10
24.1 cm	3.3 cm	2.5 cm	22.6 cm

Revised 09/14/2009

Data is based upon tests performed by Philips Lighting Electronics N.A. 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.

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PHILIPS
ADVANCE

ICN-2S28-N@120	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be provided with integral leads or poke-in wire trap connectors color-coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -28C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.

2.13 Four-lamp ballast shall have (semi-independent or independent) lamp operation.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with UL Type CC rating.

3.7 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

Revised 09/14/2009

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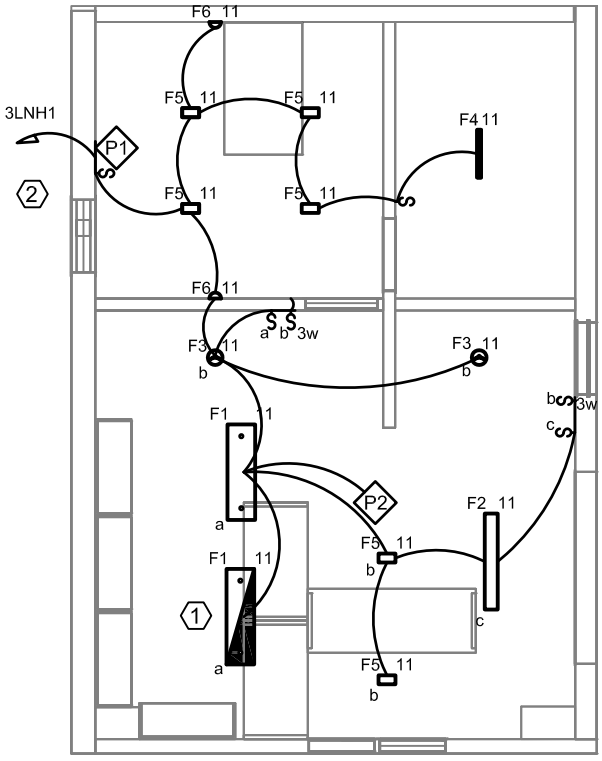
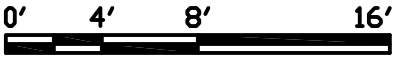
APPENDIX B



NOTES:

1. Emergency Battery Pack in marked F1 luminaires to provide reduced lumen output @ 90 min. Provided by luminaire manufacturer.
2. P1 and P2 wall-mounted and ceiling-mounted (respectively) dual tech. occupancy sensors

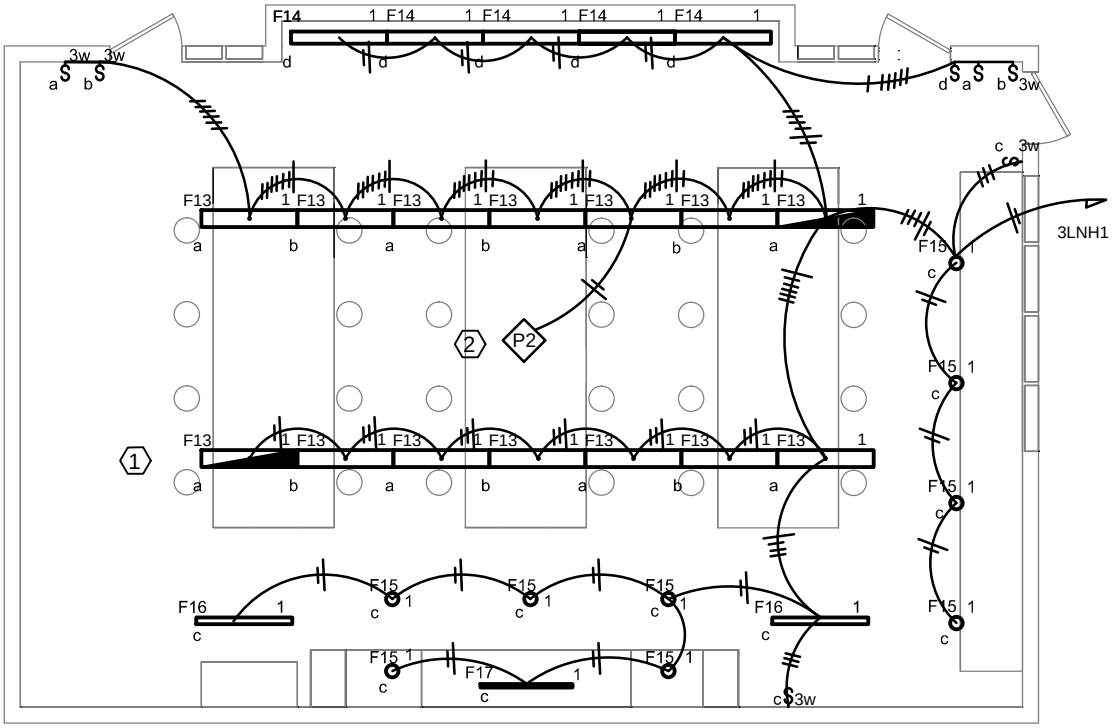


BSC SCIENCE BUILDING -PHASE 1

1300 Elmwood Ave
Buffalo, NY 14222

ISSUED: APRIL 7, 2010
DRAWN BY: MARIE OSTROWSKI

AE SENIOR THESIS
OFFICE LIGHTING PLAN



NOTES:

1. 28 W Emergency Battery Pack in marked F13 luminaires to provide 520 lumens @ 90 min. Provided by luminaire manufacturer.
2. Ceiling mounted occupancy sensor with 360 degree view

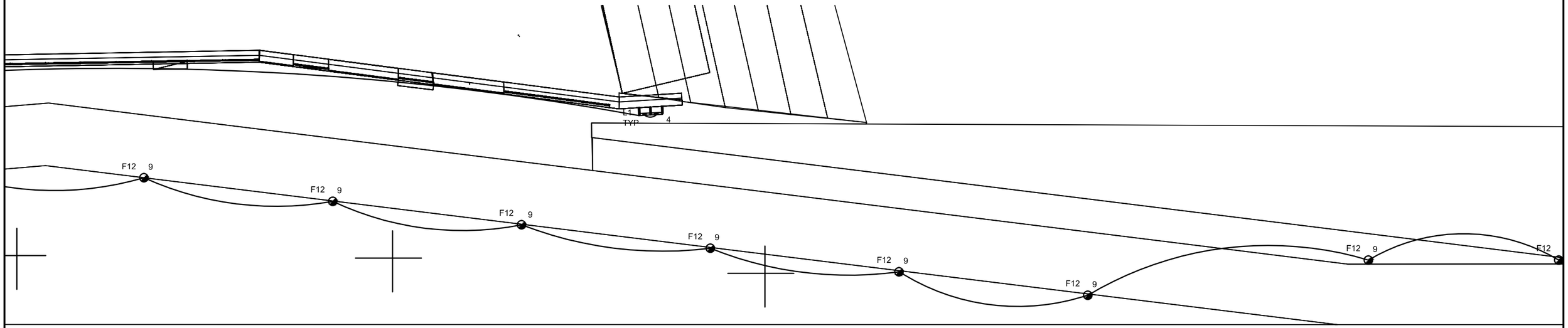
0′ 4′ 8′ 16′

BSC SCIENCE BUILDING -PHASE 1

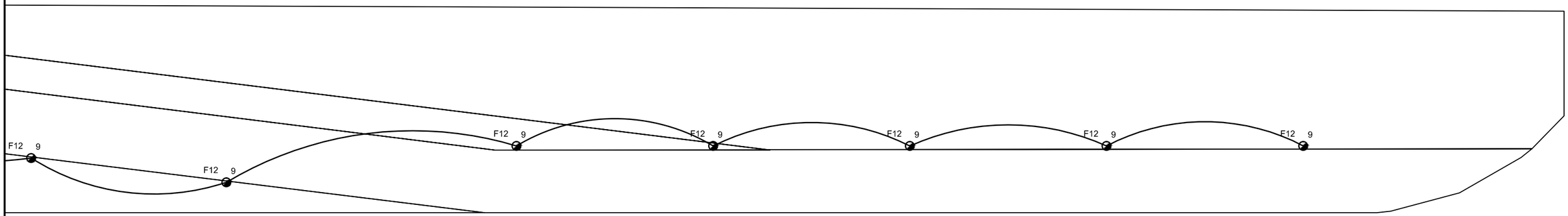
1300 Elmwood Ave
Buffalo, NY 14222

ISSUED: APRIL 7, 2010
DRAWN BY: MARIE OSTROWSKI

AE SENIOR THESIS
LAB LIGHTING PLAN



West Facade - Walkway



West Facade - Walkway Southern Limit

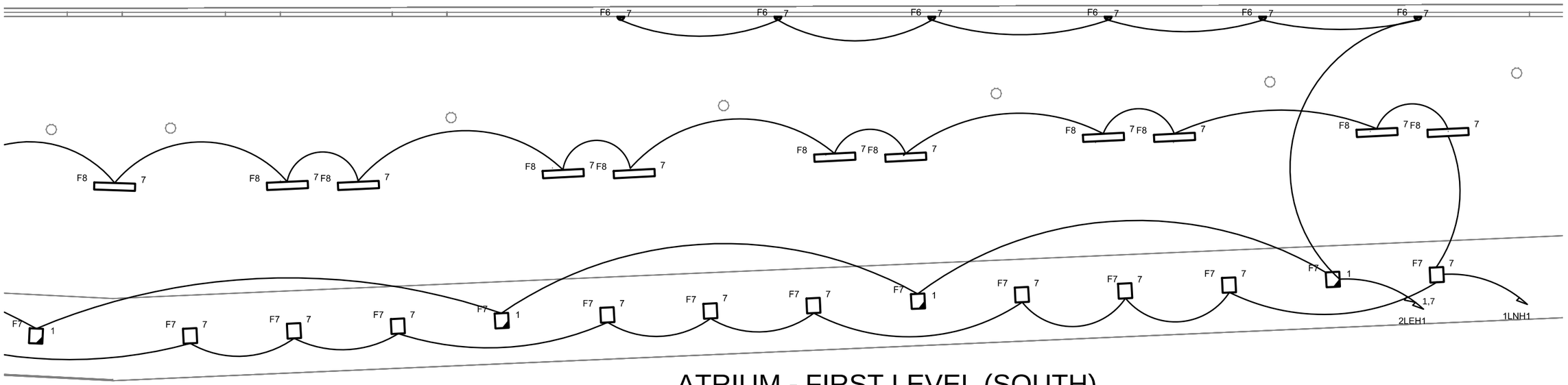
0′ 4′ 8′ 16′

BSC SCIENCE BUILDING -PHASE 1

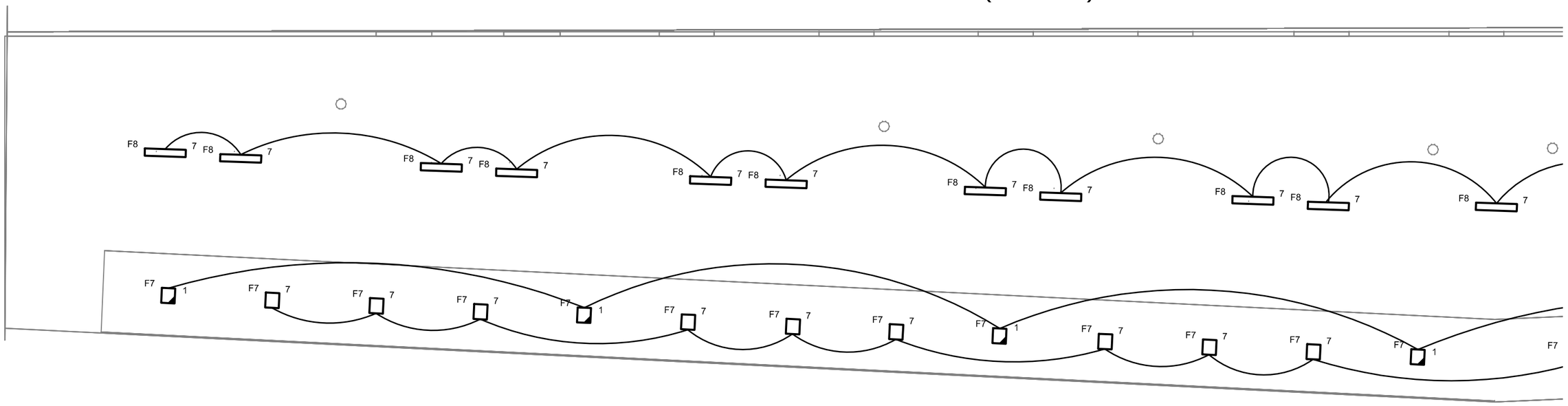
1300 Elmwood Ave
Buffalo, NY 14222

ISSUED: APRIL 7, 2010
DRAWN BY: MARIE OSTROWSKI

AE SENIOR THESIS
EXTERIOR B LIGHTING PLAN



ATRIUM - FIRST LEVEL (SOUTH)



0′ 4′ 8′ 16′

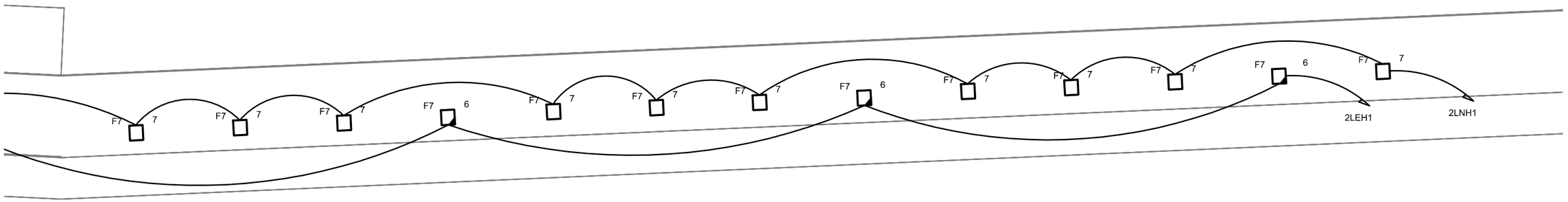
ATRIUM - FIRST LEVEL (NORTH)

BSC SCIENCE BUILDING -PHASE 1

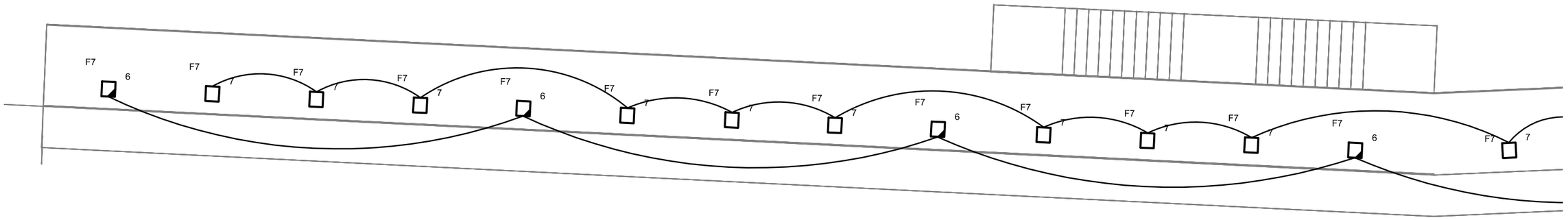
1300 Elmwood Ave
Buffalo, NY 14222

ISSUED: APRIL 7, 2010
DRAWN BY: MARIE OSTROWSKI

AE SENIOR THESIS
ATRIUM LEVEL ONE LIGHTING PLAN



ATRIUM - SECOND LEVEL (SOUTH)



0′ 4′ 8′ 16′

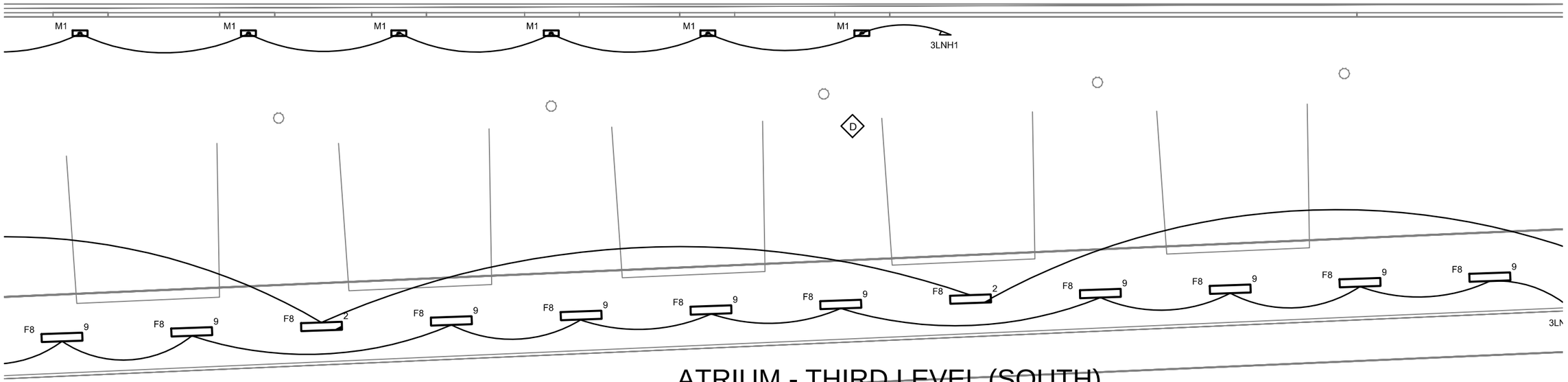
ATRIUM - SECOND LEVEL (NORTH)

BSC SCIENCE BUILDING -PHASE 1

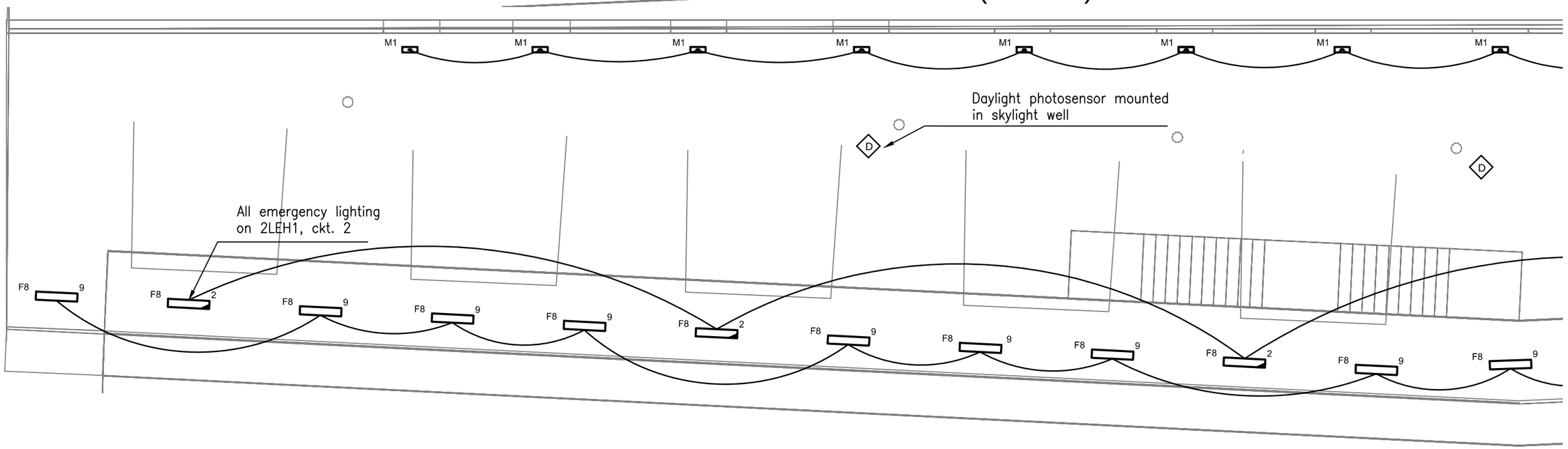
1300 Elmwood Ave
Buffalo, NY 14222

ISSUED: APRIL 7, 2010
DRAWN BY: MARIE OSTROWSKI

AE SENIOR THESIS
ATRIUM LEVEL TWO LIGHTING PLAN



ATRIUM - THIRD LEVEL (SOUTH)



0′ 4′ 8′ 16′

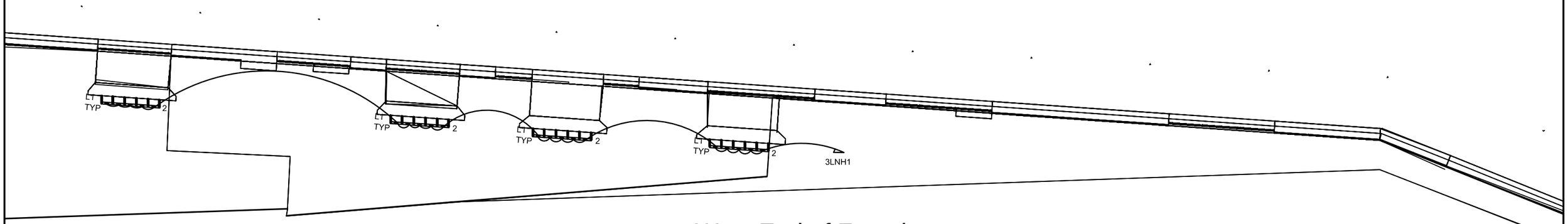
ATRIUM - THIRD LEVEL (NORTH)

BSC SCIENCE BUILDING -PHASE 1

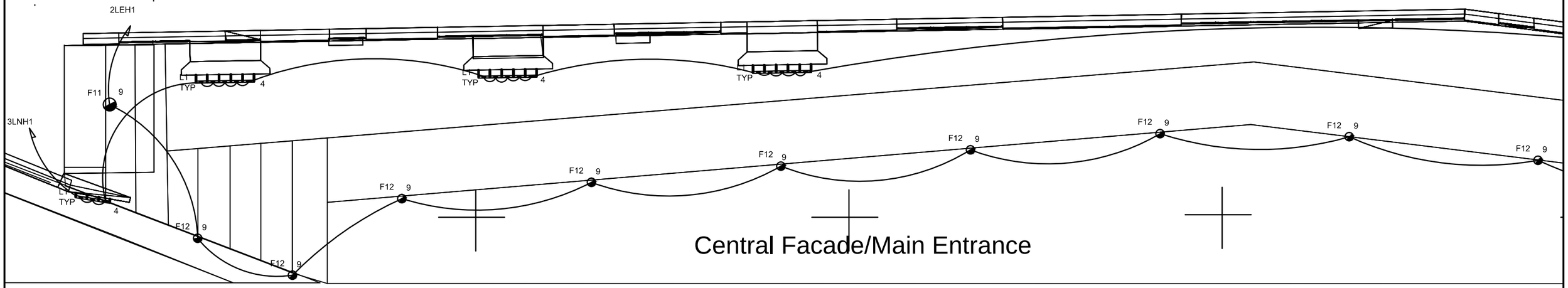
1300 Elmwood Ave
Buffalo, NY 14222

ISSUED: APRIL 7, 2010
DRAWN BY: MARIE OSTROWSKI

AE SENIOR THESIS
ATRIUM LEVEL THREE LIGHTING PLAN



West End of Facade



Central Facade/Main Entrance

0′ 4′ 8′ 16′

BSC SCIENCE BUILDING -PHASE 1

1300 Elmwood Ave
Buffalo, NY 14222

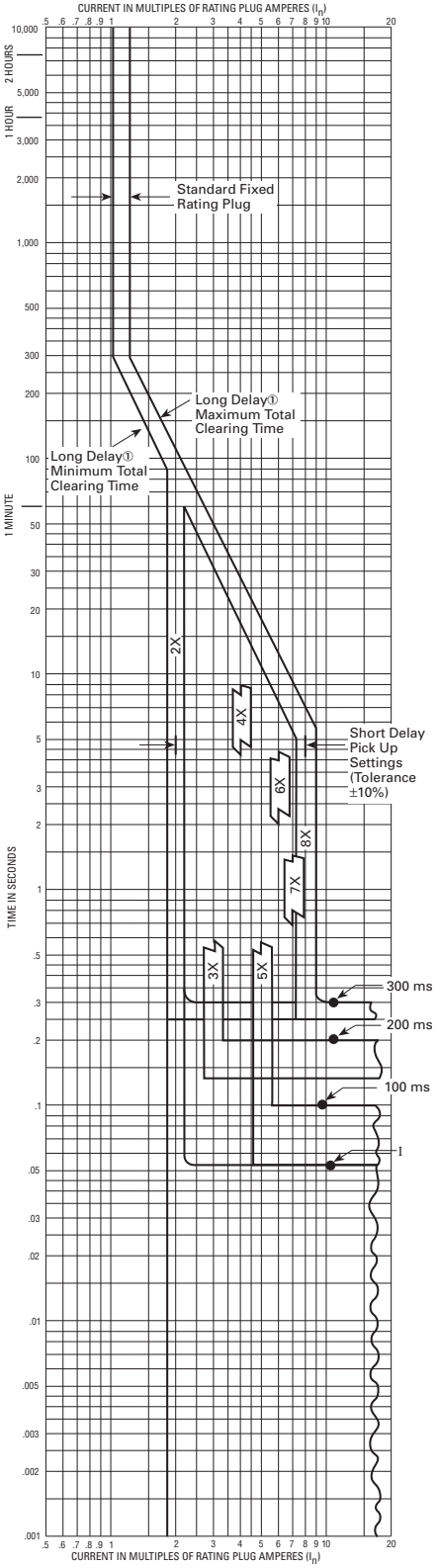
ISSUED: APRIL 7, 2010
DRAWN BY: MARIE OSTROWSKI

AE SENIOR THESIS
EXTERIOR A LIGHTING PLAN

APPENDIX C

AB DE-ION Circuit Breakers

Types LDC and CLDC Equipped With Type LES Digitrip RMS 310 Trip Units, Types LES3600LSI, LES3600LSIG, LES4600LSI, LES4600LSIP

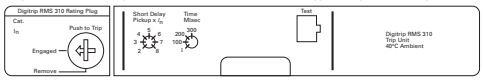


Circuit Breaker Time/Current Curves (Phase Current) ④

Series C® L-Frame Circuit Breakers
Equipped With Type LES Digitrip RMS 310 Trip Units

Catalog Types LES3600LSI, LES3600LSIG, LES4600LSI, and LES4600LSIP
Digitrip RMS 310 Trip Units for use with Circuit Breaker Types LDC and CLDC
3 and 4 Poles

Adjustable Short Delay Time **Typical Trip Unit Nameplate**



Ampere Rating (I_n)	Type	Rating Plug Catalog Number	Short Delay Pickup Range Amperes
600	Fixed	6LES600T	1200-4800
500	Fixed	6LES500T	1000-4000
400	Fixed	6LES400T	800-3200
350	Fixed	6LES350T	700-2800
300	Fixed	6LES300T	600-2400
300, 400, 500, 600	Adjustable	A6LES600T1	600-4800

Interrupting Ratings @ 50/60 Hz RMS Sym. Amperes (kA)

Breaker Type	UL/CSA					
	Volts	240		480		600
LDC, CLDC	kA	200		100		50
	IEC 947-2					
	Volts (U_e)	240		380		415
	Rating	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}
LDC, CLDC	kA	200	100	100	50	100	50
	Utilization Category A U_{imp} = 8kV						

Notes
Digitrip RMS 310 trip units are suitable for functional field testing with test kit Cat. No. STK2. For field testing using primary injection methods, follow NEMA AB4-1991 publications.

Calibration response in short delay pick-up range is same for 1, 2 or 3 poles in series.

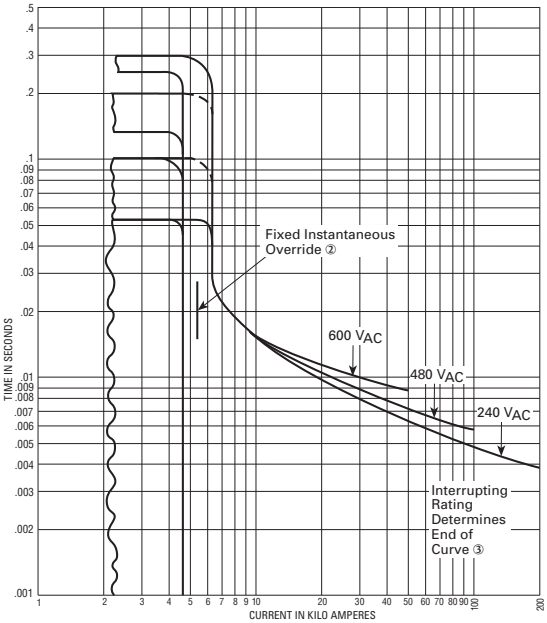
There is a memory effect that can act to shorten the long delay. The memory effect comes into play if a current above the long delay pick-up value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately five minutes is required between overloads to completely reset the memory.

① Curve accuracy applies from –20°C to +55°C ambient. For possible continuous ampere derating for ambient above 40°C, refer to Cutler-Hammer.

② For high fault current levels a fixed instantaneous override is provided at 5500A. (Tolerance ±15%).

③ The end of the curve is determined by the interrupting rating of the circuit breaker. See above tabulation.

④ For ground fault time/current curves see SC-5661-93.

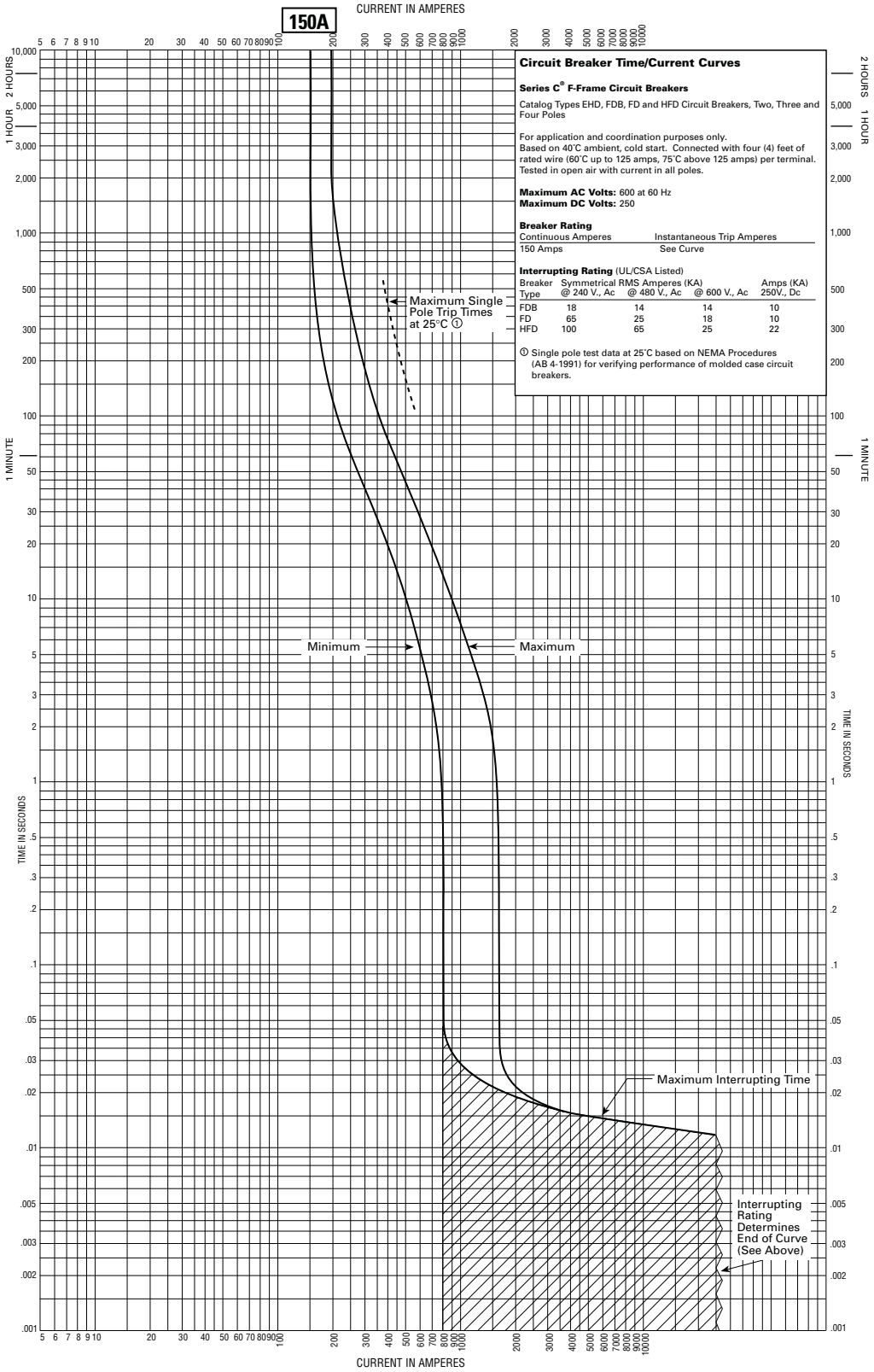


Curve No. SC-5658-93

October 1997

AB DE-ION Circuit Breakers

Types FDB, FD and HFD 150 Amperes

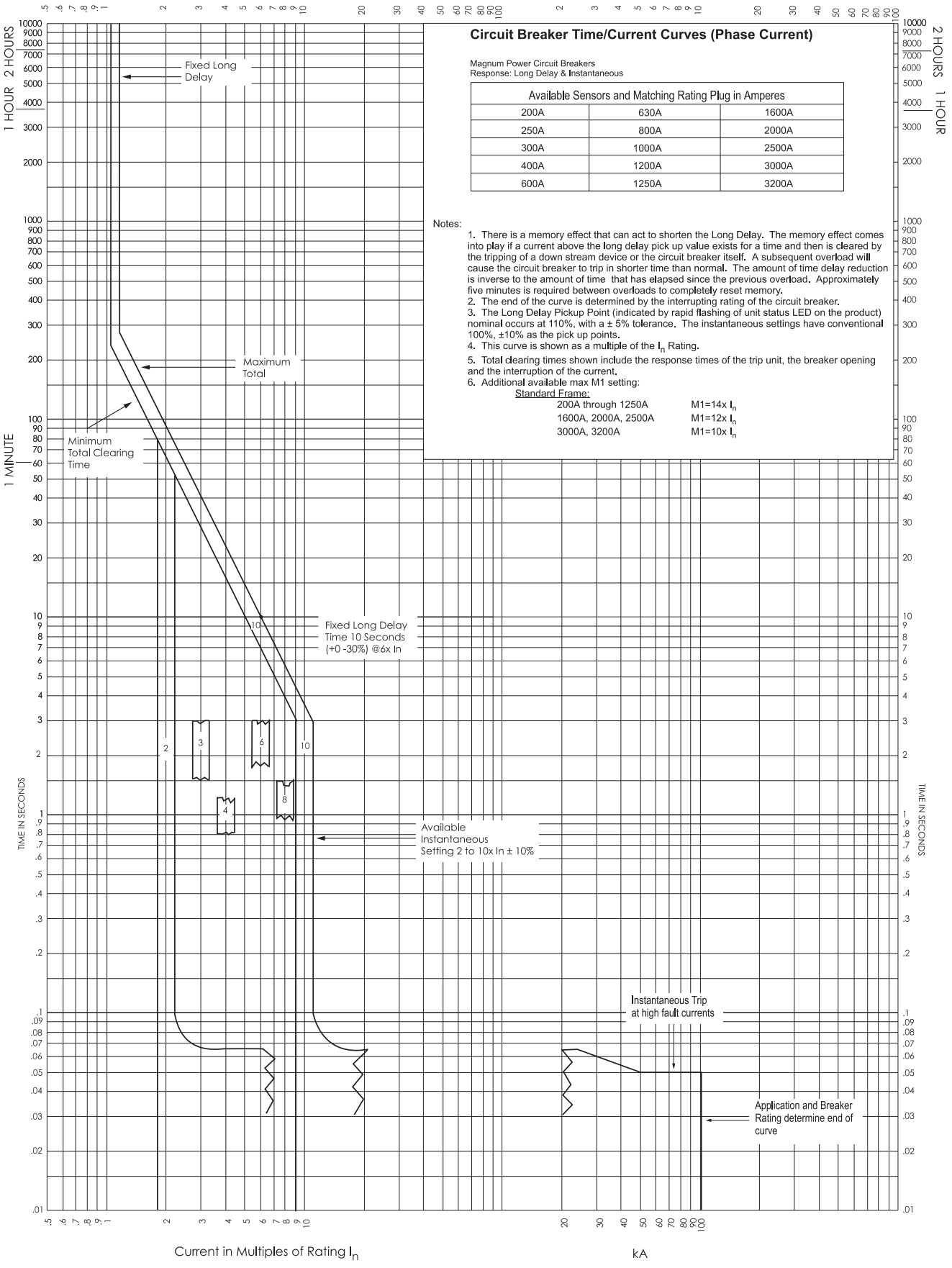


Curve No. SC-4149-87B

October 1997

Cutler-Hammer

Digitrip 220 - Long Delay & Instantaneous Curves



Circuit Breaker Time/Current Curves (Phase Current)

Magnum Power Circuit Breakers
Response: Long Delay & Instantaneous

Available Sensors and Matching Rating Plug in Amperes		
200A	630A	1600A
250A	800A	2000A
300A	1000A	2500A
400A	1200A	3000A
600A	1250A	3200A

Notes:

1. There is a memory effect that can act to shorten the Long Delay. The memory effect comes into play if a current above the long delay pick up value exists for a time and then is cleared by the tripping of a down stream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately five minutes is required between overloads to completely reset memory.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. The Long Delay Pickup Point (indicated by rapid flashing of unit status LED on the product) nominal occurs at 110%, with a ± 5% tolerance. The instantaneous settings have conventional 100%, ±10% as the pick up points.
4. This curve is shown as a multiple of the I_n Rating.
5. Total clearing times shown include the response times of the trip unit, the breaker opening and the interruption of the current.
6. Additional available max M1 setting:

Standard Frame:

200A through 1250A	M1=14x I_n
1600A, 2000A, 2500A	M1=12x I_n
3000A, 3200A	M1=10x I_n

EATON

Curve No. SC-7215-99
Dwg. No. 70C1010
Printed in U. S. A. March 1999

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	BSC New Science Building
LOCATION/TYPE	OFFICE/P1

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

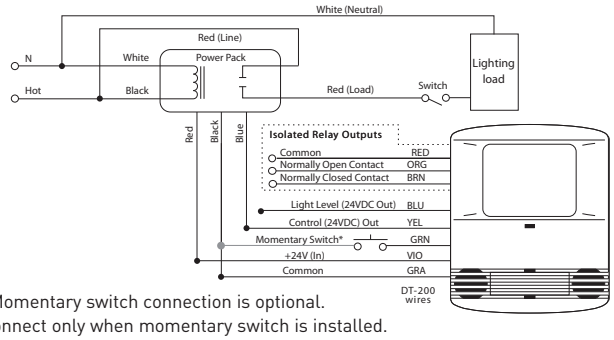
- Advanced control logic based on RISC microcontroller provides:
  - Detection Signature Processing to eliminate false triggers and provides immunity to RFI and EMI
  - Walk-through Mode turns lights off three minutes after the area is initially occupied – ideal for brief visits, such as mail delivery
  - 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

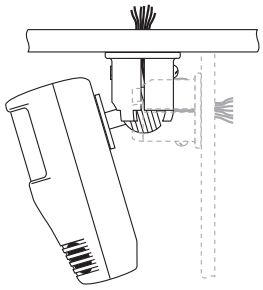
Wiring & Mounting

Wiring Diagram



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

Mounting



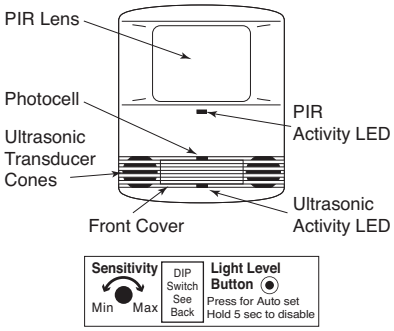
A swivel mounting bracket attached to the sensor allows the sensor to be angled for wall or ceiling mounting.

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	●	●	●

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)	

Time Delay	4	5	6
5 sec/SmartSet	–	–	–
5 minutes	–	–	●
10 min.	–	●	–
10 minutes	–	●	●
15 min.	●	–	–
15 minutes	●	–	●
20 minutes	●	●	– ◀
30 min.	●	●	●

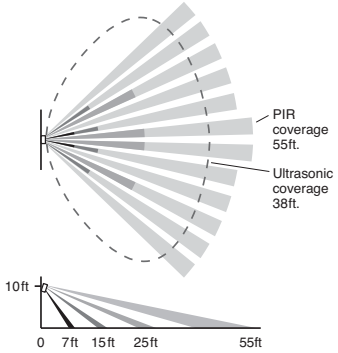
= walk-through mode

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.

COMMERCIAL OCCUPANCY SENSORS & CONTROLS

DT-355 Dual Technology Line Voltage Ceiling Sensor

PROJECT	BSC New Science Building
LOCATION/TYPE	P2

Product Overview

Description

WattStopper's low profile DT-355 dual technology occupancy sensor combines the benefits of passive infrared (PIR) and ultrasonic technologies. The sensor mounts on the ceiling with a flat, unobtrusive appearance and provides 360 degrees of coverage.

Operation

The DT-355 is line voltage and operates at 120, 230, 277 or 347 VAC. The sensor turns lighting on when both PIR and ultrasonic technologies detect occupancy. PIR technology senses the difference between infrared energy from a human body in motion and the background space. Ultrasonic technology uses high frequency (40KHz) ultrasound to sense motion within the space. Once lighting is on, detection by either technology holds lighting on. When no occupancy is detected for the length of the time delay, lighting turns off. The DT-355 can also be set so that only one technology is needed to trigger or both technologies are needed to hold lighting on.

Auto Set

The DT-355 requires no adjustment at installation. Auto set continuously monitors the controlled space to identify usage patterns. Using this information, it automatically adjusts the time delay and sensitivity settings for optimal performance and energy efficiency. The sensor assigns short delays (as low as 5 minutes) for times when the space is usually vacant, and longer delays (up to 30 minutes) for busier times.

Application

WattStopper's patented dual technology has the flexibility to work in a variety of applications, where one technology alone could encounter false triggers. Ideal applications include classrooms, open office spaces, large offices, and computer rooms. In addition, because the DT-355 can be mounted onto a variety of junction boxes, the sensor has the flexibility to be used in a wide range of spaces. The sensors eliminate the need for a power pack by using line voltage wiring.

Features

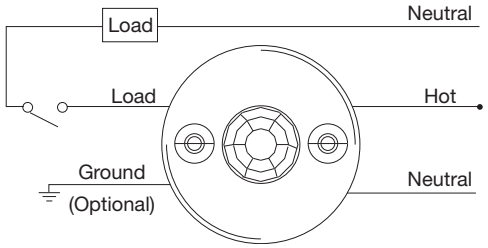
- Advanced control logic based on RISC microcontroller provides:
  - Detection Signature Processing eliminates false triggers and provides immunity to RFI and EMI
  - Walk-through mode turns lights off 3 minutes after the area is initially occupied – ideal for brief visits such as mail delivery
  - Built-in light level sensor featuring simple, one-step setup
- Ultrasonic diffusion technology spreads coverage to a wider area (patent pending)
- DIP switch simplifies sensor adjustments
- LEDs indicate occupancy detection
- Uses existing line voltage wiring and doesn't require a power pack
- Six occupancy logic options give users the ability to customize control to meet application needs
- Qualifies for ARRA-funded public works projects

Specifications

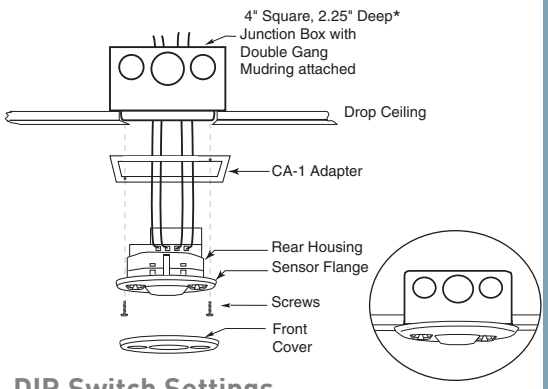
- 120/230/277/347 VAC, 50/60 Hz
- Ultrasonic frequency of 40kHz
- Time delays: Auto set, fixed (5, 10, 15, 20, or 30 minutes), walk-through, test-mode
- Sensitivity adjustment: Auto set or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with trimpot
- Built-in light level sensor – works from 10 to 300 footcandles (107.6 to 3,229.2 lux)
- Multi-level, 360° Fresnel lens for superior occupancy detection
- Mounting options: 4 square junction box with double gang mudring; 4 inch octagonal junction box
- Dimensions: 4.50" diameter x 1.45" deep (114.3mm x 25.9mm)
- UL and cUL listed
- Five year warranty

Wiring & Mounting

DT-355 Wiring Diagram

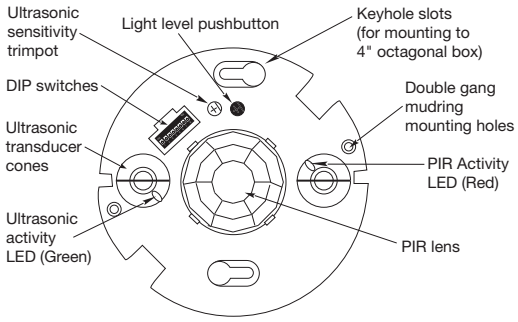


Ceiling Mounting



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	●	●	●

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)

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

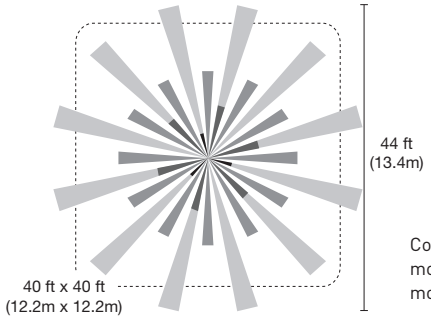
LEDs	7
Disabled	–
Enabled	●

PIR Sensitivity	8
Minimum	–
Max./SmartSet	●

The technology control (occupancy logic) options are adjustable by user. The standard setting (recommended for most applications) is 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 (92.9 m²).

Ordering Information

Catalog No.	Voltage	Load Rating	Coverage
☐ DT-355 ☐ DT-355-U	120 VAC, 50/60 Hz 230/277 VAC, 50/60 Hz 347 VAC, 50/60 Hz	0-800W Ballast/Tungsten 0-1200W Ballast 0-1500W Ballast	up to 1000 ft², (92.9 m²)
☐ CA-1	Cosmetic adapter for ceiling installations with 4" square j-box or Wiremold #V5748-2 box		

Sensors are white.

Pub. No. 15806 rev. 10/2009

Catalog numbering system—Pow-R-Stock panelboard interiors

PRL1A 1 225 X 42 A S

Panel Type
PRL1A = PRL1a
PRL2A = PRL2a

Phase
1 = Single-phase
3 = Three-phase

Bus Amps
100 = 100A
225 = 225A
400 = 400A

Main Device
X indicates no main/ use main breaker or main lug kit

Number of Circuits
18, 30, and 42

Bus Type
A = Aluminum bus
C = Copper bus

Option
S = Short—no TFL or SFB provisions

Special note: This option applies only to 42 circuit 225A interiors.

Note: Top-feed provision for main lugs or main breaker, no provision for through-feed lugs or sub-feed breaker.

NEMA 1 Pow-R-Stock Panelboard Boxes

EZB 20 36 R BS

EZB are available boxes used for all Type 1 PRL1a, PRL2a, and PRL3a panels
Width in inches = 20 **Height in inches** = 36, 48, 60, or 72

R = Right-hand flange

NEMA 1 Pow-R-Stock Panelboard Trims

EZT 20 36 S

EZT are available laser cut trims used on all PRL1a, PRL2a, and PRL3a panels
Width in inches = 20 **Height in inches** = 36, 48, 60, or 72

Mounting
S = Surface
F = Flush

Main Breaker Kits

BK ED 100 T

Breaker kit
Breaker frame
ED or FD or KD
Trip rating 100, 125 150, 175, 200, 225, 250, 300, 350, 400

Mounting
T = Top
B = Bottom

Single-Phase, 3-Wire 120/240 Vac

		Catalog Number	
		Interiors (Less Main Device)	
Ampere Rating	Max. No. of Poles	Aluminum Bus	Copper Bus
100	18	PRL1A1100X18A	PRL1A1100X18C
100	30	PRL1A1100X30A	PRL1A1100X30C
225	30	PRL1A1225X30A	PRL1A1225X30C
225	42	PRL1A1225X42AS ❶	PRL1A1225X42CS ❶
225	42	PRL1A1225X42A	PRL1A1225X42C
400	42	PRL1A1400X42A	PRL1A1400X42C

Three-Phase, 4-Wire 208Y/120 Vac or Three-Phase, 3-Wire 240 Vac

		Catalog Number	
		Interiors (Less Main Device)	
Ampere Rating	Max. No. of Poles	Aluminum Bus	Copper Bus
100	18	PRL1A3100X18A	PRL1A3100X18C
100	30	PRL1A3100X30A	PRL1A3100X30C
225	30	PRL1A3225X30A	PRL1A3225X30C
225	42	PRL1A3225X42AS ❶	PRL1A3225X42CS ❶
225	42	PRL1A3225X42A	PRL1A3225X42C
400	42	PRL1A3400X42A	PRL1A3400X42C

Three-Phase, 4-Wire 480Y/277 Vac

		Catalog Number	
		Interiors (Less Main Device)	
Ampere Rating	Max. No. of Poles	Aluminum Bus	Copper Bus
100	18	PRL2A3100X18A	PRL2A3100X18C
100	30	PRL2A3100X30A	PRL2A3100X30C
225	30	PRL2A3225X30A	PRL2A3225X30C
225	42	PRL2A3225X42AS ❶	PRL2A3225X42CS ❶
225	42	PRL2A3225X42A	PRL2A3225X42C
400	42	PRL2A3400X42A	PRL2A3400X42C

Single-Phase, 3-Wire 120/240 Vac; Three-Phase, 4-Wire 208Y/120 Vac or Three-Phase, 3-Wire 240 Vac; Three-Phase, 4-Wire 480Y/277 Vac Boxes and Trims

Boxes	Trims (NEMA 1)		
NEMA 1	Surface	Flush	NEMA 3R Enclosures
EZB2036R	EZT2036S	EZT2036F	GWPBQ2036PR
EZB2048R	EZT2048S	EZT2048F	GWPBQ2048PR
EZB2048R	EZT2048S	EZT2048F	GWPBQ2048PR
EZB2048R	EZT2048S	EZT2048F	GWPBQ2048PR
EZB2060R	EZT2060S	EZT2060F	GWPBQ2060PR
EZB2072R	EZT2072S	EZT2072F	GWPBQ2072PR

❶ S = Short—no TFL or SFB provisions.

Note 1: The colors shown in the tables correspond to the color coding on the trim, interior, and box product packaging labels. Be sure all three parts match when delivering to your customer.

Note 2: Distributors can purchase boxes in quantities via the Distributor toolbox.

LightSaver® LS-290C Photosensor

Photosensor for LightSaver LCD-203 and LCO-203 Controllers

Mounts vertically or horizontally

Footcandle range from 3 - 6000

Architecturally attractive design

PROJECT	BSC New Science Building
LOCATION/TYPE	Atrium-skylight well

Product Overview

Description

WattStopper's LightSaver LS-290C open loop Photosensor provides the daylight data necessary for operation of the LCD-203 and LCO-203 daylighting control systems.

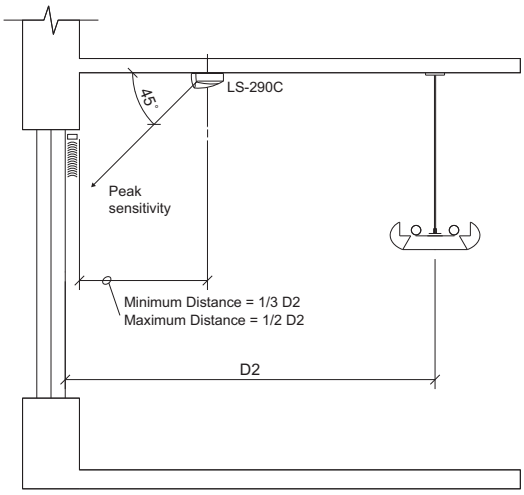
Operation

Utilizing a photodiode element, the LS-290C continuously measures ambient light levels. The Photosensor is positioned to 'see' incoming daylight from either a window or skylight without seeing electrical light. Users select the applicable footcandle range by a jumper beneath the front cover.

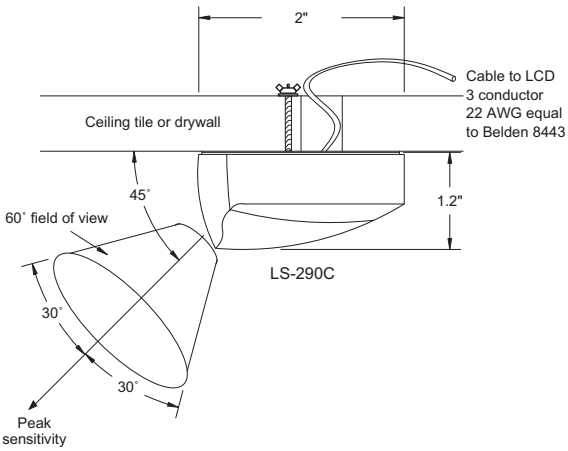
Specifications

- Three jumper-selectable footcandle ranges: 3-300 fc, 30-3000 fc, 60-6000 fc
- Low voltage, Class 2 device
- Protective hard plastic cover
- 3 conductor 22 AWG twisted cable equal to Belden 8443
- Maximum wire length is 250 feet (76.2m)
- Dimensions: 2" diameter x 1.2" deep (50.8mm diameter x 30.5mm deep)
- UL and CUL listed
- Five year warranty

Photosensor Placement



Installation and Wiring



Ordering Information

Catalog No.	Description	Footcandle range
☑ LS-290C	Open Loop Photosensor	3 - 6000 (32 - 64,000 lux)

Qualifies for use on ARRA-funded public works projects.

PRODUCT PROFILE

CENTERLINE® 2100 MOTOR CONTROL CENTERS

PRODUCT DESCRIPTION

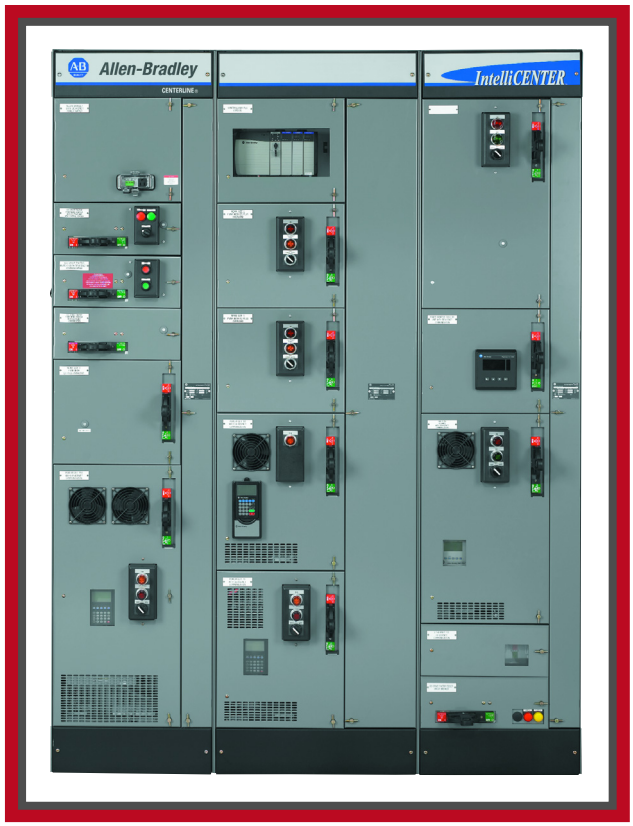
The CENTERLINE 2100 Motor Control Center (MCC) combines rugged-durability and premium quality, meeting UL and NEMA standards. CENTERLINE 2100 MCCs integrate control and power in one centralized package with a wide variety of motor control options.

The industry leading Motor Control Center that has delivered the safety, performance and reliability you need for over 35 years.

CENTERLINE 2100 MCC PRODUCT FEATURES

- Designs are certified to UL 845 and meet NEMA standards
- Built-in DeviceNet with IntelliCENTER® technology
- ArcShield™ helps you reduce arc flash hazards
- Consistent design allowing for backward compatibility
- Proven CENTERLINE bus design
- Solid grounding system to help reduce shock hazards
- Fully isolated enclosures for maximum fault containment
- Space saving designs maximize section utilization reducing MCC footprint
- Variety of intelligent motor control options
  - Across-the-line starters
  - Soft starters
  - Variable speed drives

INDUSTRY LEADING MOTOR CONTROL CENTERS DELIVERING SAFETY, PERFORMANCE AND RELIABILITY



STRONG PERFORMANCE & RELIABILITY

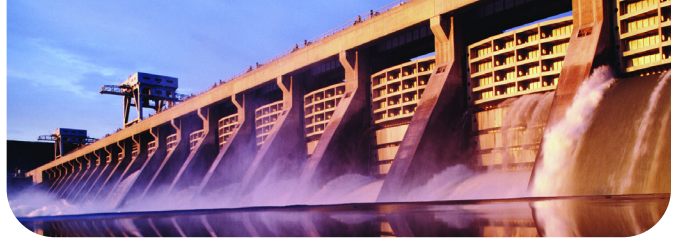
The CENTERLINE 2100 MCC uses proven CENTERLINE technology for high quality and years of dependable service.

- High short circuit withstand ratings in type-tested enclosures
- Continuous bus bracing provides uniform support
- Durable NEMA components
- Factory tested for faster and more dependable start-up
- CENTERLINE 2100 MCCS with IntelliCENTER Technology use built-in networking and pre-configured software to:
  - Enhance performance through system-wide communications
  - Share diagnostic information for predictive maintenance
  - Initiate warnings before potential faults occur

ARCSHIELD

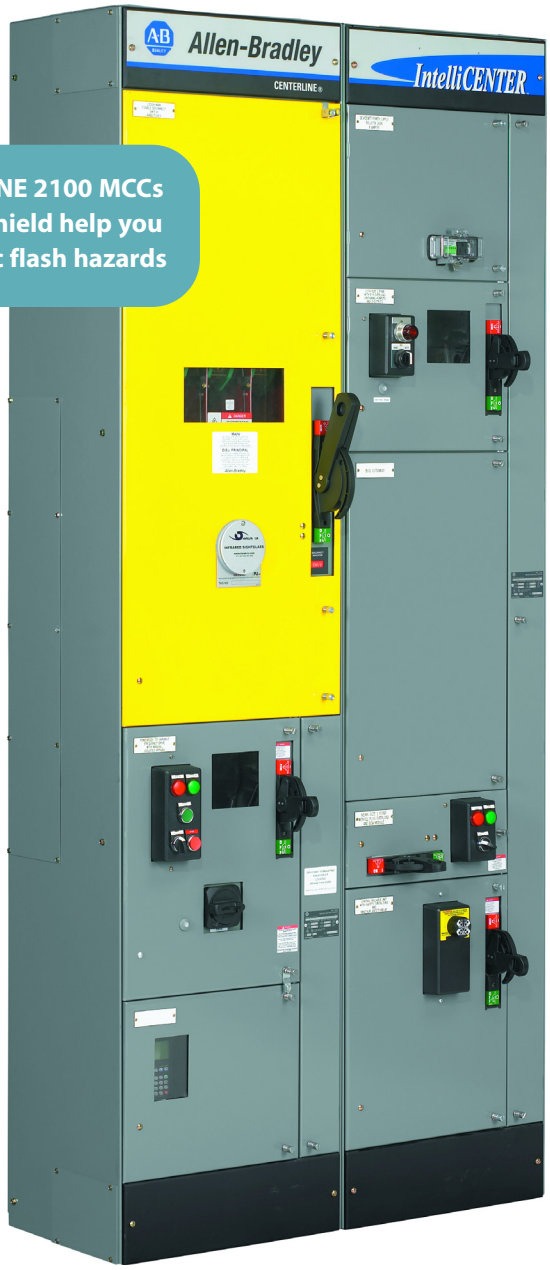
The CENTERLINE 2100 MCC with ArcShield provides you with enhanced safety features

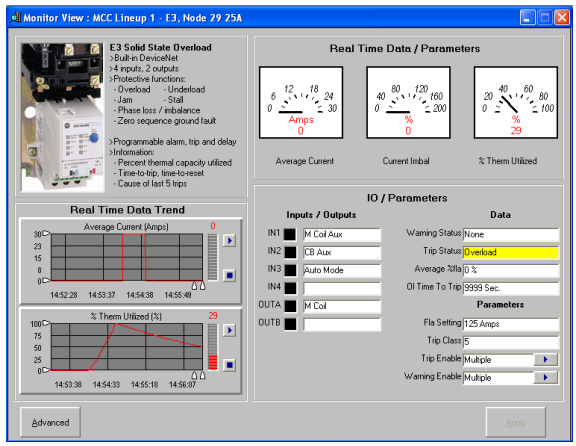
- Advanced diagnostics of IntelliCENTER software provide remote access to data and troubleshooting, minimizing the need for entry in the arc flash boundary zone
- IntelliCENTER software allows you to troubleshoot your MCC remotely, without Personal Protective Equipment (PPE)
- High degree of fault containment helps prevent a single fault from cascading throughout the enclosure, limiting equipment damage
- Arc-containment latches provide an extra level of protection against internal arcing faults
- Type 2 accessibility protects personnel at front, sides and rear of enclosure



- Isolation, grounding and remote monitoring help prevent accidental exposure to energized parts
- Automatic shutters isolate vertical bus when unit is removed
- Continuous bus bracing provides more uniform support than point bracing
- Infrared windows allow completion of thermal inspection without opening doors, to minimize personnel entry in to the enclosure
- Plug-in replacement units allow maintenance to be performed away from energized controls
- Intelligent motor control devices warn of an impending failure before it occurs
- NEMA components help deliver dependable operation
- Locking and Interlocking features allow for easier implementation of your company's lockout/tagout safety procedures
- Through the door DeviceNet port for access to network without opening unit door
- Through the door viewing window for visible disconnect inspection without opening unit door

CENTERLINE 2100 MCCs with ArcShield help you reduce arc flash hazards





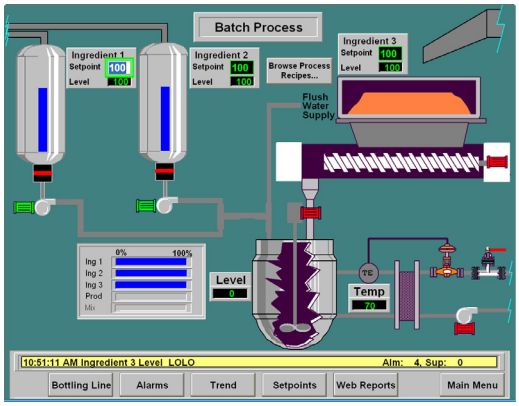
Unit monitor view of IntelliCENTER software shows advanced diagnostics and trip status eliminating the need to enter the unit for maintenance

Arc-containment latches on all doors
Non-vented enclosure
Maximum 1200 A bus
Copper vertical ground bus for plug-in structures
Heavy duty ground stab on plug-in units
Manual or automatic shutters on plug-in structures
Insulating covers on horizontal bus closing plates

INTELLICENTER TECHNOLOGY

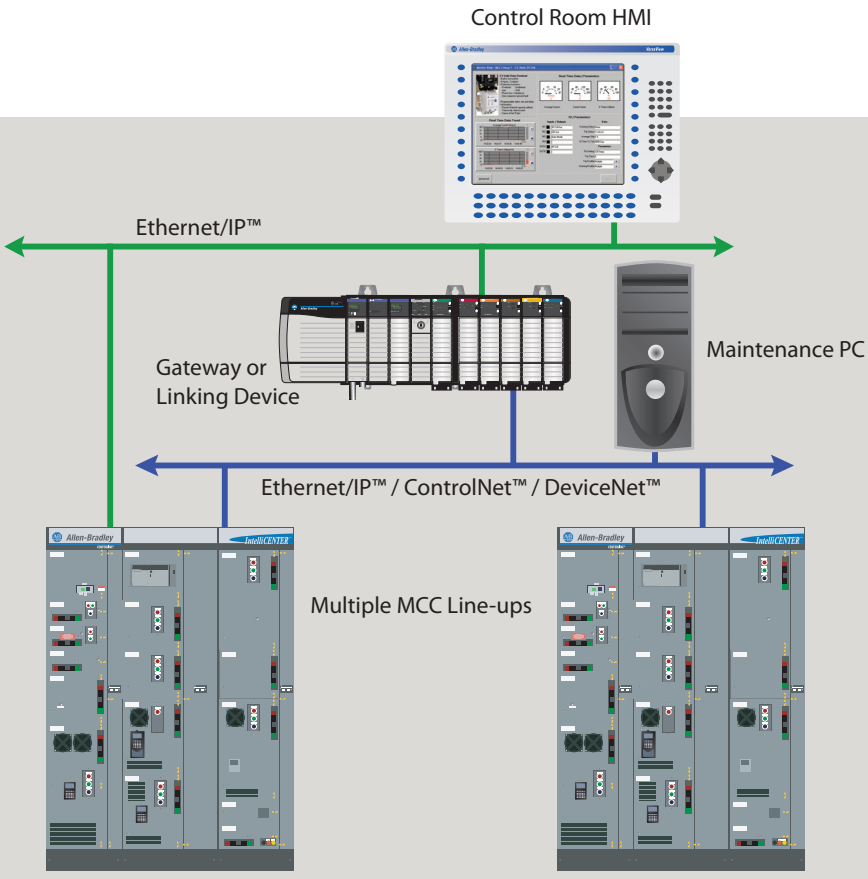
IntelliCENTER technology enhances the intelligence of your MCC using built-in DeviceNet to capture information used for predictive maintenance, process monitoring and advanced diagnostics.

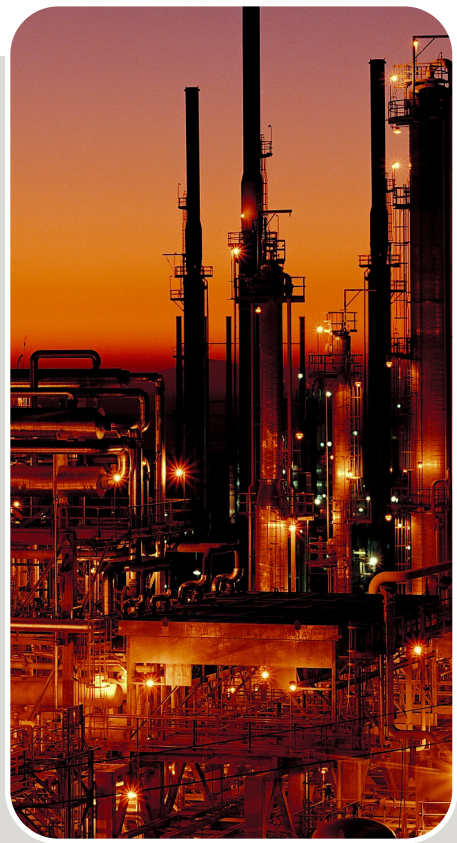
- IntelliCENTER software, using NetLinx open network architecture, features pre-configured screens and allows for monitoring anywhere in the enterprise
- ActiveX controls allow seamless integration into RSView and interfaces with third party visualization packages
- Faster start-up
  - Networking reduces complex interwiring to a single cable
  - Factory network pre-configuration validates connections, sets baud rates and assigns node addresses
  - Pre-configured screens shorten programming time
- Efficient troubleshooting
  - Trending and event logging capabilities allow you to diagnose your electrical problems
  - AutoCAD® documentation allows you to trace out wiring and understand control circuits using wiring diagrams
  - Ability to supplement “as built” drawings with “as installed” drawings
  - Unit specific manuals and spare parts lists are provided electronically
- Optimized polling to ensure system performance
- Option to operate in stand-alone mode
- IntelliCENTER software allows you to troubleshoot your MCC remotely, without Personal Protective Equipment (PPE)



IntelliCENTER software, with ActiveX controls, allows users to easily view powerful information and change parameter values in devices

Elevation View quickly diagnoses the condition of the motor controls in the MCC





STRUCTURE FEATURES

CENTERLINE bus design means more current carrying capacity per section.

- Standard vertical bus is rated twice the industry norm – 300 A above and 300 A below the horizontal bus for an effective 600 A capacity per section
- Allows more flexibility for field changes without exceeding vertical bus rating
- Sections available in back-to-back design with separate front and rear vertical bus for maximum loading capacity

Vertical wireway contains NO control or power terminations making **cable installation safer**. For added safety, a permanent barrier separates the vertical wireway from units.

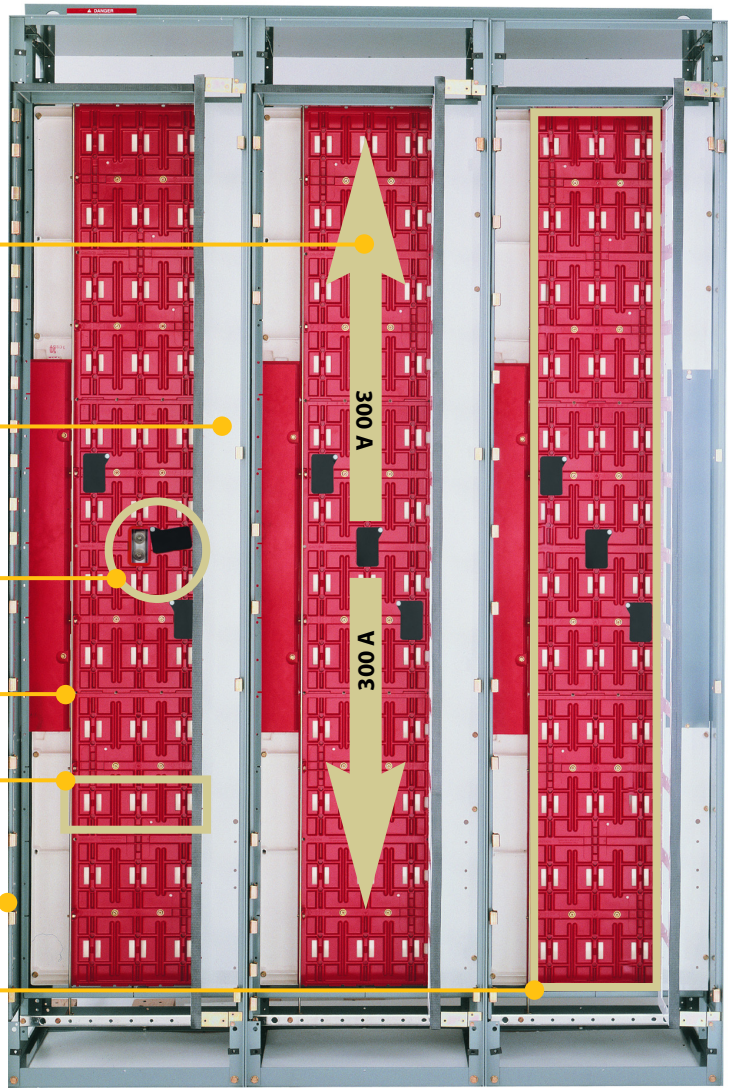
Computerized fastening system used in the assembly of horizontal to vertical bus connection:
- **reduces periodic maintenance**
- **minimizes exposure to hazardous voltage**

Dedicated plug-in ground bus is part of a **solid grounding system**.

Automatic shutters available to **immediately isolate vertical bus when unit is removed**.

Fault containment is enhanced with two side sheets on every section.

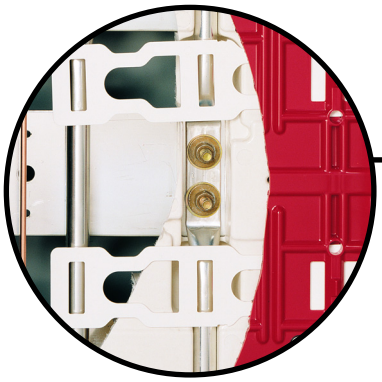
Continuous bus bracing provides **more uniform support** than commonly used standoffs.



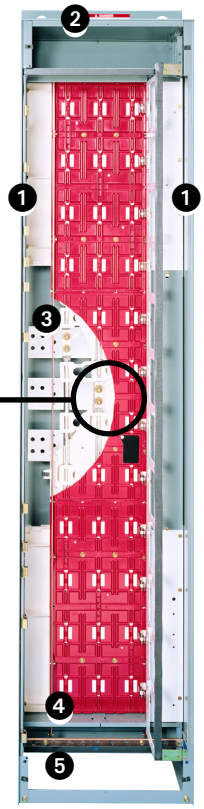
DURABILITY THROUGHOUT

An MCC is a long term investment.

CENTERLINE MCC rigid design ensures longer life. Doors close securely and plug-in units can still be installed and removed after years of dependable service.



Two-bolt bus connections minimize the likelihood of "hot spots."



Rugged construction provides rigidity during shipping, installation and operation for longer service life.

1. Two side sheets on every section

The following elements are continuous across the shipping block:

2. Solid lifting angle
3. Horizontal power bus
4. Horizontal ground bus
5. Internal mounting angle

Over 30 years of backward compatibility!

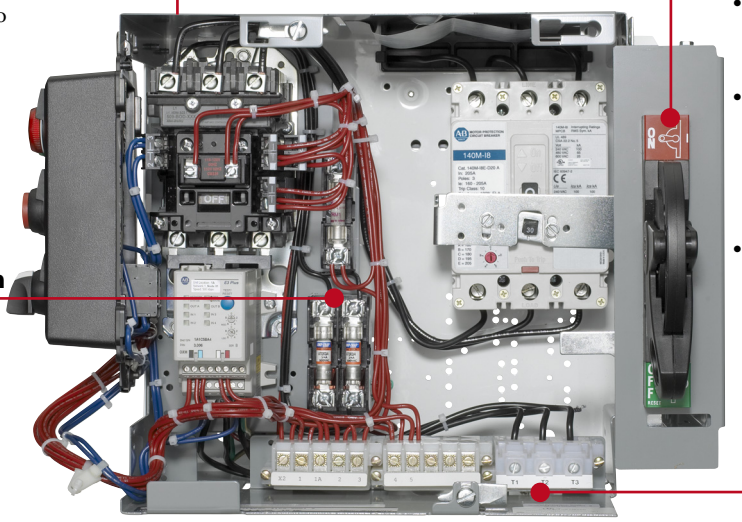
A new MCC unit will plug into a CENTERLINE 2100 MCC purchased decades ago or just last week. Our dedication to backward compatibility means:

- No costly special orders
- No long lead times for replacement units
- Less spare parts inventory
- Simplified upgrades

UNIT FEATURES

Superior fault containment helps minimize downtime

- Units have top and bottom plates
- Stab housing is designed to extinguish arcing fault by segregating three phases



Rugged, flange-mounted handle

- Keeps operator in control whether door is opened or closed
- Accepts multiple padlocks for easy implementation of lockout/tag-out procedures
- Non-conductive material helps isolate operator from hazardous voltages

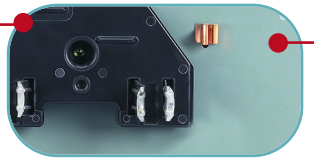
Durable NEMA components provide dependable operation

- Push buttons, Pilot lights and Selector Switches
- Contactors and starters – documented life of up to 10 million operations for NEMA Size 1

Unit withdrawal made safer and quicker

- Standard pull-apart terminal blocks allow quick disconnection of field wiring
- No need to stuff wiring into vertical wireway where hazardous voltages exist – wiring tunnel allows unit to pass safely over field wiring

Dedicated ground stab is part of a solid grounding system



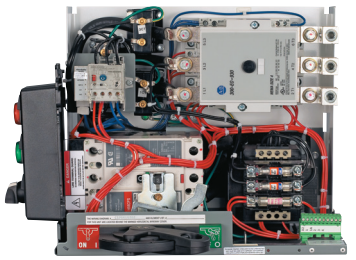
Hot spots reduced

- Stabs use a high pressure, four point contact construction
- Stabs directly crimped to power wires – no screws or connectors to loosen
- Free-floating stabs self-align to bus

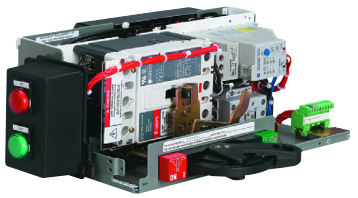
Versatile interlock mechanism designed to make servicing safer

- Unit cannot be inserted or withdrawn when the disconnect handle is ON
- If unit is removed for maintenance, padlock can be attached to prevent installation
- Unit can be secured in a service position (partially withdrawn, power stabs disengaged)

Space Saving Unit Designs



Size 4 FVNR Space Saving NEMA Starter Unit in 1.0 space factor

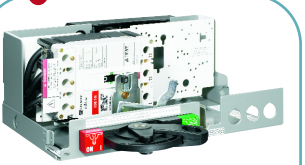


Size 1 FVNR Space Saving NEMA Starter Unit in 0.5 space factor

Space Saving NEMA Units, Size 1-5 Starter Units

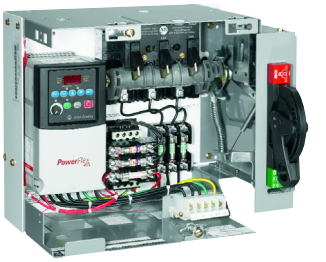
- Up to 50% less space than comparable Traditional NEMA starter units

Space Saving Feeder Disconnects



At least 50% less space than typical feeder disconnect

Space Saving Drive Units



Compact unit sizes with PowerFlex Drives

Space Saving Soft Starter Units

Compact unit sizes with SMC-3 and SMC-Flex

MORE OPTIONS WITH FASTER DELIVERY

For quick delivery, choose from the largest selection of standard units and options.

- Over 60 standard units in a variety of sizes combined with more than 100 options yield millions of possibilities for standard units
- Components for standard units are stocked for immediate assembly
- Individual units and unpopulated sections can ship in 3 days
- Complete CENTERLINE 2100 MCCs, even with IntelliCENTER technology, can ship in 7-10 days

TECHNICAL DATA

STANDARDS	Certifications & Listings	NEMA ICS-18, UL845, CSA C22.2 No. 14 and EN 60439-1
SECTION DESIGN	Height	90" (2286 mm) standard; 71" (1790 mm) available
	Width	20" (508 mm) standard; wider sections available for larger equipment in 5" (127 mm) increments
	Depth	15" (381 mm) or 20 (508 mm) available 30" (762 mm) or 40" (1016 mm) back-to-back
	Vertical Wireway	4.37" (111 mm) wide standard; 9" (229 mm) wide available
	NEMA Type	1 (IP20, IP30, IP40) 1 with gasketing around perimeter of unit doors (IP20, IP30, IP40) 12 (IP54) 3R non walk-in (IP44) 4 non walk-in (IP65)
BUS MATERIAL AND PLATING	Horizontal Bus Rating	600 A; 800 A; 1200 A; 1600 A; 2000 A; 2500A or 3000A
	Horizontal Bus Withstand Rating	42 kA; 65 kA or 100 kA
	Horizontal Bus Material	Aluminum Tin-plated; Copper Tin-plated or Copper Silver-plated
	Vertical Bus Rating	300 A (600 A effective) or 600 A (1200 A effective)
	Vertical Bus Material	Copper Tin-plated or Copper Silver-plated (matches horizontal bus material)
UNIT DESIGN	Unit Size	6.5" (165 mm) x 14" (356 mm) wide = half space factor 13" (330 mm) x 14" (356 mm) wide = one space factor Unit designs are in 0.5 space factor increments
	Maximum Space Factor per Section	6
STRUCTURAL SURFACE TREATMENTS	Exterior (NEMA Type 1, 1G, 12)	ANSI 49 - Medium Light Gray
	Exterior (NEMA Type 3R)	UV Resistant High Gloss White - Recognized by UL for outdoor use
	Exterior (NEMA Type 4)	Unpainted Stainless Steel
	Interior	ANSI 49 - Medium Light Gray; High Visibility White Gloss (vertical wireways and unit back plates)
ENVIRONMENT	Storage Temperature	0 - 40° C with up to 95% non-condensing humidity
	Operating (Ambient) Temperature	32 - 104° F (0 - 40° C) with up to 95% non-condensing humidity
	Altitude	6600 feet (2km)

www.rockwellautomation.com

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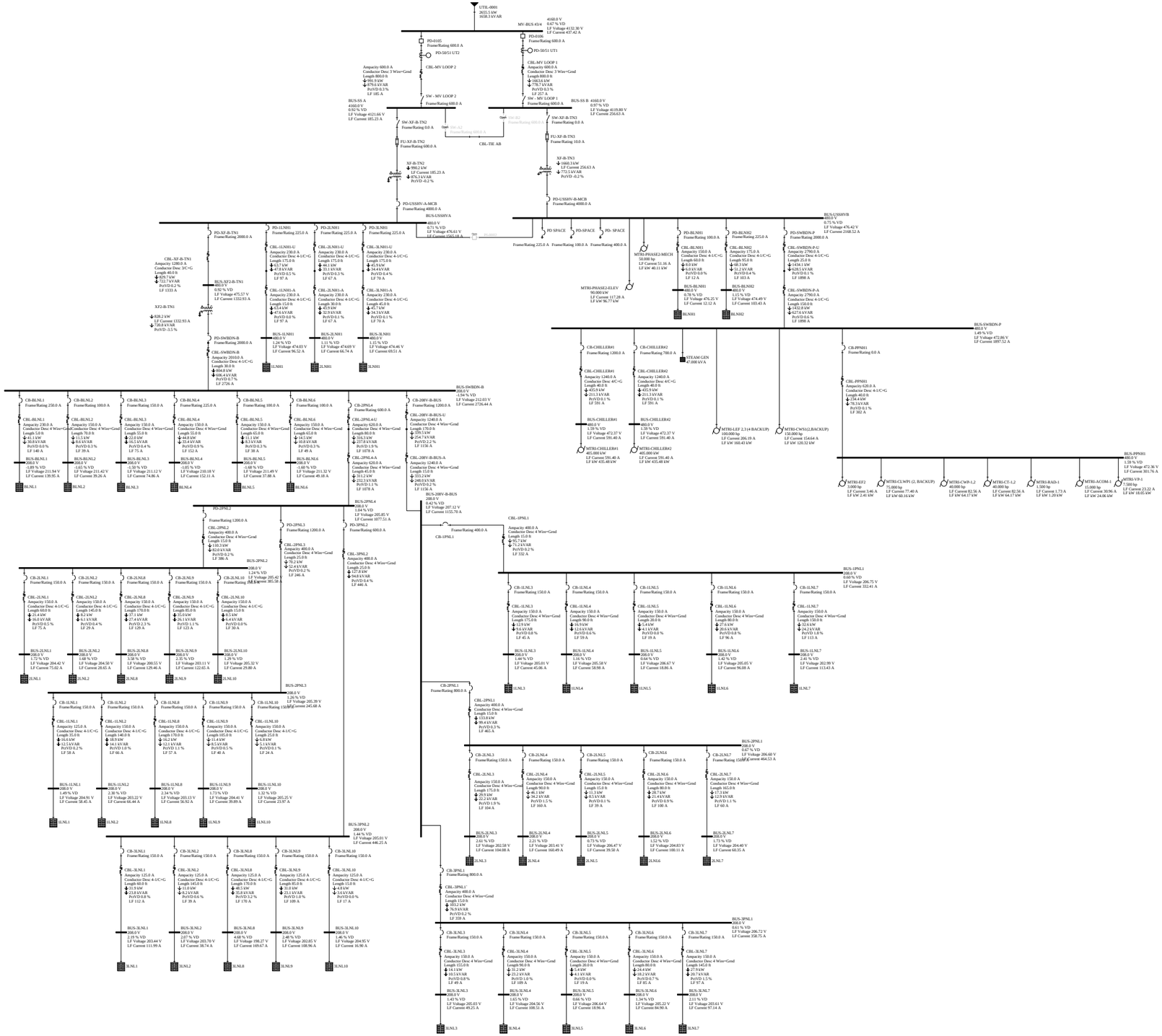
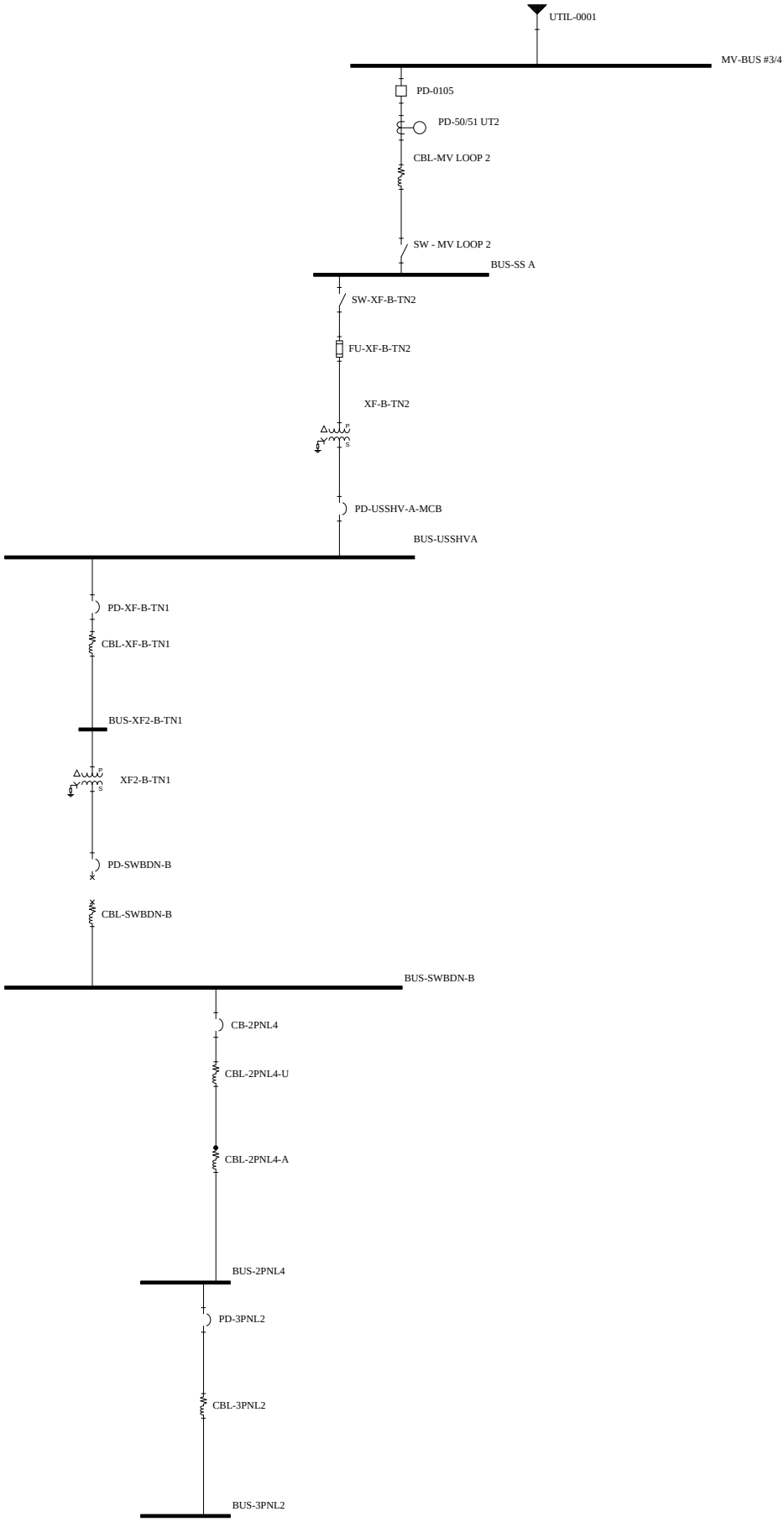
APPENDIX D


UTIL-0001
2655.5 kW
1650.3 kVAR
4160.0 V
MV-BUS #3/4
0.67 % VD
LF Voltage 4132.30 V
LF Current 437.42 A
PD-0105
Frame/Rating 600.0 A
PD-0106
Frame/Rating 600.0 A
PD-50/51 UT2
PD-50/51 UT1
CBL-MV LOOP 2
Ampacity 600.0 A
Conductor Desc 3 Wire+Gnd
Length 880.0 ft
991.9 kW
679.6 kVAR
PoVD 0.3 %
LF 185 A
CBL-MV LOOP 1
Ampacity 600.0 A
Conductor Desc 3 Wire+Gnd
Length 880.0 ft
160.5 kW
78.7 kVAR
PoVD 0.1 %
LF 257 A
SW - MV LOOP 2
Frame/Rating 600.0 A
SW - MV LOOP 1
Frame/Rating 600.0 A
BUS-SS A
4160.0 V
0.92 % VD
LF Voltage 4121.66 V
LF Current 185.23 A
BUS-SS B
4160.0 V
0.97 % VD
LF Voltage 4119.80 V
LF Current 256.63 A
SW-XF-B-TN2
Frame/Rating 0.0 A
Open
SW-XF-B-TN3
Frame/Rating 600.0 A
SW-XF-B-TN3
Frame/Rating 0.0 A
Open
SW-XL2
Frame/Rating 600.0 A
FU-XF-B-TN2
Frame/Rating 600.0 A
CBL-TIE AB
FU-XF-B-TN3
Frame/Rating 10.0 A
XF-B-TN2
990.2 kW
LF Current 185.23 A
676.3 kVAR
PoVD -0.2 %
XF-B-TN3
1660.3 kW
LF Current 256.63 A
772.5 kVAR
PoVD -0.2 %
PD-USSHV-A-MCB
Frame/Rating 4000.0 A
PD-USSHV-B-MCB
Frame/Rating 4000.0 A
BUS-USSHVA
4160.0 V
0.71 % VD
LF Voltage 4156.61 V
LF Current 1365.18 A
BUS-USSHVB
4160.0 V
0.75 % VD
LF Voltage 4156.42 V
LF Current 2168.52 A
PD-XF-B-TN1
Frame/Rating 2000.0 A
PD-1LNH1
Frame/Rating 225.0 A
PD-2LNH1
Frame/Rating 225.0 A
PD-3LNH1
Frame/Rating 225.0 A
PD SPACE
Frame/Rating 225.0 A
PD-SPACE
Frame/Rating 100.0 A
PD- SPACE
Frame/Rating 400.0 A
PD-BLNH1
Frame/Rating 100.0 A
PD-BLNH2
Frame/Rating 225.0 A
PD-SWBDN-P
Frame/Rating 2000.0 A
CBL-XF-B-TN1
Ampacity 12800.0 A
Conductor Desc 3Cx6 Length 40.0 ft
829.7 kW
722.7 kVAR
PoVD 0.2 %
LF 1333 A
CBL-1LNH1-U
Ampacity 230.0 A
Conductor Desc 4-1/C+G
Length 175.0 ft
15.4 kW
47.6 kVAR
PoVD 0.0 %
LF 97 A
CBL-2LNH1-U
Ampacity 230.0 A
Conductor Desc 4-1/C+G
Length 175.0 ft
15.4 kW
33.1 kVAR
PoVD 0.3 %
LF 67 A
CBL-3LNH1-U
Ampacity 230.0 A
Conductor Desc 4-1/C+G
Length 175.0 ft
15.4 kW
34 kVAR
PoVD 0.4 %
LF 70 A
CBL-BLNH1
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 60.0 ft
14.1 kW
63 kVAR
PoVD 0.0 %
LF 12 A
CBL-BLNH2
Ampacity 175.0 A
Conductor Desc 4-1/C+G
Length 95.0 ft
15.4 kW
51.2 kVAR
PoVD 0.4 %
LF 103 A
CBL-SWBDN-P
Ampacity 2700.0 A
Conductor Desc 4-1/C+G
Length 25.0 ft
1.4 kW
6.2 kVAR
PoVD 0.1 %
LF 1898 A
BUS-XF-B-TN1
0.92 % VD
LF Voltage 475.57 V
LF Current 1332.93 A
XF2-B-TN1
828.2 kW
LF Current 1332.93 A
550.8 kVAR
PoVD -3.5 %
CBL-1LNH1-A
Ampacity 230.0 A
Conductor Desc 4-1/C+G
Length 15.0 ft
15.4 kW
47.6 kVAR
PoVD 0.0 %
LF 97 A
CBL-2LNH1-A
Ampacity 230.0 A
Conductor Desc 4-1/C+G
Length 30.0 ft
15.9 kW
32.9 kVAR
PoVD 0.1 %
LF 67 A
CBL-3LNH1-A
Ampacity 230.0 A
Conductor Desc 4-1/C+G
Length 45.0 ft
15.7 kW
34.3 kVAR
PoVD 0.1 %
LF 70 A
MTR1-PHASE2-MECH
50.000 hp
LF Current 51.16 A
LF kW 40.11 kW
MTR1-PHASE2-ELEV
90.000 kW
LF Current 117.28 A
LF kW 96.77 kW
BUS-BLNH1
480.0 V
0.78 % VD
LF Voltage 476.25 V
LF Current 12.12 A
BUS-BLNH2
480.0 V
1.15 % VD
LF Voltage 474.49 V
LF Current 103.43 A
BLNH1
BLNH2
BUS-SWBDN-P
480.0 V
1.49 % VD
LF Voltage 472.86 V
LF Current 1897.52 A
BUS-1LNH1
480.0 V
1.24 % VD
LF Voltage 474.83 V
LF Current 96.52 A
BUS-2LNH1
480.0 V
1.11 % VD
LF Voltage 474.69 V
LF Current 66.74 A
BUS-3LNH1
480.0 V
1.15 % VD
LF Voltage 474.46 V
LF Current 69.51 A
1LNH1
2LNH1
3LNH1
CBL-SWBDN-B
Ampacity 2010.0 A
Conductor Desc 4-1/C+G
Length 25.0 ft
1664.8 kW
606.4 kVAR
PoVD 0.7 %
LF 2726 A
CB-CHILLER#1
Frame/Rating 1200.0 A
CB-CHILLER#2
Frame/Rating 700.0 A
STEAM GEN
47.000 kVA
CBL-CHILLER#1
Ampacity 1240.0 A
Conductor Desc 4#C+G
Length 60.0 ft
415.9 kW
211.3 kVAR
PoVD 0.1 %
LF 591 A
CBL-CHILLER#2
Ampacity 1240.0 A
Conductor Desc 4#C+G
Length 60.0 ft
415.9 kW
211.3 kVAR
PoVD 0.1 %
LF 591 A
CB-PPNH1
Frame/Rating 0.0 A
CBL-PPNH1
Ampacity 620.0 A
Conductor Desc 4-1/C+G
Length 40.0 ft
234.4 kW
78.3 kVAR
PoVD 0.1 %
LF 302 A
BUS-CHILLER#1
480.0 V
1.59 % VD
LF Voltage 472.37 V
LF Current 591.40 A
BUS-CHILLER#2
480.0 V
1.59 % VD
LF Voltage 472.37 V
LF Current 591.40 A
MTR1-CHILLER#1
405.000 kW
LF Current 591.40 A
LF kW 435.48 kW
MTR1-CHILLER#2
405.000 kW
LF Current 591.40 A
LF kW 435.48 kW
MTR1-LEF 2.3 (4 BACKUP)
100.000 hp
LF Current 206.19 A
LF kW 160.43 kW
MTR1-CWS1(2.BACKUP)
150.000 hp
LF Current 154.64 A
LF kW 120.32 kW
BUS-PPNH1
480.0 V
1.59 % VD
LF Voltage 472.36 V
LF Current 301.76 A
MTR1-EF2
5.000 hp
LF Current 3.46 A
LF kW 2.41 kW
MTR1-CLWPJ (2, BACKUP)
75.000 hp
LF Current 77.40 A
LF kW 60.16 kW
MTR1-CWP-1,2
40.000 hp
LF Current 82.56 A
LF kW 64.17 kW
MTR1-CT-1,2
40.000 hp
LF Current 82.56 A
LF kW 64.17 kW
MTR1-RAD-1
1.500 hp
LF Current 1.73 A
LF kW 1.20 kW
MTR1-ACOM-1
15.000 hp
LF Current 16.96 A
LF kW 24.06 kW
MTR1-VP-1
7.500 hp
LF Current 23.22 A
LF kW 18.05 kW
CB-BLNL1
Frame/Rating 250.0 A
CB-BLNL2
Frame/Rating 100.0 A
CB-BLNL3
Frame/Rating 150.0 A
CB-BLNL4
Frame/Rating 225.0 A
CB-BLNL5
Frame/Rating 100.0 A
CB-BLNL6
Frame/Rating 100.0 A
CB-2PNL4
Frame/Rating 600.0 A
CB-2HV-B-BUS
Frame/Rating 1200.0 A
CBL-BLNL1
Ampacity 230.0 A
Conductor Desc 4 Wire+Gnd
Length 5.0 ft
45.1 kW
30.8 kVAR
PoVD 0.1 %
LF 140 A
CBL-BLNL2
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 70.0 ft
11.5 kW
8.6 kVAR
PoVD 0.0 %
LF 39 A
CBL-BLNL3
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 55.0 ft
22.0 kW
16.4 kVAR
PoVD 0.1 %
LF 72 A
CBL-BLNL4
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 55.0 ft
46.8 kW
34.4 kVAR
PoVD 0.3 %
LF 152 A
CBL-BLNL5
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 65.0 ft
8.3 kVAR
PoVD 0.0 %
LF 38 A
CBL-BLNL6
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 65.0 ft
54.5 kW
39.8 kVAR
PoVD 0.4 %
LF 45 A
CBL-2PNL4-U
Ampacity 620.0 A
Conductor Desc 4 Wire+Gnd
Length 80.0 ft
237.8 kVAR
PoVD 0.4 %
LF 1078 A
CBL-2HV-B-BUS-U
Ampacity 1240.0 A
Conductor Desc 4 Wire+Gnd
Length 170.0 ft
599.5 kW
254.7 kVAR
PoVD 2.2 %
LF 1156 A
CBL-2PNL4-A
Ampacity 620.0 A
Conductor Desc 4 Wire+Gnd
Length 15.0 ft
311.2 kW
232.3 kVAR
PoVD 1.1 %
LF 1078 A
CBL-2HV-B-BUS-A
Ampacity 1240.0 A
Conductor Desc 4 Wire+Gnd
Length 15.0 ft
333.2 kW
248.6 kVAR
PoVD 0.2 %
LF 1156 A
BUS-BLNL1
208.0 V
-1.80 % VD
LF Voltage 211.94 V
LF Current 139.95 A
BUS-BLNL2
208.0 V
-1.65 % VD
LF Voltage 211.42 V
LF Current 39.26 A
BUS-BLNL3
208.0 V
-1.50 % VD
LF Voltage 211.12 V
LF Current 74.86 A
BUS-BLNL4
208.0 V
-1.05 % VD
LF Voltage 210.18 V
LF Current 152.11 A
BUS-BLNL5
208.0 V
-1.48 % VD
LF Voltage 211.49 V
LF Current 37.88 A
BUS-BLNL6
208.0 V
-1.60 % VD
LF Voltage 211.32 V
LF Current 49.18 A
BUS-2PNL4
208.0 V
1.04 % VD
LF Voltage 205.85 V
LF Current 1077.51 A
BUS-2HV-B-BUS
208.0 V
0.42 % VD
LF Voltage 207.12 V
LF Current 1155.70 A
BUS-SWBDN-B
208.0 V
-1.94 % VD
LF Voltage 212.03 V
LF Current 2726.44 A
PD-2PNL2
Frame/Rating 1200.0 A
PD-2PNL3
Frame/Rating 1200.0 A
PD-2PNL2
Frame/Rating 600.0 A
CBL-2PNL2
Ampacity 400.0 A
Conductor Desc 4 Wire+Gnd
Length 15.0 ft
110.3 kW
82.0 kVAR
PoVD 0.2 %
LF 386 A
CBL-2PNL3
Ampacity 400.0 A
Conductor Desc 4 Wire+Gnd
Length 25.0 ft
70.2 kW
52.4 kVAR
PoVD 0.2 %
LF 246 A
CBL-2PNL2
Ampacity 400.0 A
Conductor Desc 4 Wire+Gnd
Length 25.0 ft
127.8 kW
94.8 kVAR
PoVD 0.4 %
LF 446 A
BUS-2PNL2
208.0 V
1.24 % VD
LF Voltage 205.42 V
LF Current 365.58 A
CB-1PNL1
Frame/Rating 400.0 A
CBL-1PNL1
Ampacity 400.0 A
Conductor Desc 4 Wire+Gnd
Length 15.0 ft
95.7 kW
71.2 kVAR
PoVD 0.2 %
LF 332 A
CB-2PNL1
Frame/Rating 800.0 A
CBL-2PNL1
Ampacity 400.0 A
Conductor Desc 4 Wire+Gnd
Length 15.0 ft
133.8 kW
99.4 kVAR
PoVD 0.3 %
LF 465 A
CB-1PNL2
Frame/Rating 800.0 A
CBL-2PNL2-1
Ampacity 400.0 A
Conductor Desc 4 Wire+Gnd
Length 15.0 ft
103.2 kW
76.9 kVAR
PoVD 0.2 %
LF 359 A
BUS-1PNL1
208.0 V
0.61 % VD
LF Voltage 206.72 V
LF Current 358.75 A
CB-1LNL1
Frame/Rating 150.0 A
CB-1LNL2
Frame/Rating 150.0 A
CB-1LNL8
Frame/Rating 150.0 A
CB-1LNL9
Frame/Rating 150.0 A
CB-1LNL10
Frame/Rating 150.0 A
CBL-1LNL1
Ampacity 125.0 A
Conductor Desc 4-1/C+G
Length 60.0 ft
16.6 kW
12.5 kVAR
PoVD 0.2 %
LF 58 A
CBL-1LNL2
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 140.0 ft
18.9 kW
14.1 kVAR
PoVD 1.0 %
LF 66 A
CBL-1LNL8
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 160.0 ft
19.2 kW
12.1 kVAR
PoVD 1.1 %
LF 57 A
CBL-1LNL9
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 190.0 ft
19.2 kW
9.5 kVAR
PoVD 0.5 %
LF 46 A
CBL-1LNL10
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 25.0 ft
6.8 kW
5.1 kVAR
PoVD 0.1 %
LF 24 A
BUS-1LNL1
208.0 V
1.40 % VD
LF Voltage 204.91 V
LF Current 58.45 A
BUS-1LNL2
208.0 V
2.30 % VD
LF Voltage 203.22 V
LF Current 66.44 A
BUS-1LNL8
208.0 V
2.34 % VD
LF Voltage 203.13 V
LF Current 56.92 A
BUS-1LNL9
208.0 V
1.73 % VD
LF Voltage 204.41 V
LF Current 39.89 A
BUS-1LNL10
208.0 V
1.32 % VD
LF Voltage 205.25 V
LF Current 23.97 A
1LNL1
1LNL2
1LNL8
1LNL9
1LNL10
CB-2LNL1
Frame/Rating 150.0 A
CB-2LNL2
Frame/Rating 150.0 A
CB-2LNL8
Frame/Rating 150.0 A
CB-2LNL9
Frame/Rating 150.0 A
CB-2LNL10
Frame/Rating 150.0 A
CBL-2LNL1
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 60.0 ft
21.4 kW
16.0 kVAR
PoVD 0.5 %
LF 75 A
CBL-2LNL2
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 170.0 ft
8.2 kW
6.1 kVAR
PoVD 0.4 %
LF 29 A
CBL-2LNL8
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 170.0 ft
37.1 kW
27.6 kVAR
PoVD 2.3 %
LF 129 A
CBL-2LNL9
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 85.0 ft
35.0 kW
26.1 kVAR
PoVD 1.1 %
LF 122 A
CBL-2LNL10
Ampacity 150.0 A
Conductor Desc 4-1/C+G
Length 150.0 ft
8.5 kW
6.4 kVAR
PoVD 0.0 %
LF 28 A
BUS-2LNL1
208.0 V
1.72 % VD
LF Voltage 204.42 V
LF Current 71.02 A
BUS-2LNL2
208.0 V
1.68 % VD
LF Voltage 204.50 V
LF Current 28.65 A
BUS-2LNL8
208.0 V
3.08 % VD
LF Voltage 200.55 V
LF Current 129.46 A
BUS-2LNL9
208.0 V
2.35 % VD
LF Voltage 203.11 V
LF Current 122.65 A
BUS-2LNL10
208.0 V
1.28 % VD
LF Voltage 205.32 V
LF Current 29.80 A
2LNL1
2LNL2
2LNL8
2LNL9
2LNL10
CB-3LNL1
Frame/Rating 150.0 A
CB-3LNL2
Frame/Rating 150.0 A
CB-3LNL8
Frame/Rating 150.0 A
CB-3LNL9
Frame/Rating 150.0 A
CB-3LNL10
Frame/Rating 150.0 A
CBL-3LNL1
Ampacity 125.0 A
Conductor Desc 4-1/C+G
Length 60.0 ft
21.9 kW
23.8 kVAR
PoVD 0.8 %
LF 112 A
CBL-3LNL2
Ampacity 125.0 A
Conductor Desc 4-1/C+G
Length 145.0 ft
11.0 kW
8.2 kVAR
PoVD 0.6 %
LF 39 A
CBL-3LNL8
Ampacity 125.0 A
Conductor Desc 4-1/C+G
Length 170.0 ft
48.5 kW
35.8 kVAR
PoVD 3.2 %
LF 170 A
CBL-3LNL9
Ampacity 125.0 A
Conductor Desc 4-1/C+G
Length 85.0 ft
31.0 kW
23.1 kVAR
PoVD 1.0 %
LF 109 A
CBL-3LNL10
Ampacity 125.0 A
Conductor Desc 4-1/C+G
Length 15.0 ft
4.9 kW
3.6 kVAR
PoVD 0.0 %
LF 17 A
BUS-3LNL1
208.0 V
2.07 % VD
LF Voltage 203.44 V
LF Current 111.99 A
BUS-3LNL2
208.0 V
2.87 % VD
LF Voltage 203.70 V
LF Current 38.74 A
BUS-3LNL8
208.0 V
4.68 % VD
LF Voltage 198.27 V
LF Current 169.67 A
BUS-3LNL9
208.0 V
2.48 % VD
LF Voltage 202.85 V
LF Current 108.56 A
BUS-3LNL10
208.0 V
1.46 % VD
LF Voltage 204.95 V
LF Current 16.90 A
3LNL1
3LNL2
3LNL8
3LNL9
3LNL10
CB-3LNL3
Frame/Rating 150.0 A
CB-3LNL4
Frame/Rating 150.0 A
CB-3LNL5
Frame/Rating 150.0 A
CB-3LNL6
Frame/Rating 150.0 A
CB-3LNL7
Frame/Rating 150.0 A
CBL-3LNL3
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 155.0 ft
14.1 kW
10.3 kVAR
PoVD 0.8 %
LF 49 A
CBL-3LNL4
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 90.0 ft
31.2 kW
23.2 kVAR
PoVD 1.0 %
LF 109 A
CBL-3LNL5
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 20.0 ft
5.4 kW
4.1 kVAR
PoVD 0.0 %
LF 19 A
CBL-3LNL6
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 80.0 ft
24.4 kW
18.2 kVAR
PoVD 0.7 %
LF 85 A
CBL-3LNL7
Ampacity 150.0 A
Conductor Desc 4 Wire+Gnd
Length 145.0 ft
27.9 kW
20.7 kVAR
PoVD 1.5 %
LF 97 A
BUS-3LNL3
208.0 V
1.43 % VD
LF Voltage 205.03 V
LF Current 49.25 A
BUS-3LNL4
208.0 V
1.65 % VD
LF Voltage 204.56 V
LF Current 108.51 A
BUS-3LNL5
208.0 V
0.66 % VD
LF Voltage 206.64 V
LF Current 18.96 A
BUS-3LNL6
208.0 V
1.34 % VD
LF Voltage 205.22 V
LF Current 84.90 A
BUS-3LNL7
208.0 V
2.11 % VD
LF Voltage 203.61 V
LF Current 97.14 A
3LNL3
3LNL4
3LNL5
3LNL6
3LNL7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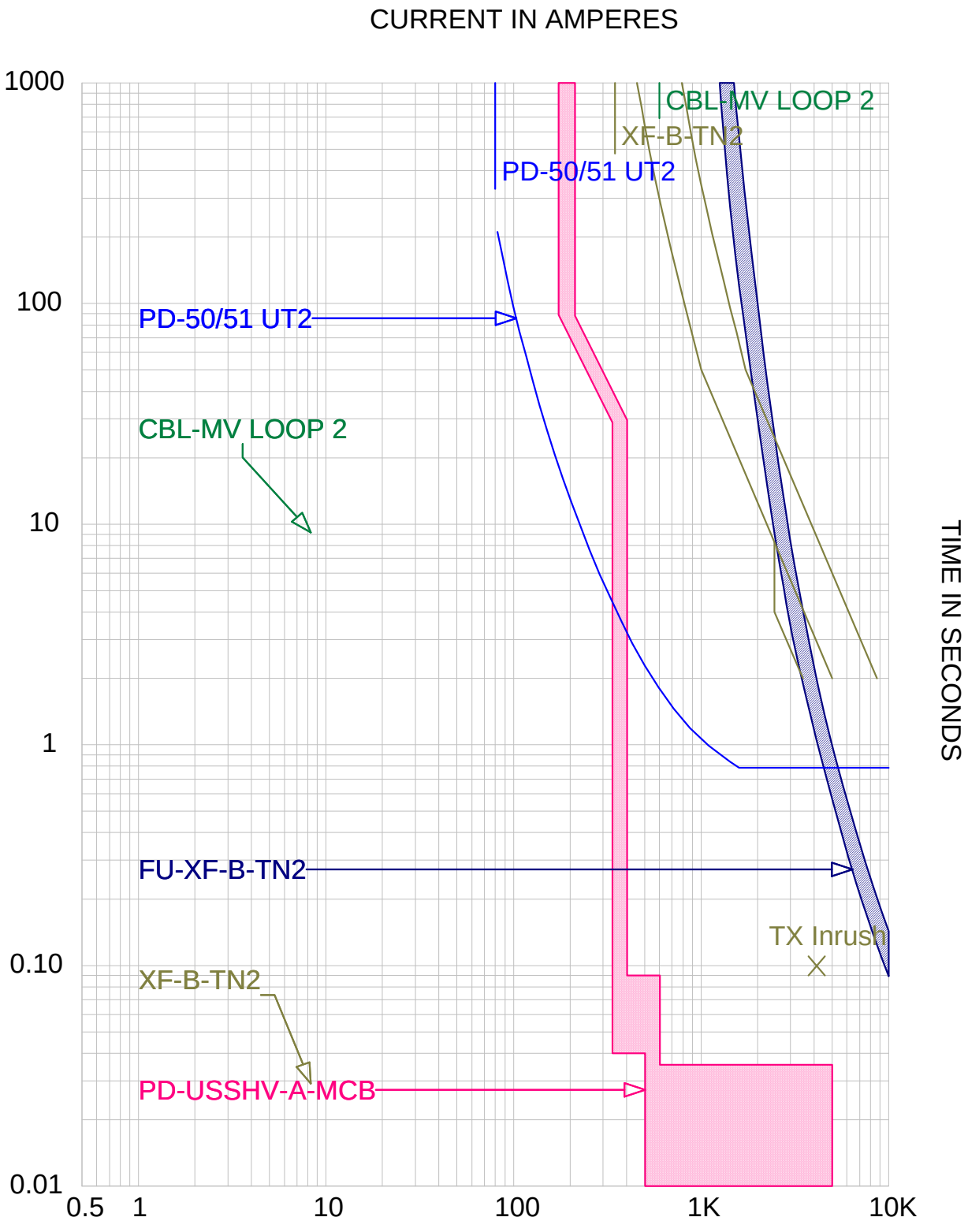
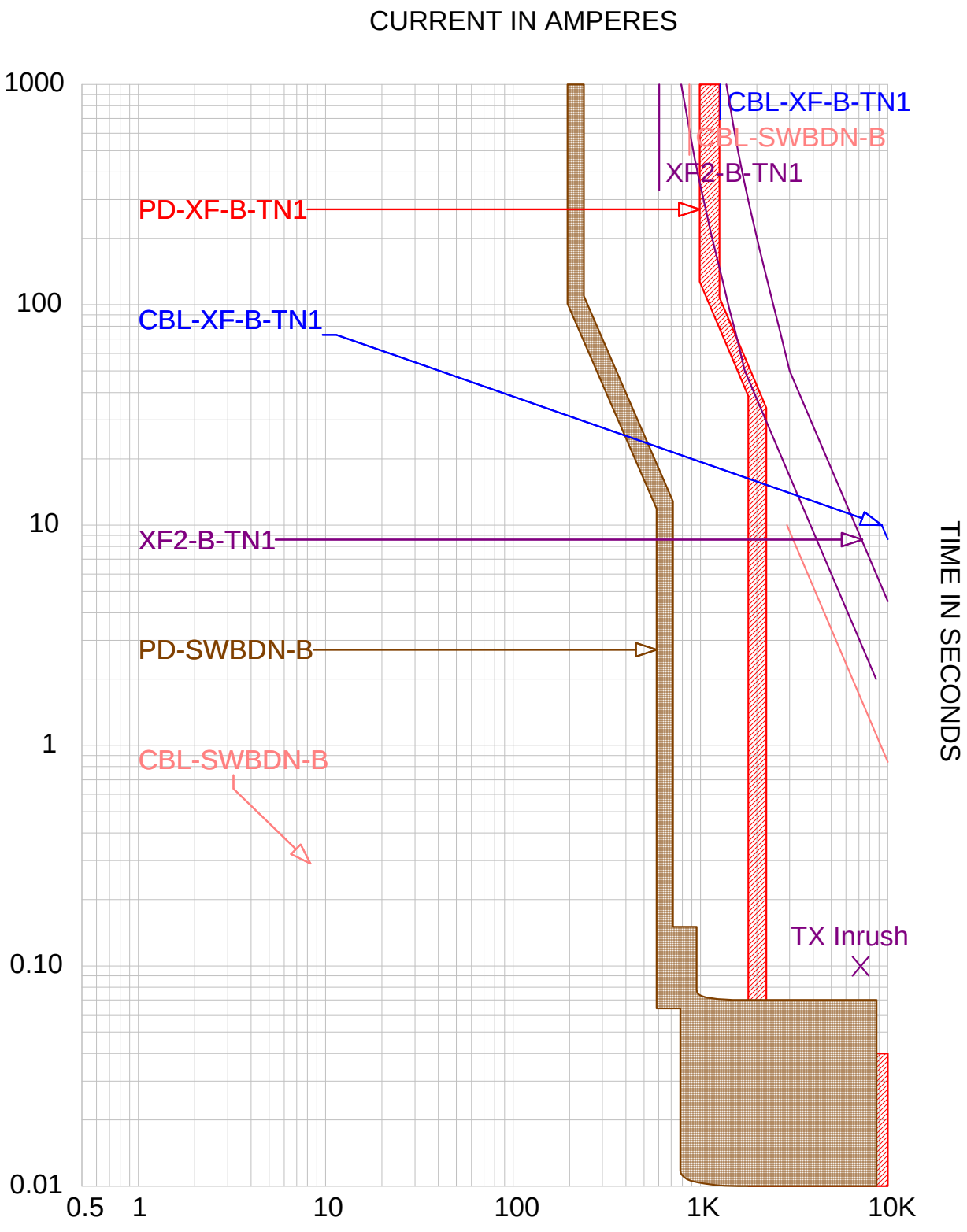
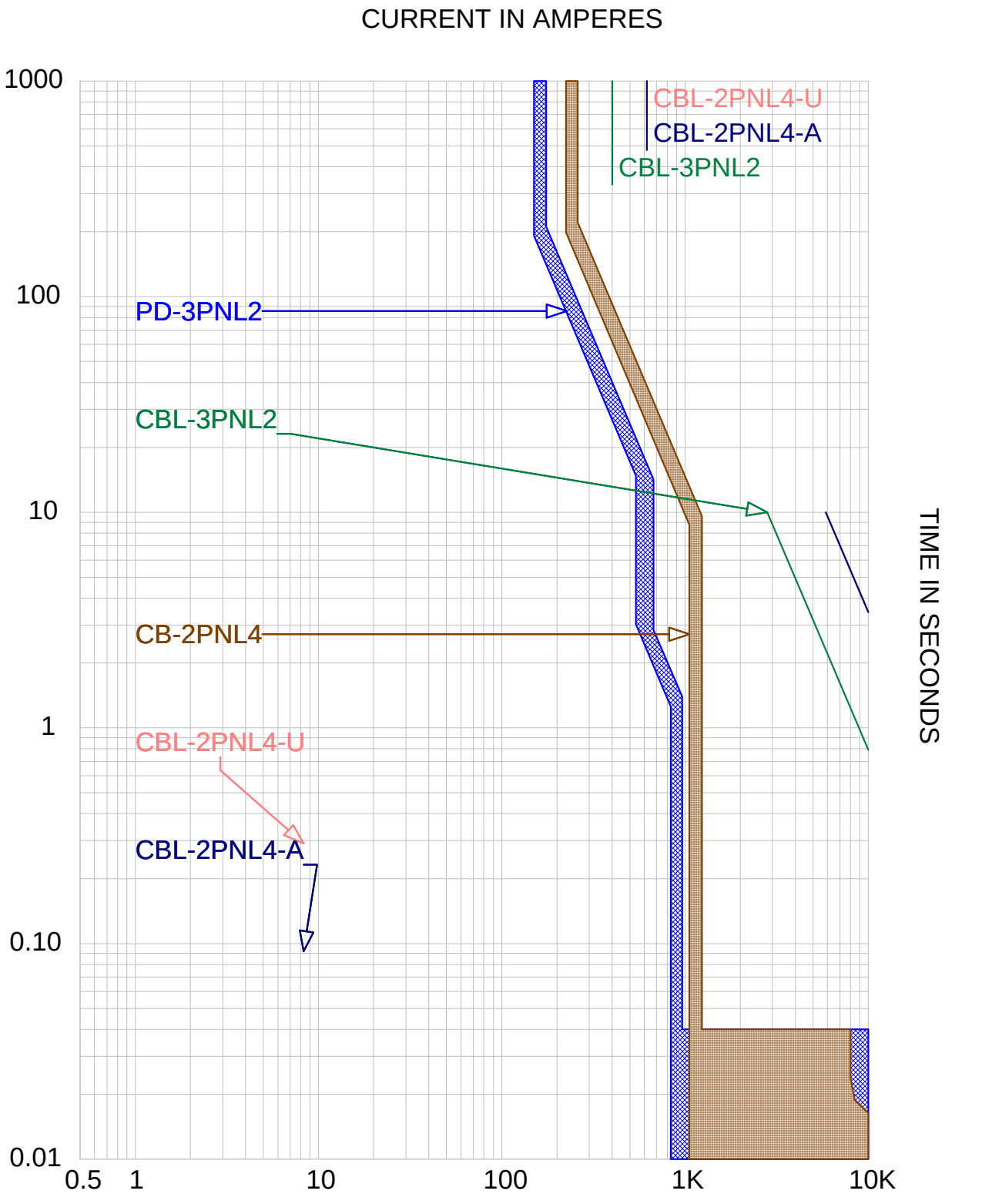
MV-BUS #3/4
PD-0105
PD-50/51 UT2
CBL-MV LOOP 2
SW - MV LOOP 2
BUS-SS A
SW-XF-B-TN2
FU-XF-B-TN2
XF-B-TN2
P
S
PD-USSHV-A-MCB
BUS-USSHVA
PD-XF-B-TN1
CBL-XF-B-TN1
BUS-XF2-B-TN1
XF2-B-TN1
PD-SWBDN-B
CBL-SWBDN-B
BUS-SWBDN-B
CB-2PNL4
CBL-2PNL4-U
CBL-2PNL4-A
BUS-2PNL4
PD-3PNL2
CBL-3PNL2
BUS-3PNL2



tcc5.tcc Ref. Voltage: 4160V Current in Amps x 1



tcc4.tcc Ref. Voltage: 480V Current in Amps x 1



2PNL4-3PNL4.tcc Ref. Voltage: 208V Current in Amps x 1 2PNL4-3PNL4

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category
1	BUS-1LNH1	PD-1LNH1	0.480	13.67	8.57	13.67	8.57	0.017	0.000	Yes	PNL	25	10	18	0.47	Category 0
2																
3	BUS-1LNL1	CB-1LNL1	0.208	9.21	4.10	9.21	4.10	0.019	0.000	Yes	PNL	25	7	18	0.24	Category 0
4																
5	BUS-1LNL10	CB-1LNL10	0.208	10.00	4.35	10.00	4.35	0.018	0.000	Yes	PNL	25	7	18	0.24	Category 0
6																
7	BUS-1LNL2	PD-2PNL3 (CB-1LNL2)	0.208	4.84	2.61	4.84	2.61	0.08	0.000	Yes	PNL	25	12	18	0.62	Category 0 (*N5)
8																
9	BUS-1LNL3	CB-1LNL3	0.208	4.49	2.48	4.49	2.48	2	0.000	Yes	PNL	25	83	18	15	Category 3 (*N9)
10																
11	BUS-1LNL4	CB-1LNL4	0.208	6.92	2.85	6.92	2.85	0.032	0.000	Yes	PNL	25	7	18	0.28	Category 0 (*N3)
12																
13	BUS-1LNL5	CB-1LNL5	0.208	11.71	4.86	11.71	4.86	0.017	0.000	Yes	PNL	25	7	18	0.26	Category 0
14																
15	BUS-1LNL6	CB-1LNL6	0.208	7.37	2.99	7.37	2.99	0.029	0.000	Yes	PNL	25	7	18	0.26	Category 0 (*N3)
16																
17	BUS-1LNL7	CB-1LNL7	0.208	5.01	2.68	5.01	2.68	2	0.000	Yes	PNL	25	87	18	16	Category 3 (*N9)
18																
19	BUS-1LNL8	PD-2PNL3 (CB-1LNL8)	0.208	4.24	2.38	4.24	2.38	0.08	0.000	Yes	PNL	25	11	18	0.56	Category 0 (*N5)
20																
21	BUS-1LNL9	PD-2PNL3 (CB-1LNL9)	0.208	5.77	2.51	5.77	2.51	0.08	0.000	Yes	PNL	25	12	18	0.60	Category 0 (*N3) (*N5)
22																
23	BUS-1PNL1	CB-1PNL1	0.208	14.02	4.69	14.02	4.69	0.028	0.000	Yes	PNL	25	9	18	0.40	Category 0 (*N3)
24																
25	BUS-208V-B-BUS	CB-208V-B-BUS	0.208	14.77	5.72	14.77	5.72	0.05	0.000	Yes	PNL	25	15	18	0.91	Category 0
26																
27	BUS-2LNH1	PD-2LNH1	0.480	12.93	8.17	12.93	8.17	0.017	0.000	Yes	PNL	25	10	18	0.45	Category 0

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category
28																
29	BUS-2LNL1	CB-2LNL1	0.208	8.04	3.17	8.04	3.17	0.025	0.000	Yes	PNL	25	7	18	0.24	Category 0 (*N3)
30																
31	BUS-2LNL10	CB-2LNL10	0.208	11.38	4.76	11.38	4.76	0.017	0.000	Yes	PNL	25	7	18	0.26	Category 0
32																
33	BUS-2LNL2	PD-2PNL2 (CB-2LNL2)	0.208	4.97	2.66	4.97	2.66	0.08	0.000	Yes	PNL	25	12	18	0.64	Category 0 (*N5)
34																
35	BUS-2LNL3	CB-2PNL1 (CB-2LNL3)	0.208	4.49	2.48	4.49	2.48	0.08	0.000	Yes	PNL	25	12	18	0.59	Category 0 (*N5)
36																
37	BUS-2LNL4	CB-2LNL4	0.208	6.92	2.85	6.92	2.85	0.032	0.000	Yes	PNL	25	7	18	0.28	Category 0 (*N3)
38																
39	BUS-2LNL5	CB-2LNL5	0.208	12.24	5.01	12.24	5.01	0.017	0.000	Yes	PNL	25	7	18	0.27	Category 0
40																
41	BUS-2LNL6	CB-2LNL6	0.208	7.37	2.99	7.37	2.99	0.029	0.000	Yes	PNL	25	7	18	0.26	Category 0 (*N3)
42																
43	BUS-2LNL7	CB-2PNL1 (CB-2LNL7)	0.208	4.68	2.55	4.68	2.55	0.08	0.000	Yes	PNL	25	12	18	0.61	Category 0 (*N5)
44																
45	BUS-2LNL8	PD-2PNL2 (CB-2LNL8)	0.208	4.46	2.47	4.46	2.47	0.08	0.000	Yes	PNL	25	12	18	0.58	Category 0 (*N5)
46																
47	BUS-2LNL9	CB-2LNL9	0.208	6.83	2.83	6.83	2.83	0.033	0.000	Yes	PNL	25	7	18	0.28	Category 0 (*N3)
48																
49	BUS-2PNL1	CB-208V-B-BUS (CB-2PNL1)	0.208	14.02	5.51	14.02	5.51	0.05	0.000	Yes	PNL	25	15	18	0.87	Category 0 (*N5)
50																
51	BUS-2PNL2	CB-2PNL4 (PD-2PNL2)	0.208	12.94	5.21	12.94	5.21	0.04	0.000	Yes	PNL	25	12	18	0.66	Category 0 (*N5)
52																

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category
53	BUS-2PNL3	CB-2PNL4 (PD-2PNL3)	0.208	12.53	5.10	12.53	5.10	0.04	0.000	Yes	PNL	25	12	18	0.64	Category 0 (*N5)
54																
55	BUS-2PNL4	CB-2PNL4	0.208	13.59	5.40	13.59	5.40	0.04	0.000	Yes	PNL	25	13	18	0.68	Category 0
56																
57	BUS-3LNH1	PD-3LNH1	0.480	12.27	7.81	12.27	7.81	0.017	0.000	Yes	PNL	25	10	18	0.42	Category 0
58																
59	BUS-3LNL1	CB-3LNL1	0.208	7.63	3.06	7.63	3.06	0.027	0.000	Yes	PNL	25	7	18	0.25	Category 0 (*N3)
60																
61	BUS-3LNL10	CB-3LNL10	0.208	10.91	4.63	10.91	4.63	0.017	0.000	Yes	PNL	25	7	18	0.25	Category 0
62																
63	BUS-3LNL2	PD-3PNL2 (CB-3LNL2)	0.208	4.72	2.57	4.72	2.57	0.04	0.000	Yes	PNL	25	8	18	0.31	Category 0 (*N5)
64																
65	BUS-3LNL3	CB-3PNL1 (CB-3LNL3)	0.208	4.90	2.63	4.90	2.63	0.08	0.000	Yes	PNL	25	12	18	0.63	Category 0 (*N5)
66																
67	BUS-3LNL4	CB-3LNL4	0.208	6.92	2.85	6.92	2.85	0.032	0.000	Yes	PNL	25	7	18	0.28	Category 0 (*N3)
68																
69	BUS-3LNL5	CB-3LNL5	0.208	11.71	4.86	11.71	4.86	0.017	0.000	Yes	PNL	25	7	18	0.26	Category 0
70																
71	BUS-3LNL6	CB-3LNL6	0.208	7.37	2.99	7.37	2.99	0.029	0.000	Yes	PNL	25	7	18	0.26	Category 0 (*N3)
72																
73	BUS-3LNL7	CB-3PNL1 (CB-3LNL7)	0.208	5.13	2.72	5.13	2.72	0.08	0.000	Yes	PNL	25	12	18	0.65	Category 0 (*N5)
74																
75	BUS-3LNL8	PD-3PNL2 (CB-3LNL8)	0.208	4.24	2.38	4.24	2.38	0.04	0.000	Yes	PNL	25	7	18	0.28	Category 0 (*N5)
76																
77	BUS-3LNL9	PD-3PNL2 (CB-3LNL9)	0.208	6.48	2.73	6.48	2.73	0.04	0.000	Yes	PNL	25	8	18	0.33	Category 0 (*N3) (*N5)

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category
78																
79	BUS-3PNL1	CB-208V-B-BUS (CB-3PNL1)	0.208	14.02	5.51	14.02	5.51	0.05	0.000	Yes	PNL	25	15	18	0.87	Category 0 (*N5)
80																
81	BUS-3PNL2	PD-3PNL2	0.208	12.53	5.10	12.53	5.10	0.04	0.000	Yes	PNL	25	12	18	0.64	Category 0
82																
83	BUS-BLNH1	FU-XF-B-TN3 (PD-BLNH1)	0.480	23.72	13.71	19.18	11.09	0.008	0.000	Yes	PNL	25	9	18	0.39	Category 0 (*N5)
84																
85	BUS-BLNH2	FU-XF-B-TN3 (PD-BLNH2)	0.480	19.34	11.52	15.64	9.31	0.008	0.000	Yes	PNL	25	8	18	0.32	Category 0 (*N5)
86																
87	BUS-BLNL1	CB-BLNL1	0.208	18.66	6.74	18.66	6.74	0.017	0.000	Yes	PNL	25	9	18	0.36	Category 0
88																
89	BUS-BLNL2	CB-BLNL2	0.208	9.58	4.22	9.58	4.22	0.017	0.000	Yes	PNL	25	6	18	0.22	Category 0
90																
91	BUS-BLNL3	CB-BLNL3	0.208	10.94	4.63	10.94	4.63	0.017	0.000	Yes	PNL	25	7	18	0.24	Category 0
92																
93	BUS-BLNL4	CB-BLNL4	0.208	10.94	4.63	10.94	4.63	0.019	0.000	Yes	PNL	25	7	18	0.28	Category 0
94																
95	BUS-BLNL5	CB-BLNL5	0.208	10.00	4.35	10.00	4.35	0.017	0.000	Yes	PNL	25	7	18	0.23	Category 0
96																
97	BUS-BLNL6	CB-BLNL6	0.208	10.00	4.35	10.00	4.35	0.017	0.000	Yes	PNL	25	7	18	0.23	Category 0
98																
99	BUS-CHILLER#1	CB-CHILLER #1	0.480	46.76	24.49	43.31	22.68	0.025	0.000	Yes	PNL	25	26	18	2.2	Category 1
100																
101	BUS-CHILLER#2	CB-CHILLER #2	0.480	46.76	24.49	43.31	22.68	0.025	0.000	Yes	PNL	25	26	18	2.2	Category 1
102																

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category
103	BUS-PPNH1	FU-XF-B-TN3 (PD-SWBDN-P)	0.480	42.98	22.79	33.49	17.76	0.004	0.000	Yes	PNL	25	8	18	0.34	Category 0 (*N5)
104	BUS-PPNH1	CB-CHILLER #1	0.480	42.98	22.79	3.01	1.59	0.083	0.000	Yes	PNL	25	24	18	1.9	Category 1
105	BUS-PPNH1	CB-CHILLER #2	0.480	42.98	22.79	3.01	1.59	0.083	0.000	Yes	PNL	25	24	18	1.9	Category 1
106																
107	BUS-SS A	PD-50/51 UT2	4.16	26.55	25.34	26.55	25.34	0.787	0.083	Yes	SWG	104	872	36	27	Category 4
108																
109	BUS-SS B	FU-XF-B-TN3	4.16	27.24	25.99	1.13	1.08	0.008	0.000	Yes	SWG	104	8	36	0.27	Category 0
110	BUS-SS B	PD-50/51 UT1	4.16	27.24	25.99	26.12	24.92	0.016	0.083	Yes	SWG	104	94	36	3.0	Category 1
111																
112	BUS-SWBDN-B	PD-XF-B-TN1 (PD-SWBDN-B)	0.208	19.36	6.92	21.85	7.81	0.04	0.000	Yes	PNL	25	15	18	0.89	Category 0 (*N5)
113																
114	BUS-SWBDN-P	FU-XF-B-TN3 (PD-SWBDN-P)	0.480	49.71	25.80	38.95	20.22	0.004	0.000	Yes	PNL	25	9	18	0.39	Category 0 (*N5)
115	BUS-SWBDN-P	CB-CHILLER #1	0.480	49.71	25.80	3.49	1.81	0.083	0.000	Yes	PNL	25	26	18	2.2	Category 1
116	BUS-SWBDN-P	CB-CHILLER #2	0.480	49.71	25.80	3.49	1.81	0.083	0.000	Yes	PNL	25	26	18	2.2	Category 1
117																
118	BUS-USSHVA	PD-USSHV-A-MCB	0.480	43.31	22.94	43.31	22.94	0.036	0.000	Yes	PNL	25	31	18	2.9	Category 1
119																
120	BUS-USSHVB	FU-XF-B-TN3	0.480	54.77	28.03	43.17	22.10	0.004	0.000	Yes	PNL	25	10	18	0.42	Category 0
121	BUS-USSHVB	PD-SWBDN-B	0.480	54.77	28.03	10.60	5.43	0.07	0.000	Yes	PNL	25	25	18	2.0	Category 1
122																

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category
123	BUS-XF2-B-TN1	PD-USSHV-A-MCB (PD-XF-B-TN1)	0.480	40.81	21.80	40.81	21.80	0.036	0.000	Yes	PNL	25	30	18	2.7	Category 1 (*N5)
124																
125	MV-BUS #3/4	PD-50/51 UT1	4.16	42.74	40.47	1.11	1.05	0.083	0.000	Yes	SWG	104	134	36	4.3	Category 2 (*N2)
126	MV-BUS #3/4	MaxTripTime @2.0s	4.16	42.74	40.47	41.63	39.44	2	0.000	Yes	SWG	104	3415	36	100	Dangerous! (*N2) (*N9)
127																
128	Category 0: Nonmelting, Flammable Materials with Weight >= 4.5 oz/sq yd														#Cat 0 = 48	(*N2) < 80% Cleared Fault Threshold
129	Category 1: Arc-rated FR Shirt & Pants														#Cat 1 = 8	(*N3) - Arcing Current Low Tolerances Used
130	Category 2: Arc-rated FR Shirt & Pants														#Cat 2 = 0	(*N5) - Miscoordinated, Upstream Device Tripped
131	Category 3: Arc-rated FR Shirt & Pants & Arc Flash Suit														#Cat 3 = 2	(*N9) - Max Arcing Duration Reached
132	Category 4: Arc-rated FR Shirt & Pants & Arc Flash Suit														#Cat 4 = 1	
133	Category Dangerous!: No FR Category Found	Device with 80% Cleared Fault Threshold													#Danger = 1	IEEE 1584 - 2002/2004a Edition Bus Report (80% Cleared Fault Threshold, include Ind. Motors for 5.0 Cycles), mis-coordination checked

	Bus Name	Label #	Cable Length From Trip Device (ft)	Incident Energy at Low Marginal	Incident Energy at High Marginal
1	BUS-1LNH1	# 0014	190.00		
2					
3	BUS-1LNL1	# 0002	35.00		
4					
5	BUS-1LNL10	# 0002	25.00		
6					
7	BUS-1LNL2	# 0002	165.00		
8					
9	BUS-1LNL3	# 0005	175.00		
10					
11	BUS-1LNL4	# 0005	90.00		
12					
13	BUS-1LNL5	# 0005	20.00		
14					
15	BUS-1LNL6	# 0005	80.00		
16					
17	BUS-1LNL7	# 0005	150.00		
18					
19	BUS-1LNL8	# 0002	195.00		
20					
21	BUS-1LNL9	# 0002	130.00		
22					
23	BUS-1PNL1	# 0012	15.00		
24					
25	BUS-208V-B-BUS	# 0013	185.00		
26					
27	BUS-2LNH1	# 0014	205.00		

	Bus Name	Label #	Cable Length From Trip Device (ft)	Incident Energy at Low Marginal	Incident Energy at High Marginal
28					
29	BUS-2LNL1	# 0015	60.00		
30					
31	BUS-2LNL10	# 0015	15.00		
32					
33	BUS-2LNL2	# 0015	160.00		
34					
35	BUS-2LNL3	# 0018	190.00		
36					
37	BUS-2LNL4	# 0019	90.00		
38					
39	BUS-2LNL5	# 0020	15.00		
40					
41	BUS-2LNL6	# 0020	80.00		
42					
43	BUS-2LNL7	# 0020	180.00		
44					
45	BUS-2LNL8	# 0015	185.00		
46					
47	BUS-2LNL9	# 0015	85.00		
48					
49	BUS-2PNL1	# 0025	200.00		
50					
51	BUS-2PNL2	# 0026	140.00		
52					

	Bus Name	Label #	Cable Length From Trip Device (ft)	Incident Energy at Low Marginal	Incident Energy at High Marginal
53	BUS-2PNL3	# 0027	150.00		
54					
55	BUS-2PNL4	# 0028	125.00		
56					
57	BUS-3LNH1	# 0014	220.00		
58					
59	BUS-3LNL1	# 0030	60.00		
60					
61	BUS-3LNL10	# 0030	15.00		
62					
63	BUS-3LNL2	# 0030	170.00		
64					
65	BUS-3LNL3	# 0033	170.00		
66					
67	BUS-3LNL4	# 0033	90.00		
68					
69	BUS-3LNL5	# 0033	20.00		
70					
71	BUS-3LNL6	# 0033	80.00		
72					
73	BUS-3LNL7	# 0033	160.00		
74					
75	BUS-3LNL8	# 0030	195.00		
76					
77	BUS-3LNL9	# 0030	110.00		

	Bus Name	Label #	Cable Length From Trip Device (ft)	Incident Energy at Low Marginal	Incident Energy at High Marginal
78					
79	BUS-3PNL1	# 0040	200.00		
80					
81	BUS-3PNL2	# 0041	25.00		
82					
83	BUS-BLNH1	# 0042	60.00		
84					
85	BUS-BLNH2	# 0042	95.00		
86					
87	BUS-BLNL1	# 0044	5.00		
88					
89	BUS-BLNL2	# 0044	70.00		
90					
91	BUS-BLNL3	# 0044	55.00		
92					
93	BUS-BLNL4	# 0044	55.00		
94					
95	BUS-BLNL5	# 0044	65.00		
96					
97	BUS-BLNL6	# 0044	65.00		
98					
99	BUS-CHILLER#1	# 0050	40.00		
100					
101	BUS-CHILLER#2	# 0051	40.00		
102					

	Bus Name	Label #	Cable Length From Trip Device (ft)	Incident Energy at Low Marginal	Incident Energy at High Marginal
103	BUS-PPNH1		215.00		
104	BUS-PPNH1	# 0052	40.00		
105	BUS-PPNH1		40.00		
106					
107	BUS-SS A	# 0052	800.00		
108					
109	BUS-SS B				
110	BUS-SS B	# 0052	800.00		
111					
112	BUS-SWBDN-B	# 0054	70.00		
113					
114	BUS-SWBDN-P		175.00		
115	BUS-SWBDN-P	# 0055			
116	BUS-SWBDN-P				
117					
118	BUS-USSHVA	# 0058			
119					
120	BUS-USSHVB				
121	BUS-USSHVB	# 0060			
122					

	Bus Name	Label #	Cable Length From Trip Device (ft)	Incident Energy at Low Marginal	Incident Energy at High Marginal
123	BUS-XF2-B-TN1	# 0058	40.00		
124					
125	MV-BUS #3/4				
126	MV-BUS #3/4	# 0059			
127					
128	Category 0: Nonmelting, Flammable Materials with Weight >= 4.5 oz/sq yd				
129	Category 1: Arc-rated FR Shirt & Pants				
130	Category 2: Arc-rated FR Shirt & Pants				
131	Category 3: Arc-rated FR Shirt & Pants & Arc Flash Suit				
132	Category 4: Arc-rated FR Shirt & Pants & Arc Flash Suit				
133	Category Dangerous!: No FR Category Found				

********** F A U L T A N A L Y S I S S U M M A R Y **********

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT 3 PHASE	X/R	LINE/GRND	X/R
BUS-1LNH1	480.	13673.5	1.2	2451.73	0.2
BUS-1LNL1	208.	9207.2	1.3	1170.62	0.1
BUS-1LNL10	208.	10002.1	1.4	1193.50	0.1
BUS-1LNL2	208.	4835.3	0.8	973.61	0.2
BUS-1LNL3	208.	4486.3	0.6	1012.29	0.2
BUS-1LNL4	208.	6918.1	0.9	1123.36	0.1
BUS-1LNL5	208.	11706.9	1.6	1233.96	0.1
BUS-1LNL6	208.	7373.6	0.9	1137.98	0.1
BUS-1LNL7	208.	5011.4	0.7	1042.69	0.1
BUS-1LNL8	208.	4238.3	0.7	928.74	0.2
BUS-1LNL9	208.	5773.7	0.9	1031.64	0.1
BUS-1PNL1	208.	14018.0	2.4	1269.46	0.1
BUS-208V-B-BUS	208.	14765.8	2.7	1277.94	0.1
BUS-2LNH1	480.	12932.9	1.2	2413.87	0.2
BUS-2LNL1	208.	8038.8	1.0	1160.30	0.1
BUS-2LNL10	208.	11382.4	1.6	1233.74	0.1
BUS-2LNL2	208.	4973.8	0.7	1042.28	0.2
BUS-2LNL3	208.	4486.3	0.6	1012.29	0.2
BUS-2LNL4	208.	6918.1	0.9	1123.36	0.1
BUS-2LNL5	208.	12240.1	1.7	1242.66	0.1
BUS-2LNL6	208.	7373.6	0.9	1137.98	0.1
BUS-2LNL7	208.	4683.0	0.7	1024.24	0.2
BUS-2LNL8	208.	4457.7	0.7	1011.87	0.2
BUS-2LNL9	208.	6833.5	0.9	1123.01	0.1
BUS-2PNL1	208.	14018.0	2.4	1269.46	0.1
BUS-2PNL2	208.	12940.3	2.2	1260.22	0.1
BUS-2PNL3	208.	12530.5	2.1	1254.68	0.1
BUS-2PNL4	208.	13591.4	2.4	1268.61	0.1
BUS-3LNH1	480.	12267.1	1.1	2377.05	0.2
BUS-3LNL3	208.	4897.1	0.7	1036.47	0.2
BUS-3LNL4	208.	6918.1	0.9	1123.36	0.1
BUS-3LNL5	208.	11706.9	1.6	1233.96	0.1
BUS-3LNL6	208.	7373.6	0.9	1137.98	0.1
BUS-3LNL7	208.	5130.9	0.7	1048.98	0.1
BUS-3PNL1	208.	14018.0	2.4	1269.46	0.1
BUS-3PNL2	208.	12530.5	2.1	1254.68	0.1

********** F A U L T A N A L Y S I S S U M M A R Y **********

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT 3 PHASE	X/R	LINE/GRND	X/R
BUS-BLNH1	480.	23716.2	1.0	16457.11	0.7
BUS-BLNH2	480.	19339.0	1.0	13125.66	0.7
BUS-BLNL1	208.	18663.4	3.8	1299.90	0.1
BUS-BLNL2	208.	9581.6	1.0	1182.95	0.1
BUS-BLNL3	208.	10936.3	1.1	1207.20	0.1
BUS-BLNL4	208.	10936.3	1.1	1207.20	0.1
BUS-BLNL5	208.	9999.0	1.0	1190.93	0.1
BUS-BLNL6	208.	9999.0	1.0	1190.93	0.1
BUS-CHILLER#1	480.	46756.3	3.4	41006.59	2.6
BUS-CHILLER#2	480.	46756.3	3.4	41006.59	2.6
BUS-PPNH1	480.	42976.9	3.0	36768.02	2.4
BUS-SS A	4160.	26548.5	3.8	27144.67	3.5
BUS-SS B	4160.	27242.2	3.9	27626.52	3.6
BUS-SWBDN-B	208.	19362.9	4.4	1304.74	0.1
BUS-SWBDN-P	480.	49710.4	3.9	44760.47	2.8
BUS-USSHVA	480.	43312.1	5.2	3040.15	0.1
BUS-USSHVB	480.	54767.5	5.6	54385.75	5.6
BUS-XF2-B-TN1	480.	40811.8	4.4	3022.74	0.1
MV-BUS #3/4	4160.	42743.3	8.0	64113.86	8.0

********** FAULT ANALYSIS REPORT COMPLETED **********