

NORTHERN LIGHTS SOLUTIONS

# 2021 ELECTRICAL CONTRACTING INNOVATION CHALLENGE PROPOSAL

APRIL 30, 2021

CECA/NECA UNIVERSITY OF TORONTO STUDENT CHAPTER



## Table of Contents

1	Proposal Introduction .....	2
1.1	Executive Summary .....	2
1.1.1	NLS Mission Statement .....	3
1.1.2	NLS Team .....	3
1.2	Interaction with the Community .....	3
1.3	Team Resumes .....	4
2	Technical Analysis and Design Scope of the Electrical System .....	7
2.1	Technical Design .....	7
2.1.1	Lighting .....	7
2.1.2	Building Energy Management .....	11
2.1.3	Smart Building Design .....	17
2.2	Project Budget .....	27
2.2.1	Lighting .....	27
2.2.2	Building Energy Management .....	27
2.2.3	Smart Building Design .....	28
2.3	BIM and Construction Documents .....	29
2.4	Net-Zero Recommendations .....	30
2.4.1	Addressing Customer Needs .....	31
2.4.2	Life Cycle Cost Savings .....	31
2.5	Final Recommendation .....	32
2.5.1	Lighting .....	32
2.5.2	Building Energy Management .....	32
2.5.3	Smart Building Design .....	33
3	Estimate, Schedule, and other Construction Considerations .....	33
3.1	Cost Estimate .....	33
3.2	Shop Drawings .....	35
3.3	Gantt Chart Schedule .....	36
4	Interaction with the NECA Community .....	39
4.1	NECA Trainings .....	39
4.2	Interactions with NECA contractors .....	39
5	Campus/Local Media Engagement .....	40
6	References .....	41
7	Appendix .....	50





# 1 Proposal Introduction

## Executive Summary

Northern Lights Solutions (NLS) is the team representing University of Toronto in the Electrical Contracting Innovation Challenge in 2021. The team has designed the electrical systems for a new 3-storey student residence hall that is being built in University of Toronto campus, located 1.1 in Toronto, Ontario.

The entire electrical system has been subdivided into three sub-systems: Lighting, Building Energy Management, and Smart Building Design.

- The Lighting system consists of 11 different fixtures of LED lights for the entire building. The lights located in public areas can be dimmed and timed due to the integration of KNX building automation systems, leading to up to 60% savings in lighting energy consumption.
- The Building Energy Management (BEM) sub-systems consists of renewable energy, electrical infrastructure, and control systems that contribute to the sustainability goals of the building. Notable BEM systems include
  - Rooftop solar panels has been proposed that will generate over 39 MWh electricity annually.
  - All-electric variant refrigerant flow (VRF) HVAC system for heating and cooling will contribute up to 30% energy savings compared to conventional HVAC systems.
- The Smart Building Design (SBD) sub-system consists of 16 innovative technologies addressing areas of security, access control, communication, hands-free control, and building automation systems, to provide residents with an enhanced occupant experience. Notable SBD systems include:
  - Smart card technology for accessing dorm rooms
  - IP addressed security systems
  - Wide coverage mesh router system for reliable internet connection.

Furthermore, NLS provides the client with the option to reach net-zero energy demand by installing additional solar panels on the ground and external building platforms at the extra cost of \$650,000 CAD.

The total project cost is approximately \$2.74 million CAD, which adheres to the project budget of \$2.8 million CAD (or \$2.3 million USD). The total life cycle impact cost for the entire electrical system is estimated to be \$2.65 million CAD, where annual maintenance costs is estimated to be approximately \$122,000 CAD. The proposal includes shop drawings depicting locations of fixtures, equipment and controls and a 3D model of the electrical system.

Throughout the ECIC, NLS has engaged with CECA and NECA contractors to enrich our understanding of electrical systems and the electrical contracting profession. The team has also reached out to the University of Toronto staff and community to gauge the needs of the students living in dorms and the operation and maintenance requirements.



### 1.1.1 NLS Mission Statement

Northern Lights Solutions (NLS) allows students the opportunity to engineer environmentally conscious building systems and infrastructure. It creates a space for like minded individuals to gain experience in leadership and teamwork. NLS will continue to provide students with the tools they need to develop their professional skills in the electrical contracting industry.

### 1.1.2 NLS Team

Our Team is made up of many members who all played a specific role to help us complete the ECIC Design Challenge. The first group is our executive team who deal with general logistics and team management. Next are our team leads who are in charge of the technical design and analysis for the proposal. Finally, our general members contribute to the technical design and supporting work. As shown in Figure 1.1 below.

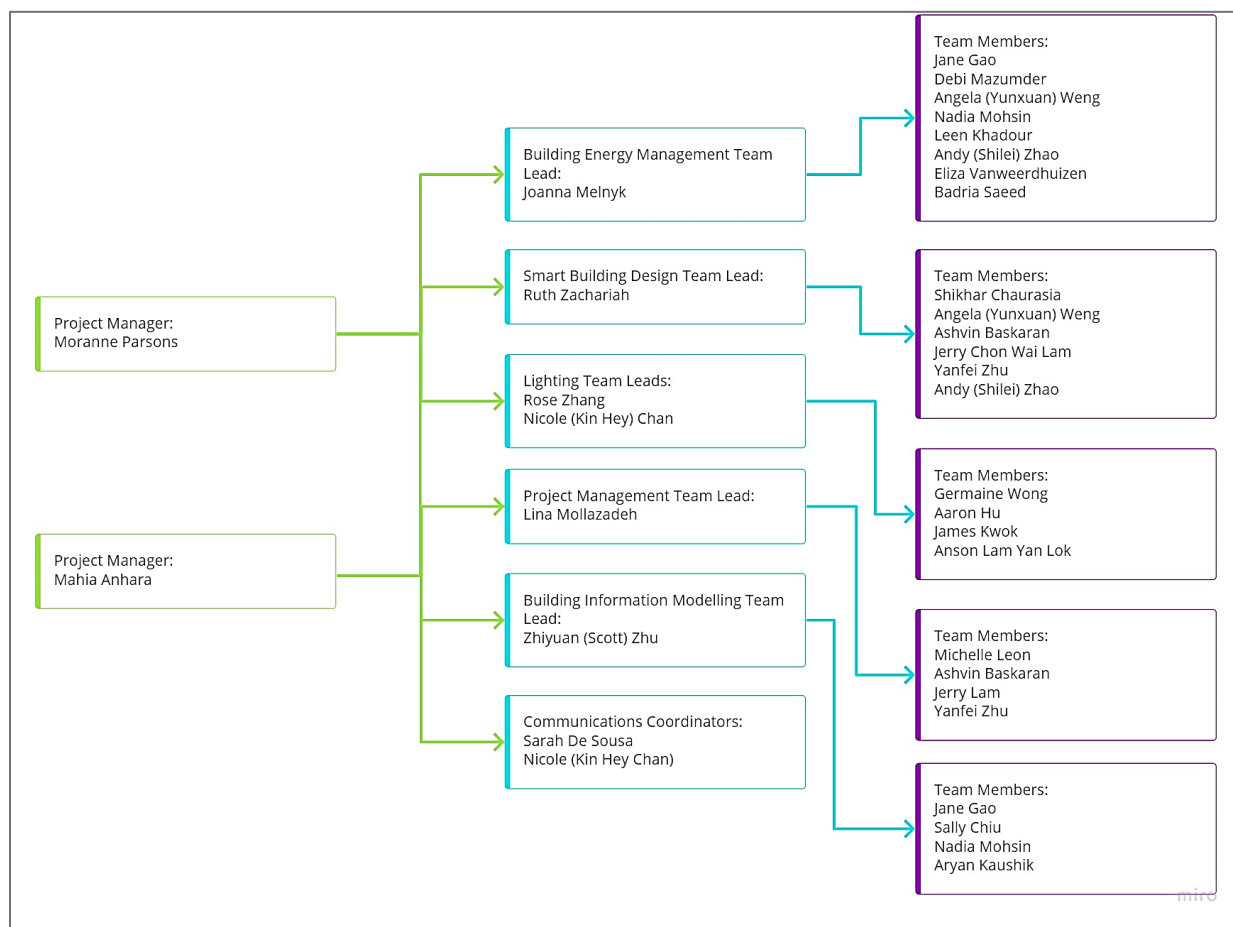


Figure 1.1: NLS Team Structure

### Interaction with the Community

A summary of all interactions with NECA contractors and chapter representatives and with university employees, staff and students can be found in Appendix A, pg 50. Appendix A also contains an Occupant Survey that we conducted to determine the needs of the student residents. NECA interactions can also be found in Section 4.2.



## Team Resumes



### Sarah De Sousa

#### Communications Coordinator

sarah.desousa@mail.utoronto.ca

#### University of Toronto

Bachelor of Applied Science in Civil Engineering

Expected Graduation: July 2022

#### Leadership

**Sustainability and Environmental Justice Project Lead**  
Aug 2020 - Ongoing  
*Engineers Without Borders*

**Student Chapter President**  
July 2020 - Ongoing  
*Canadian Electrical Contractors Association*

#### Experience

**Transit Technology and Data Analyst, IBI Group** Aug 2020-Ongoing

- Support the planning and procurement of intelligent transportation systems by transit agencies.
- Review and manage static and real-time transit feeds and open-source trip planning applications.

**Project Management Intern, WSP Canada** May-Aug 2019

- Reviewed and updated submission documents to ensure they complied with design standards.
- Corresponded with project members to ensure that 95%+ of project targets were met on their submission date.



### Joanna Melnyk

#### Building Energy Management Lead

joanna.melnyk@mail.utoronto.ca

#### University of Toronto

Bachelor of Applied Science in Civil Engineering

Expected Graduation: July 2022

#### Leadership

**Sustainability and Environmental Justice Project Lead**  
Aug 2020 - Ongoing  
*Engineers Without Borders*

**Editor-In-Chief**  
May 2019 - April 2020  
*University Of Toronto, Toike Oike Publication*

#### Experience

**Energy Systems Analyst, METSCO Energy Solutions Inc.** May 2020-Ongoing

- Prepare investment business cases, asset management plans, and strategies for clients in the electrical utilities industry.
- Perform data analytics on electrical utility asset data.
- Prepare project proposal reports in response to Requests for Proposals, as well as other engineering and executive reports.

**Environmental Engineering Researcher, University of Toronto** May-Aug 2019

- Conducted research regarding the water security in megacities worldwide, and how environmental and social factors impact it.
- Also conducted research regarding the social, environmental, and economic impacts of several alternative fuels in the Canadian trucking industry.



## Kin Hey Chan

Lighting Lead

kinhey.chan@mail.utoronto.ca

University of Toronto

Bachelor of Applied Science in Civil Engineering

Expected Graduation: July 2024

### Leadership

**Indigenous**

**Reconciliation**

**Integration Lead**

Aug 2020 - Ongoing

*Engineers Without*

*Borders*

**Civ Club Mentor**

July 2020 - Ongoing

*University of Toronto*

*Civ Club*

### Experience

**BIM Intern, *New World China***

June-Aug 2019

- Help create weekly schedule and assist external communications.
- Learn applications of BIM and visit construction sites.

**Community Engagement Lead, *CECA UofT***

Jan-May 2020

- Make community learning lessons related to sustainability.
- Work with other subteams to create an energy retrofit proposal in a local school.



## Ruth Zachariah

Smart Building Design Lead

Ruth.zachariah@mail.utoronto.ca

University of Toronto

Bachelor of Applied Science in Civil Engineering

Expected Graduation: July 2022

### Leadership

**Journalist**

September 2020 –

April 2021

*University of Toronto*

*Hyperloop Team*

**Vice Chair**

September 2019 - April

2020

*Civil Engineering*

*Discipline Club*

### Experience

**Co-op Project Coordinator, *Modern Niagara***

August 2020 - Ongoing

- Prepare close-out documentation on commissioning of HVAC and Lighting systems required for occupancy
- Track deficiencies on outstanding works and issue weekly reports to General Contractor

**Content Specialist, *Da Vinci Engineering Enrichment Program*** April-August 2019

- Developed course content for students from Grade 9-12, over four weeks, in specialisations within Civil Engineering
- Collaborated with Ph.D. student instructors to facilitate the delivery of lectures and materials, and improve student engagement



**Zhiyuan Zhu**  
**Building Information Modelling Lead**

scott.zhu@mail.utoronto.ca  
**University of Toronto**  
Bachelor of Arts in Architectural Studies  
Expected Graduation: July 2022

**Leadership**

**Director of Operations**  
October 2019-Ongoing  
*Applied Architecture Landscape and Design*

**Faculty Ambassador**  
February 2020  
*Daniels – Saturday Program*

**Experience**

- Seasonal Instructor, AALD**    October 2019-Ongoing
- Devised and taught lectures on key AutoCAD and Rhino commands to up to 40 students.
  - Organized campaigns and workshops on 3D modelling and digital editing software, primarily from Autodesk and Adobe Suite.
- Designer, Demo Organic Model For Urban Sustainability**    May-August 2019
- Designed a recycled organic garden installed within the faculty compound to raise awareness to the urban pollution crisis.
  - Researched various prospects to integrate recycled materials within building structures.



**Lina Mollazadeh**  
**Project Management Lead**

Lina.mollazadeh@mail.utoronto.ca  
**University of Toronto**  
Bachelor of Applied Science in Civil Engineering  
Expected Graduation: July 2024

**Leadership**

**Commuter Program Director**  
May 2021 - Ongoing  
*University of Toronto Engineering Society*

**Mentorship Director**  
Sep 2020 - May 2021  
*Hi-Skule Engineering Outreach*

**Experience**

- Academic Mentor, University of Toronto Engineering Outreach**    June-Aug 2020
- Delivered 4 hours of virtual tutorials per week for 30 first year engineering students on core grade 12 mathematics concepts and engineering application.
  - Held weekly office hours to answer questions and provided feedback on weekly problem sets.
- Project Coordinator, Engineering Strategies and Practices II**    January-April 2019
- Designed a new waste management system to increase residential waste diversion rates by 20 percent between recyclable waste and garbage in an apartment.
  - Created AutoCAD engineering drawings of the positioning of two internal trash chutes as a new building waste management system and 3D design drawings of the chute on SketchUp.





## 2 Technical Analysis and Design Scope of the Electrical System

The new University of Toronto residence hall will house 164 students. It has three floors that accommodate dorms with a total of 15,531 GSF. NLS is proposing an innovative electrical system designed to meet the needs of the students. While designing the electrical system NLS considered the lighting needs, security needs, accessibility and other electrical requirements for students. The proposal includes a net-zero recommendation, this was a challenging design due to the heating and cooling loads experienced in Toronto with a temperatures that range from -5 °C to 25 °C. It is important to note that all costs and budgetary considerations have been calculated in Canadian dollars (\$CAD) to reflect construction in Toronto.

### Technical Design

This section outlines the evaluation of the systems proposed for the electrical design of the residence hall. The entire electrical system has been subdivided into three sub-systems: Lighting, 2.1 Building Energy Management, and Smart Building Design.

#### 2.1.1 Lighting

This sub-system encompasses the design of the lighting system for the residential hall, including lighting fixtures, controls, electrical components, and a lighting-dedicated automation system. The following section will detail the design process and the benefits of chosen components in terms of cost and energy reduction. The final recommended design is presented in Section 2.5 below.

##### 2.1.1.1 Lighting design

The entire residential hall is grouped into rooms with similar features and each room type is designed with fixtures that satisfy the lux requirements from the IESNA standard [1]. The list of room breakdowns and their respective lux requirement is listed in Appendix B, page 61. All lighting circuits are equipped with Protective Earth (PE) lines to facilitate the grounding of Class I lamps. The different circuits shall not be co-laid, and the Neutral (N) and PE lines of different circuits shall not be shared and should be separately led out from the terminal row of the distribution panel.

Fixtures are chosen based on the different purpose these rooms serve. A total of 11 fixtures were selected, all of which are LED lights because of their lower energy demand during operation in comparison to other light bulbs. More details are provided in the Lighting Specifications document in Appendix J, pg 108. The quantity of these fixtures was estimated using an online lighting analysis; Visual Interior Tool [2]. For each room type, a three-dimensional model is inputted, and basic parameters are set. The required lux level is inputted as the restrain parameter and the analysis tool returns the number of fixtures required for that room, as exemplified in Figure 2.1. The lighting layout plan was then generated and is presented in Section 2.3 below; the final quantity of each light is compiled in Appendix B, page 62.



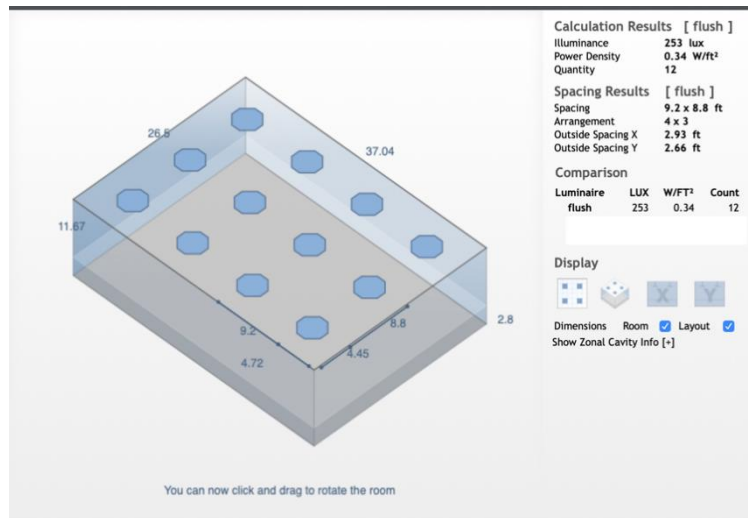


Figure 2.1: Online Lighting Analysis Tool Example – Front Lobby Flush Mounted Light Quantity Estimate [2]

The lighting system also includes emergency, evacuation and backup lighting based on the OHSA guidelines. All light fixtures are connected to the Konnex (KNX) system, which is an automation system that controls the lighting based on sensors or timers. More details are presented in Section 2.1.1.2. The emergency lights are to have an additional connection that overruns the KNX actuator if the system is down to keep the lights operational without interruption. Emergency signs are placed at staircases and along hallways, and additional emergency lights are placed at the exits of public rooms (kitchen, common room, laundry room, and study rooms). The power supply for these lights is provided by the uninterruptible power supply and have built-in batteries that supply power for no less than 90 minutes according to OHSA [3]. Other emergency lights are the hallway lights, which will be connected to the emergency lighting panel in the basement, that is connected to an onsite generator to continue supplying power when there is a power outage. The purpose of the backup lighting is to ensure that, when an accident happens, the fire control room, self-generated power supply room, transformer room, water pump room, mechanical room, and data room can still function without the interruption of proper lighting. These backup and emergency lights will be connected to the generator onsite.

Based on the lighting size, control components for lighting on each floor, as well as consulting with electrical contractors the team selected three 200A panels for floor 1 to 3, one 100 A panel for the basement and one 50A sub-panel for emergency lighting (Appendix J, pg 108). The panel in use is the Powerlink MVP with the following features [4]:

- NEMA 1, 277 V,
- Ethernet communications using BACnet/IP protocols
- 64 communication inputs available for network connection
- 4000 sq. inches (L78xW51)
- Under Electrical Installation Code NEC 110.10

### 2.1.1.2 Use of innovative technologies & Systems controls

The team recommends the KNX system for lighting automation control in the residential hall, which strictly follows the ISO 14543 standard [5]. This allows individual components such as the KNX power supply unit, line couplers, sensors, controllers, and actuators to effectively communicate with each other regardless of its manufacturer. The KNX system is built upon small groups of line couplers, each connecting to its power system, actuators, and up to 64 devices [5]. Each of the couplers transmits and receives commands to and from the main workstation [5]. The purpose of adopting this system solely for lighting control is to lower the workload of the main BAS system. This can enhance the overall performance of the system. The BAS and KNX will communicate based on the 24 Port Switch and the BACnet IP that connect both workstations together. The BAS design will be presented in the sections below.



Figure 2.2: KNX Lighting System Component [6]

The system can effectively reduce energy consumption. The proposed system mainly utilizes two types of sensors: brightness and occupancy sensors. They operate under the 1-10V Digital Addressable Lighting Interface (DALI) circuit [7] which offers high dimming precision with the use of only one driver. Brightness sensors can detect the real-time brightness level of the room and adjust the lighting intensity in the room. They will be placed in public areas such as hallways and lobbies to reduce power consumption based on the amount of natural sunlight received.

Moreover, occupancy sensors can detect the number of occupants in a room using infrared (IR) rays, allowing the system to switch on the lights when someone walks into the room and switch off when no one is present for 10 minutes. They will be placed in study rooms, laundry rooms, kitchens, and single and double bedrooms. This is to ensure that no energy is wasted on lights in rooms with no occupants. According to a report from the KNX Association, the KNX system helped schools and office buildings reduce up to 60% of their lighting energy consumption [8]. Using a similar setup, we expect the proposed system in the residential hall to yield a similar result. This system will not only reduce energy usage in the long run but can also improve the quality of life of the residents of the hall.



### *2.1.1.3 Scheduled lighting features for user experience*

The brightness of the lights in the common rooms, study rooms, hallways, laundry rooms and kitchens will be automatically adjusted depending on the time of day. With the use of built-in timer settings, these lights will operate at 50% capacity from sunrise to sunset, which is generally 6:30 a.m. and 6:30 p.m. respectively on average [9] [10]. The actual sunrise and sunset time vary year-round but this time will be assumed as constant for this timer setup. Natural sunlight is the most abundant at this time of the day, so indoor lighting can be kept at a normal level. The sky gets dark from 6:30 p.m. to 12 p.m., so more lighting is preferred. The specified lights will therefore operate at 100% capacity at this time [10]. Finally, from 12:00 p.m. to 6:30 a.m., until the sun rises again, lights will be at 50% capacity for energy-saving purposes [10]. This scheduled timing will be constant for better user experience and energy saving; students will not be able to make changes as these are lighting operation for public areas.

### *2.1.1.4 Overall life cycle impact cost considerations*

Accounting for Operation and Maintenance (O&M) costs and a 30-year life span for the lighting system, the reduced total life cycle cost is \$657,700 (Appendix B, page 64). This was calculated under the assumption that light fixtures will not have any residual value and half of the cost is a result of the annual O&M costs. Operation hours and power intensity are reduced by the automated system. The system is equipped with timer and dimmer adjustments as detailed in Section 2.1.1.3. For LED lights, wattage is proportional to the percentage of dimming [12], thus the lights in the building's corridors and non-dorm rooms will operate using less energy throughout the day.

Public areas will have lights operating for 24 hours a day and dorm rooms lights are assumed to operate for 6 hours per day [12]. The dorm lights have dimmer switches as well, but it is difficult to estimate the variability of dimming level different occupants use, so these energy savings were not accounted for in the operating cost. Using a tiered electricity cost of 11.8 cents/kWh CAD based on Toronto Hydro [13], an estimated annual operating cost with the KNX system is \$6,500 CAD. In contrast, with no automation and dimming system installed, an additional \$2,300 CAD would be spent by the customer annually. The detailed calculations can be found in Appendix B, page 62. These cost estimates are very conservative; additional savings can be granted if occupancy sensors and dorm room dimmer switches are used effectively.

With regard to annual maintenance, there is no maintenance for the lighting system when KNX is implemented [14]. The potential maintenance will only involve annual checks for system operation. An additional benefit of dimmable bulbs is that they will prolong the operating lifetime of the bulbs [11], reducing the number of replacements, the cost of new bulbs and corresponding labour costs over the building's lifetime. The LED fixtures last, on average, 50,000 hours [15]. The estimated annual maintenance cost is \$5,900 and the total labour cost would be \$7,300.



## 2.1.2 Building Energy Management

The Building Energy Management (BEM) sub-system design consists of renewable solar generation, electrical infrastructure and control systems, and an electric HVAC system. The following sections outline the technical design of these systems, and further BEM recommendations regarding a net-zero facility are outlined in Section 2.4.

### 2.1.2.1 Solar Generation

The new University of Toronto Residence hall will be located in an empty plot of land on Bloor St. W and Sussex Mews (see Figure 2.3) and will include a solar photovoltaic (PV) system. Sized at approximately 49,713 square feet, this plot will be able to comfortably house the proposed 42,160 square foot residence. Due to the surrounding city life and the expectation of human activity surrounding the building, it was decided that the ground floor is not suitable for PV installation. A grid-tied system is recommended for the residence building, as it was determined that the power generated by the proposed PV system will not be sufficient on its own to meet the building's expected annual energy needs [16]. Additionally, the building code does not allow for ground-located systems, and the proposed system is net-metered.

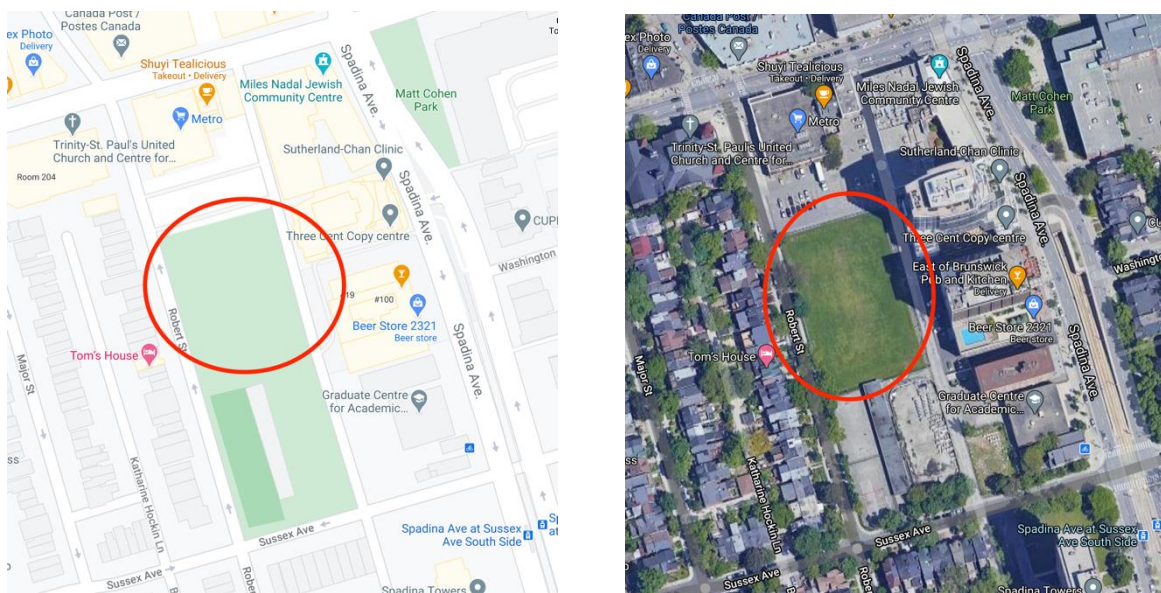


Figure 2.3 : Plan view of proposed site location in map and satellite view [17]

### Solar Panel Selection & Layout

As shown in Figure 2.3, the residence will be surrounded by tall, commercial complexes, predominantly on its northeast side, which will cast shadows on the residence's smaller northeast roof. The residence's roofs, dormers, and gables are oriented in four different directions: northwest, northeast, southwest, and southeast; however, it is recommended that the PV panels are exclusively mounted on the southeast and southwest roofs to maximize solar output and minimize shading from the northeast buildings [18]. The solar panels on the building would thus be strategically placed such that shading from nearby buildings and the building's adjacent roofs itself are minimized, as shown in Figure 2.4.



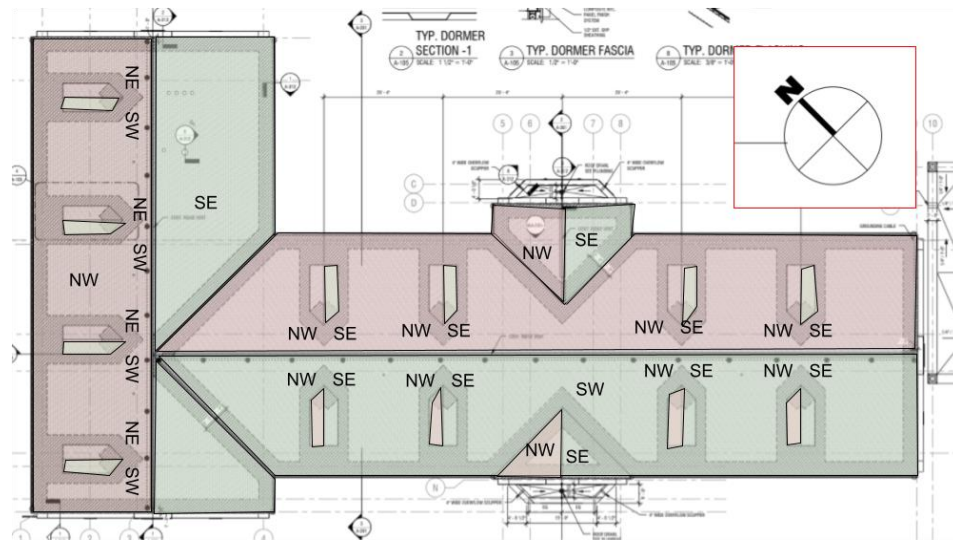


Figure 2.4: Architectural roof plan illustrating viable roof space for solar panel installation [19]

The rooftop solar panel layout will include Peimar 315W Mono solar panels on the southwest and southeast roof areas and RNG-160DB-H 175W solar panels on the dormers (see Appendix K, pg 141). The number of panels is 117, producing 39MWh of energy per year, as shown in Table 2.1.

Table 2.1: Solar panel layout count and energy production

Roof Location	Panel Model	Panel Count	Annual Energy Production (kWh)
Southwest	Peimar 315W Mono	45	16,528
Southeast	Peimar 315W Mono	48	17,630
Dormers	RNG-160DB-H	24	4,897
<b>Total</b>		<b>117</b>	<b>39,055</b>

Solar panels generate the maximum amount of energy when directly perpendicular to the Sun. Given that Toronto is located in the northern hemisphere, it is ideal for the panels to face South. The specific optimal tilt angle will vary given the time of year as the Earth’s rotation changes during the seasons. It was thus a priority to maintain an intermediary panel angle to maximize solar generation year-round. It was determined that the optimal tilt is 68.3° in the Winter and 15.8° in the Summer [20]. Due to the high snowfall Toronto experiences in the Winter, another consideration in determining a tilt angle is ensuring that snow and other precipitation will easily be able to shed off the panels; maintaining a steeper pitch, between 35° to 40°, allows the solar panels to remain clear during heavy snowfall [21]. It is proposed that the PV system remains parallel to the building’s roof, at a 34° tilt, to reach a compromise between the Summer and Winter optimal tilts, minimize maintenance after snowfall, and abide by the Government of Canada’s Solar Ready Guidelines, which recommend a tilt between 23° to 53° [22].

#### Accessory Rooftop Solar Components

The proposed rooftop solar system comprises of the following accessory components: inverters, a combiner box, and a railed racking system.

Inverters are used to convert DC power from the solar array to AC power for appliances and grid-tying. A microinverter system is utilized comprising of Enphase IQ 7 model inverters (see Appendix K, pg 141). Microinverters are recommended as opposed to string inverters due to the



possibility of partial shading on the solar array by surrounding buildings and other slanted roof sections. When in partial shade, microinverters allow for increased solar yield, because only the panels in partial shade will output less power, rather than all panels connected in series, as with a string inverter system [23]. The microinverters have an efficiency of 97%. One microinverter is to be attached to each solar panel in the array for a total of 117 units.

The combiner box is used to connect the solar panels and to connect the output flow in series. The PV system consists of 3 arrays; to meet these requirements, the Enphase IQ-Combiner-3C combiner box was selected.

For the solar PV racking system, a railed slanted roof system was selected. This is because railed racking systems are compatible with sloped roofs, such as on the dorm building [24]. Slanted roofs lead to less flexibility in the choice of racking systems, because ballasted, non-invasive (rail-less) racking systems are not compatible. The recommended system is the KB Racking Rezi Rack 2.0, which has a relatively simple installation, despite its railed characteristic.

### 2.1.2.2 *Electrical Infrastructure and Controls*

The electrical infrastructure and controls portion of the BEM system comprises all wiring connections, breaker panels, and control sensors throughout the building. The following sections outline each part of the electrical infrastructure and controls design.

#### Breaker Panel Sizing

To determine the size of the breaker panel required for each floor, the team first estimated the load demand for each floor. The power loading for all appliances present in the different room types were determined using online resources (page 65 Appendix C, ) [25]. The total power demand of each room was then calculated. The power demand for each floor was then the sum of the demands for each room present on the floor (page 65 Appendix C, ). The rating was converted to Amps by dividing the power demand by 120V (Canadian voltage rating), and thus the current rating required for each floor was calculated ( Appendix C, ). For the three main floors of the building, the user appliance current rating requirements were between 999A and 1065A; considering a 10-20% safety factor, a 1200A breaker panel was selected for each floor [26]. However, 1200A breaker panels are typically rated at 480V, which is not compatible with the 120V receptacle ratings, and thus it was decided to use three 400A breaker panels per floor, rated at 120/208V.

In accordance with the National Electrical code, the placement of the breaker panels in the building is to be where there is little chance of the breaker getting in contact with a wet/damp environment or ignitable material [27]. With this in mind, the locations that consistently meet the requirements of the NEC standards on each floor are the laundry room, the study room, the trash disposal room, the storage room, and the office. The laundry room, storage room, and office were selected for the panel locations on each floor, as shown in Figure 2.5, because they are the most accessible and least-frequently occupied. Each panel on a given floor is designed to serve approximately one-third of the floor's electrical supply.



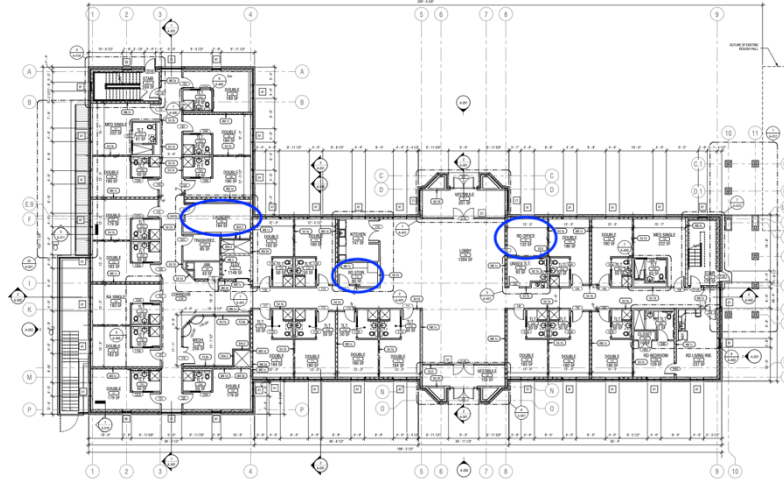


Figure 2.5: Panel location on first floor

### Electrical Control Systems

The control system utilized in the BEM system is for room temperature control and solar production monitoring. For temperature control, wireless temperature sensors were selected for ease of installation and maintenance in comparison to wired temperature sensors. Ten temperature sensors are located on each main floor. The recommended model of sensor is the Honeywell FBA C7189R1004 Wireless Indoor Sensor, because of its relatively low cost and compatibility with the Building Automation System (BAS) which utilizes Honeywell devices. For the purpose of monitoring the energy production from the rooftop solar PV system as well as the energy use from the facility, the Sense Solar model of energy monitor was selected. This is due to its compatibility with both solar production and general building energy use. Additionally, the Sense Solar provides real-time data for historical and current solar production, production-versus-usage data, and grid-usage calculations [28].

### Accessory Electrical Infrastructure Components

Table 2.2 shows a summary of all component models and counts included in the electrical infrastructure portion of the BEM system.



Table 2.2: Electrical infrastructure components

Component	Model	Count
Wireless Temperature Sensors	Honeywell FBA C7189R1004 Wireless Indoor Sensor	30
Energy Sensors	Sense Solar	94
Circuit Breaker	Circuit Breaker, 1 Pole, 20A, TEY, 277V	94
Breaker Panel	P2C42MLO400ABS, 400 MLO P2 Panel board by Siemens	9
Step-Down Transformer	15 kVA Isolation Transformer, Single Phase, 208V to 110V	3
Automatic Transfer Switch	Southwire 41390 90A Hardwire Automatic Transfer Switch	1
Receptacles	Tamper Resistant Duplex Receptacle	549
Wiring	Copper wiring	4,751 ft
Emergency Generator	WEN 56200i 2000W Inverter Generator, CARB Compliant	1

The emergency generator serves the function of powering emergency lights in the event of a power-outage. Additionally, if an outage occurs during daylight hours, then some building energy can also be provided by the solar generation system.

### 2.1.2.3 HVAC System

A Variant Refrigerant Flow (VRF) heat recovery system is recommended for the building’s HVAC system. This system can provide simultaneous cooling and heating, so one building zone can be in cooling mode while another is in heating. This can largely enhance user experience because residents are able to control the condition of their own room, which is not possible with a regular VRF heat pump system or the traditional ducted heating system [29]. This feature responds to the customer’s need of being able to adjust room temperature, as stated in the Occupant Survey. Additionally, this allows for easy change-over between the heating and cooling seasons in Toronto, which are especially volatile during Fall and Spring. The volatility of the weather during changing seasons is also expected to increase with climate change, and so this system supports climate resiliency of the residence. The VRF system is also all-electric, which contributes to energy sustainability and carbon-reduction goals, by eliminating natural gas dependency of the heating system. The system is extremely energy efficient as it provides heat recovery from one area to another, transferring unwanted heat to areas that require additional warmth. This can save up to 30% of energy over conventional systems, optimizing the energy usage for large areas such as the common room of the residential building [30].

The system is controlled by and connected to four main components, including the outdoor unit, indoor units, branch selector box and the piping system. The outdoor unit is the largest component, which will be installed on the external side-wall platform, and each condensing section would be required to be located as close as possible to the indoor units it serves.

The VRF system also offers the flexibility of choosing different indoor units to match the unique energy demand and aesthetic requirement of the individual rooms. Zoning plans for the three floors of the residence were developed; the first floor zoning is shown in Figure 2.6, below (see Appendix C, page 67 for other floors zoning plans).

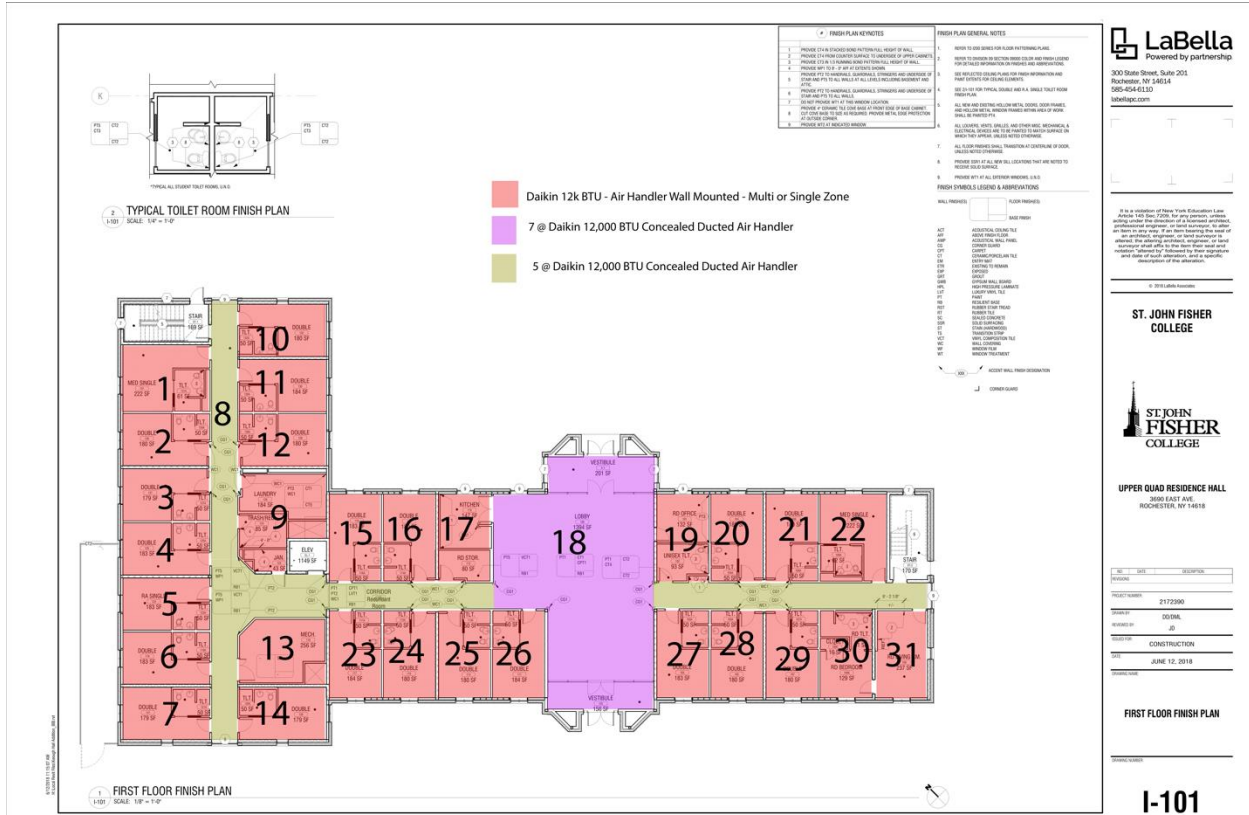


Figure 2.6: First Floor VRF Zones

We propose to install a Daikin 12k BTU/hr Wall Mounted Air Handler for each individual room and several Daikin 12k BTU/hr Concealed Ducted Air Handler units for the hallways and large common rooms. The VRF selector box is a component that controls the flow of refrigerant to individual Fan Coil Units (FCU), generally called indoor units, which can then provide heating and cooling to multiple different zones in the building. The use of the single-port branch selector box is recommended for the purpose of reducing cost and installation efforts. A single-port branch selector box would be supplied to each individual room’s units and to multiple units cooling and heating the same common rooms.

Several components of value engineering can be highlighted in the use of a VRF heat recovery system. First, the maintenance requirements for the system are relatively simple, consisting of filter changes and coil cleaning, which results in a low Total Cost of Ownership (TCO). The relatively low installation costs and energy efficiency also contribute to the low TCO [31] [32]. Additionally, the isolation of each of the indoor units from one another allow for any failures to be localized and to have no effect on the rest of the system [31] [32]. Finally, the system allows for user customizability, which is a very valuable function in a building with several people all with different needs.

2.1.2.4 Overall life cycle impact cost considerations

Accounting for O&M costs and a 30-year life span for the BEM system components, the total life cycle cost is approximately \$1,225,000 (see Appendix C, page 69). This cost is comprised of approximately \$300,000 capital cost and \$80,000 annual O&M cost. This assumes that no components will have a salvage value; this assumption is justified because it is difficult to



estimate how much value can be acquired for scrap BEM components, and so assuming a zero-salvage value presents the worst-case scenario. The O&M costs are comprised of maintenance costs equating to approximately 10% of the initial capital cost, and operation costs equating to the cost of energy use. For energy use costs, the total estimated usage is estimated at 434,549 kWh/year, using a tiered electricity cost of 11.8 cents/kWh [13]. Detailed calculations for the annual energy use estimation can be found in Appendix C, page 69. The LCC is reduced in comparison to conventional building designs due to cost savings from solar energy production, and energy efficiency from the electrical control systems and VRF HVAC infrastructure.

### 2.1.3 Smart Building Design

The Smart Building Design (SBD) team seeks to provide control systems and technologies that enhance the security levels for the UofT campus residence. Each SBD system, outlined in Table 2.3, as scored, and weighted from 1 (lowest) to 5 (highest) based on the effectiveness of the system in meeting the students’ needs. Security systems and access controls were ranked as the two most important systems. Based on the team’s vision of providing a safe and secure environment for the students and entire residence, we chose security systems as the first item of discussion for SBD.

Based on the UofT occupant survey results, the following needs were identified as critical for improving the dorm living experience. For scoping purposes, each SBD system will address the respective needs with a focus on security, enhanced user experience and sustainability.

Table 2.3: Addressing UofT Students' Needs with Relevant SBD Systems

System	Need(s) to Address
<b>Security System</b>	<ul style="list-style-type: none"> <li>Secure dorm residence from unwanted persons entering the building</li> <li>Communicate critical information for immediate and efficient evacuation</li> </ul>
<b>Access Controls</b>	<ul style="list-style-type: none"> <li>Limit access to individual dorms for privacy, safety, and security of belongings</li> <li>Manage access levels depending on space type and user</li> </ul>
<b>Communication Systems</b>	<ul style="list-style-type: none"> <li>Provide productive, engaging, and interactive residence communities</li> <li>Provide stable WiFi connection for online classes, studying, and exams</li> </ul>
<b>Hands-free controls</b>	<ul style="list-style-type: none"> <li>Ease of access to common areas for hassle-free, efficient, and post-Covid dorm living</li> </ul>
<b>Building Automation System (BAS)</b>	<ul style="list-style-type: none"> <li>Create a robust platform for connecting, controlling, and maintaining the performance of all control systems in the residence</li> </ul>



### 2.1.3.1 Security System

#### Security Cameras

In a residence building, providing security to the residents and their belongings is essential. Security systems allow for a safe environment in which the occupants can reside while protecting them against intruders, thieves, etc. Their main objective is to alert the resident or security personnel in the time of an event such as a burglary, a fire, or any other incident.

A surveillance camera is typically used to monitor an area of a building and alert the security in the event of an incident. They are typically in two forms: Internet Protocol (IP) Camera or Closed-Circuit Television (CCTV) camera. IP cameras are recommended because they require no local recording device, but rather the support of a Local Area Network (LAN) [33]. Most IP cameras connect over the WiFi/Ethernet connection, but may be susceptible to cyber-attacks if not protected adequately. They send live images using transmission protocols such as FTP and HTTP. Furthermore, Power over Ethernet (PoE) IP cameras eliminates the need of separate power supply and associated wiring.

To always maintain secure footage, the Honeywell HDZP252DI 25x Zoom IR WDR PTZ IP Camera is the recommended system (see Appendix L, pg 167, “IP Camera”). This camera eliminates the need for a separate motion detector system, because it automatically detects and responds to events such as motion, alarm inputs, network failures and camera tampering. In terms of image quality, it provides a full 1080p image resolution, with 50-60 frames per second. It has a 4.8–120 mm, F1.6-F4.4, 25x optical zoom lens with 360° continuous rotation for the flexibility to clearly view the target area with desired width and depth. It sends automated responses to the security, such as notifications via email, FTP or HTTP (see Appendix D, page 71). To prevent cyber-attacks, the IP camera has specific security protocols such as “IP Filters”, “802.1x authentication” and “hardware security chipset protection.” It can also store a video recording of a given event in its portable micro SDHC card. As UofT has an Enterprise Building Integrator (EBI) server for monitoring security systems, it charges a fee based on the additional points regarding licensing, server usage and memory of the HD252DPI IP camera. Hence, the cost of the card is excluded from design.

#### Glass Break Detector

In addition to the IP Camera system, another system that will strengthen the security measures within a residence building is a glass break detector. It is a sensor that triggers an alarm when the glass pane of a window is broken. For such detection, either acoustic sensors or shock sensors are utilized. The advantage of the former over the latter is more accuracy and fewer false alarms. Acoustic sensors include a microphone, which triggers an alarm when a sound frequency of glass breaking is attained.

The recommended system for the glass break detector is the Honeywell Ademco 5853 Wireless Glass Break Detector (see Appendix L, pg 167, “Glass Break Detector”). It has a FlexCore signal processor, which utilizes an Application Specific Integrated Circuit (ASIC). This circuit processes sound data in a parallel manner rather than sequentially, thereby making the processing of amplitude and frequency much faster than its counterparts. It can detect broken pieces of glass from up to 7.6 metres in range.



## Fire Alarm System

A fire alarm system is used to send alerts during emergencies and to enable all stakeholders to take the necessary action to protect themselves. In contrast to conventional fire alarm systems, addressable fire alarm systems consist of a two-loop connection to each component [34]. This allows the IP address to be easily traced for determining the exact location of the detected alarm. The Notifier Fire Alarm system, NFS2-640 has been chosen given its applications in dormitories and campus building settings such as Towson University, Towson, USA (see Appendix L, pg 167, “NFS2-640 Fire Alarm System” and “Notifier Product Line”) [35]. NFS2-640 can be safely installed in Canada due to its compliance with NFPA 72 Style 4 or 7 operation, and the Underwriters Laboratories, Inc.

Based on Figure 2.7, the design includes a control panel, multi-criteria detectors, manual call points, isolation modules, and horn strobes that have to be hard-wired as per the Ontario Fire Code [36].

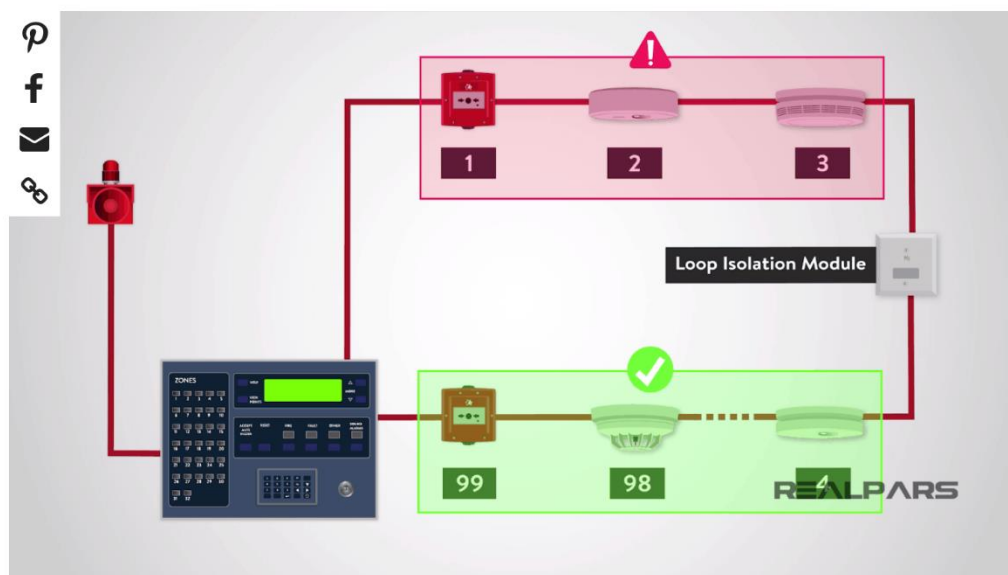


Figure 2.7: Installation Set-Up of Addressable Fire Alarms [34]

See Data Sheets, “Pull Station”, “NFS2-640 Fire Alarm System”, “Horn Strobes”, “FSP-851(A) Series”, “ISO(X)” for Fire Alarm system components.

The NFS2-640 is a robust and durable fire alarm system. Two isolation modules are placed per fire zone (i.e., per floor) (see Appendix L, pg 167, “ISO(X)”). In the event of a short circuit, the isolation module causes part of the loop to be sectioned off while the rest of the system remains functional [33]. NFS2-640 can power and communicate with 159 intelligent detectors (ionization, photoelectric, multi-criteria, thermal, laser, fire/CO), and 159 intelligent modules (monitor, control, relay, releasing) for a loop capacity of 318 devices (see Appendix L, pg 167, “Notifier Product Line” and “Intelligent Bases”). In addition, using Class A, 2-hour fire rated, metal clad wires, circuit integrity can be maintained, thereby reducing costs [38].

To further lower costs, NFS2-640 components come with multiple functions (see Appendix D, page 71). The most interesting component is the ONYX multi-criteria detector; it has the ability to detect carbon monoxide (CO), heat and smoke. This is more cost effective than purchasing





standalone detectors. Detectors are ceiling mounted per Code, providing 360° visibility and wider notification range. Each detector comes with a built-in 85 dB minimum local sounder rating; multiple tones exist based on programming for different fire situations (see Appendix L, pg 167, “FSP-851-A”). For example, Temp-4 tone detects CO, whereas a Temp-3 tone detects fire. One of the most valuable components of the ONYX multi-criteria detectors is its ability for cooperative sensing. This means that detectors can consider readings from nearby sensors to make alarm or pre-alarm decisions. This prevents false alarms because it causes the concerned sensor to increase its sensitivity to actual smoke by a factor of almost two to one (see Appendix L, pg 167, “NFS2-640 Fire Alarm System”).

The NFS2-640 uses BACnet/IP communication protocol to connect to the Building Automation System, making it easier to access information on the status of the system. Critical information such as notifying fire fighters can be directly synced when a confirmed fire alarm has been triggered. Thus, this makes the NFS2-640 a proactive, and responsive fire alarm system [38].

### 2.1.3.2 Access Control System

The purpose of access control is to grant entrance to a building or office only to those who are authorized to be there. It restricts access to secured areas (i.e., mechanical rooms, data rooms, interior/exterior entry doors), and allows for monitoring and managing access. Access control systems consist of several components that are user facing (i.e., credentials, readers), admin facing (i.e., management dashboard/software), and infrastructure facing (control panel, electronic locks, cables).

Electronic Locks (see Appendix D, page 72)

Electric Strikes / Electronic Latches (Single Door): Camden CX-ED1079DL ‘Universal’ grade 1 ANSI strike with selectable 12/24V AC/DC and fail safe/fail secure operation with latch monitoring [39] adds flexibility to the system in regard to potential modification in various security levels for different areas.

Magnetic Locks (Double Door): Camden CX-92S-12TDS 1,200 lbs. surface mount double door magnetic lock comes with an adjustable timer, door status switch, lock sensor/relay & LED at a reasonable cost. Double doors are installed mainly in technical rooms as well as the building entrances, making them most suitable to install magnetic locks.

As shown in Figure 2.8, the general set-up of the electric strikes and magnetic locks is simple and networked with the BAS.

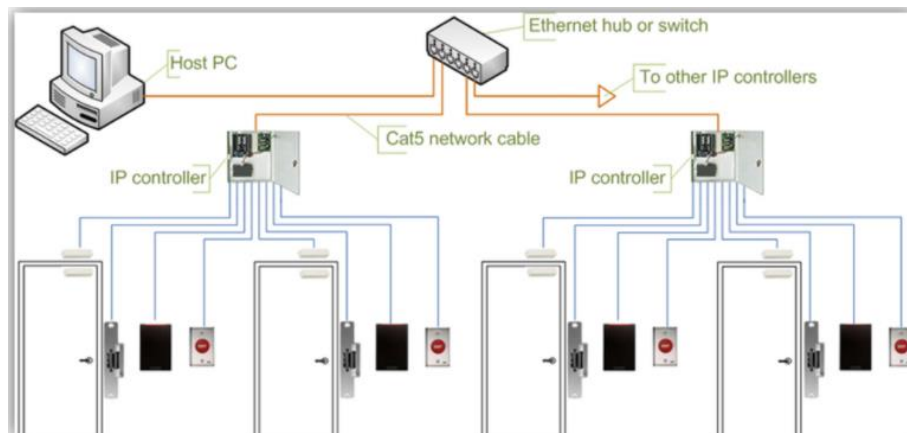


Figure 2.8: Set-up of Access Controls on Door Frames



### Management Dashboard and Control Panels

Honeywell's WIN-PAK® 4.8 is the central software that sets the parameters of persons allowed to access the premises, and under which circumstances, and can be accessed off-site. It provides a cost-effective way to integrate and manage access control, video surveillance, and intrusion detection through a single interface [40]. Honeywell's web-based NetAXS-123 Controller allows for faster installation, because its native IP-based hardware with PoE capability eliminates additional network module wiring and simplifies powering the panel. It can be expanded to control up to three doors with add-on boards, where traditional control panels only allow control over a fixed number of doors once installed. If part replacement or an upgrade is to be performed, building operators can isolate the respective control panel and/or its components to complete maintenance work.

### Visitor Management System

The Honeywell LobbyWorks® Visitor Management System provides a simple and effective way to register, badge and track visitors, with features such as detailed visitor traffic reports, and enforcing visitor/occupant security policies. With this system, visitor registration is quick and simple as it can automatically contact the visitors host by email or with real time network messaging to announce the visit. Specific visit restrictions may be set, such as clearance level, access area or visit expiry time. Overall, the LobbyWorks provides a centralized and relatively complete control over visitors to improve the security in the building.

### Smart Card Reader

Honeywell OmniClass2 Smart Mobile-Ready Mini-Mullion Reader (13.56 MHz) offers excellent reliability, consistent read range and ease of installation. It requires only a two-piece installation with mounting base and reader. It incorporates smart card technology allowing multiple applications per physical card and optional mobile credential capability. It is assumed that most occupants in the residence will have smartphones. This means that enabling mobile credential features along with card credentials would increase usability as they have flexible choices for gaining access into the residence. Furthermore, it is important that the readers and credentials have secure and encrypted communication; this is achieved through OmniClass2 Reader's multiple encryption layers using HID's SIO and Seos platforms [41].

#### *2.1.3.3 Communication System*

### Internet Connection

Due to the increasing dependencies on tablets and laptops, each occupant is estimated to own at least two electronic devices that require internet connection. With a total occupancy of 592 persons, the average number of Wi-Fi-enabled devices at a given time is 1,184 devices. As students use the internet for studying, leisure activities, watching lectures, exams, etc., there is a need for strong and stable networks. Moreover, students may choose different spaces throughout the residence to access the internet. This suggests the need for a convenient internet connection environment and wide internet coverage to improve overall user experience.

Our recommended internet connection solution is NetGear's Orbi Tri-band Mesh Wi-Fi 6 System with 802.11ac protocol. The basic setup of this mesh network system includes a main router that connects directly to a modem, and a series of satellite modules, or nodes placed throughout each floor (see Appendix L, pg 165, "Nighthawk Modem" and "Orbi WiFi 6"). The nodes are all part of a single wireless network and share the same SSID and password. Unlike



range extenders, which communicate with the router via the 2.4GHz or 5GHz radio bands, most Wi-Fi system satellites use mesh technology to seamlessly communicate between routers and other nodes (see Figure 2.9). Moreover, a wireless mesh infrastructure is, in effect, a router network without the cabling between nodes—with the inherent rerouting for fault tolerance that such networks deliver [42].

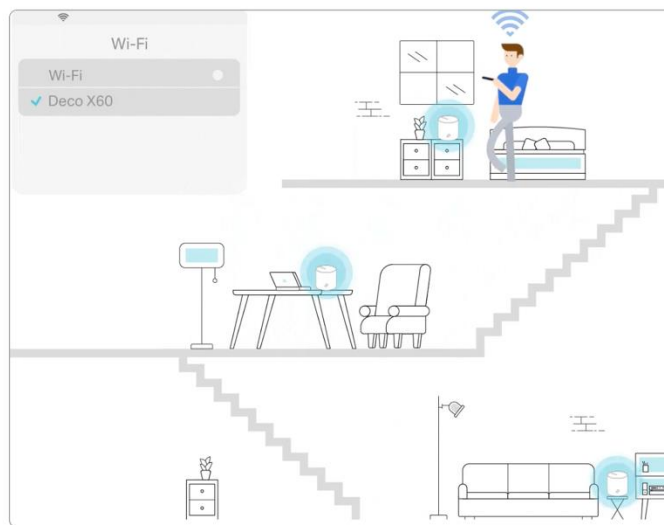


Figure 2.9: Potential placement of Orbi Wi-Fi 6 Routers throughout the residence [42]

In terms of sustainability, the system does not require ethernet network cabling nor professional installation as it can connect wirelessly to the Nighthawk Modem, reducing costs significantly. The flexibility provided by mesh networks is particularly helpful over large geographies and in hard-to-wire buildings and simplifies the whole installation process. Each Orbi Wi-Fi 6 pack contains 3 routers, each of which can connect to over 150 devices across 7500 sq ft. This means that 5 packs will be sufficient to cover the entire 42,160 sq ft residence. Similar to IP Cameras, unauthorized users may access this network. We propose that with the WPA3 encryption and IEEE 802.11i pre-shared key (PSK) authentication features, the Orbi Wi-Fi 6 provides greater protection. Moreover, by setting this feature in enterprise mode, each user will have their own username and password to access the network, thereby reducing the possibility of hacking. In addition, the Orbi Wi-Fi 6 has a separate Guest Wi-Fi Network to prevent viruses and malware from their devices infecting the residence's Wi-Fi network.

The main advantage of the Orbi Wi-Fi 6 is the capability to add more nodes, depending on the need for stronger bandwidth as student connect with more devices (see Appendix D, page 72). Students can automatically or manually connect to the best performing Wi-Fi channel and radio frequency to avoid crowded bands and maintain strong wireless signal throughout the residence building. Higher models include Multi-User Multiple Input Multiple Output (MU-MIMO) technology for serving multiple wireless stakeholders at residence. For systems graphic and installation steps of the Orbi Wi-Fi 6 system, see Appendix D, page 73).

### Sound system

The objective is to provide controlled sound levels to prevent the residence from being a noisy environment yet create the desired atmosphere for students. Audio elements can be used strategically to support the experience for both, occupants and guests. The recommended system



is Polk Audio 5.1 Channel Home Theater System with Powered Subwoofer (see Appendix L, pg 167, “Polk T-Series Manual” and “PSW10”). The sound system allows students to enjoy premium acoustics. In addition, the selected range of speaker models will facilitate a theater-like experience (see Appendix L, pg 167, “Polk Audio”). The system will mainly be installed in the common area of each floor in the building, given the room size and ability to provide a well-balanced, and room-filling sound quality [43].

#### Intercom system

Incorporating a wireless intercom system has many benefits. For example, it allows for live or asynchronous communication between users. Furthermore, all of this is based on a local network, meaning an internet connection is not necessary. This also protects user privacy as nothing is being logged into a third-party provider.

For this proposal, the HOSMART Wireless Intercom System is an excellent device that solves the need for reliable communication between residences. It has a range of 800 meters, voicemail capability, and can make group calls (see Appendix D, page 73) [44]. The wireless intercom system is entirely locally based, meaning it does not require a third-party cloud-based system.

In terms of sustainability, using a wireless intercom system could facilitate better coordination of contactless package deliveries to students’ dorms. In addition, it can act as an immediate contact point with the security desk for emergencies such as bathroom leaks, or maintenance issues as highlighted in the UofT occupant survey results.

#### Digital Signage

Digital Signage is a modern way to project information to users while being tremendously efficient. In a nutshell, TV monitors are mounted in high-traffic areas such as the lobby and common areas where they synchronously display content (see Appendix D, page 73). They are fully programmable by the user, and all of this can be done digitally. By eliminating the hassle of creating hand-drawn posters, this solution gives the user more time to create signages and provide close to real-time updates. One such update is having graphics on energy usage per dorm room. These can be specified for each floor and can incentivize students to regulate their energy consumption and be more environmentally conscious.

For this proposal, individual Raspberry Pi’s will be hooked up to each TV (see

Figure 2.10). Using Yodeck digital signage software, a link is established between all TVs from a host computer through the internet. The user can display still images and silent videos.

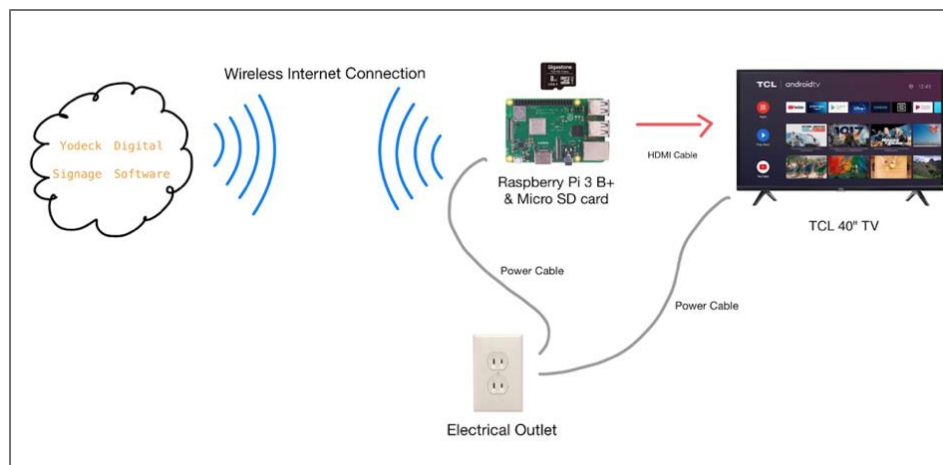


Figure 2.10: Diagram showcasing the installation of the Digital Signage System [45,46,47]

### Projector

In large common areas, projectors are ideal in sharing content with others as they can project onto a huge display far better than a traditional TV. Whether it be for watching movies, playing video games, or a presentation, projectors enable users to showcase themselves to a large audience without feeling constricted. It allows for engaging activities to be broadcasted.

For this proposal, the projector of choice is the Epson Home Cinema 2200 (see Appendix D, page 74) [48]. It includes Android TV which allows for seamless wireless connectivity between android devices and can play most media without a separate computer. For improved picture quality and long-term use at the residence, we have included an economical, 100” VIVO projector screen to complement the projector.

#### *2.1.3.4 Hands-free Controls*

When it comes to returning to work safely, eliminating the need to make contact with those common touch points upon entry creates a more hygienic environment for everyone. Openpath’s touchless access control is an excellent choice for any organization looking to remove this health hazard, with mobile credentials and hands-free unlock configurations that can accommodate any size organization.

#### Hands-free Door Entry Control

For more convenient access to building entries, we propose Openpath’s touchless access control, which uses mobile credentials and hands-free unlock configurations that is suitable for organizations of any size. With the hands-free entry, students would be able to enter the building by just a wave. Even when authentication is needed, just by having their smartphone in their bag or pocket without opening the Openpath app would grant them access to the building. The traditional key card or fob would still remain an option [49]. When students invite friends over to their place, they can simply text their friends a link for access and the visitor only needs to click on the link without log-in required and the door would unlock. The system is safe and secured with end-to-end encryption and can be integrated with BAS for monitoring access to these public areas [50].

The Openpath reader that we propose for installation is the Mullion Smart Reader, based on aesthetics and space optimization. The reader has a snap-on faceplate which blends into the





aesthetics of an entry due to its variety of colors. It is narrow in size which is ideal for where space is limited [51]. The bluetooth technology allows it to detect motion and authenticate users to unlock the door. If users encounter issues at any time, Openpath would instigate remote diagnostics, providing instant support and solutions to users [52]. Other features available with the Openpath system include elevator integration, lockdown plans, and tailgating monitoring (see Appendix D, page 74). The budget for this solution is approximately \$85,300 CAD as calculated in Appendix D, page 74.

### Hands-free Laundry Control

Another hands-free control that we are proposing is the netZtouch Laundry Master. Since laundry rooms are shared among all students and they tend to do their laundry during similar time periods, it would be convenient for them to be able to track the status of laundry machines through a Web browser. We recommend the netZtouch Laundry Master because it monitors the status of washers and dryers in connected laundry rooms from any computer or smart phone with internet access. Students would also be able to receive notification via e-mail or cell phone when a machine is free, or when their laundry is done (see Figure 2.11) [53].

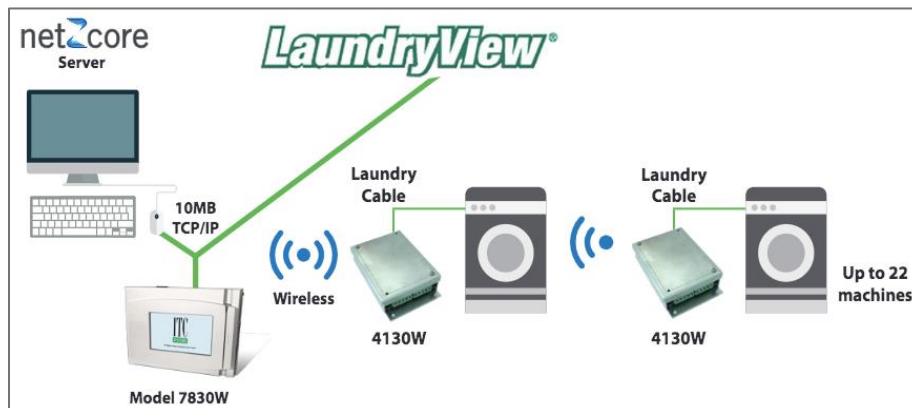


Figure 2.11: Set up of Hands-free Laundry Control

This system is compatible with most electronic coin drop laundry machines, offers configurable price and tracking per machine, displays cardholders balance and current transaction details, and stores online and offline transactions with flexible reporting capabilities. The installation process is simple, and only requires a wireless connection to each machine. The components of this system include: laundry master, laundry machine interface, and loader (see Appendix D, page 75 for descriptions and prices).

#### *2.1.3.5 Building Automation System (BAS)*

The SBD team seeks to provide university students the opportunity to live, study, and play through a connected, convenient and comfortable environment. Building Automation Systems ensure that buildings can be optimized, managed and maintained effectively to provide suitable living conditions. Components of the BAS include a computer workstation, WEB server, IP communication protocol, system network controllers, and field devices [54]. Based on UofT's Design Standard for Security Systems and Access Controls, current campus buildings are managed using the Honeywell Enterprise Building Integrator (EBI) [55]. EBI R600 is an open, scalable solution that can manage complex building uses, and integrate with 3<sup>rd</sup> party products. Moreover, it has the capability to integrate with building and energy management, access and





intrusion control, life safety, and video surveillance. The primary benefit of EBI R600 is being able to automate workflows so that the right people are alerted when they should be [56].

### WEBS-N4 System Integration

Using the WEBS-N4 platform, individual MEP systems can be connected to the BAS (Figure 2.12). The NOTI-FIRE-NET Web Server will be hardwired to the EBI and share information with the data analytics platform, WEBS-N4 View Builder. WEB-8000 and CIPer Model 50 controllers integrate well with the WEBS-N4 platform, as they can communicate via KNX, BACnet/IP and other third-party protocols to the BAS (see Appendix L, pg 167, “CIPer Controllers” and “WEB-8000”). As part of the City of Toronto BAS Specification, all controllers must be hardwired to the ethernet switch (as shown in blue) [57]. WEB-8000 controllers have expansion capabilities such as being able to monitor downstream sensors and devices wirelessly for Lighting, Access Controls, Hands-free Controls, and Security systems (as shown in red). CIPer Model 50 controllers can monitor, schedule and control HVAC systems.

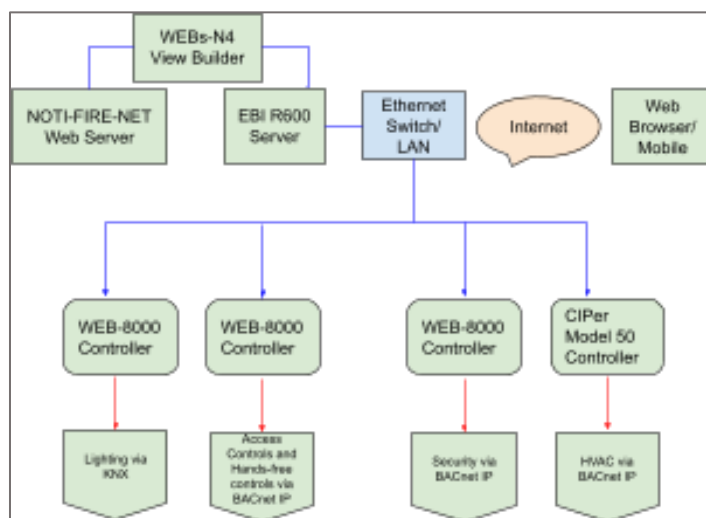


Figure 2.12: WEBS-N4 System Integration (For general system overview, see Data Sheet, “WEBS-N4 System Architecture”)

BAS can provide massive energy savings of 5-15% of total energy consumption, based on the ability to identify maintenance cycles and operational issues. Although the capital cost for installing BAS is expensive, the payback period is often less than three years [58].

#### *2.1.3.6 Overall life cycle impact cost considerations*

We have assumed that the salvage value for all SBD systems is zero because each component would be used long-term for operating the building; the BAS is assumed to last on average 12.5 years. Secondly, their in-built technology will become obsolete over a short period of time as software updates or change of components will be required [59]. The life cycle cost (LCC) was conducted with an interest rate of 8%, \$0 for salvage value and each system’s average lifespans, resulting in \$766,600. This value is lower than SBD’s total Capital and O&M costs as it does not account for other costs such as energy costs and disposal costs. The breakdown of calculations can be found in Appendix D, page 76.



## Project Budget

2.2 The total electrical system budget assigned by the client is \$2,300,000.00 USD. As a Canadian team, the budget has been converted to Canadian Dollars which is approximately \$2.8 million CAD. This section outlines the direct costs for the electricals systems. *Table 2.4* shows the overview of the electrical cost estimated for the project.

Table 2.4: Overview of the Total Electrical System's Direct Costs

Electrical sub-system	Total direct cost (CAD)
Lighting	\$307,300
Building Energy Management	\$657,500
Smart Building Design	\$785,200
Total electrical system	\$1,750,000

### 2.2.1 Lighting

The total cost of lighting is estimated as \$307,300 and is broken down into material and labour costs. The temporary lighting during construction is calculated by multiplying \$0.5 with the total square feet of the building, this estimation was provided by electrical contractors from O'Connell Electric Company. The total area of the building is 42,160 square feet, and this cost is \$21,000. This cost is also included in the total lighting cost.

The material costs of all fixtures, switches, modified lighting panels, conduit, wiring, DALI and KNX components in this project add up to \$145,200. The wiring length was estimated to account for this material and labour cost, see Appendix B, page 63 for the estimation. All materials were chosen based on their quality of performance. The total labour cost for lighting is \$162,100, detailed calculations and references for the costs will be further explained in Section 3.1.

The design also showcases the concept of value engineering. That is, all lights in the building are applied with LED, in place of incandescent lights, which can lead to the lowering of final cost estimates while maintaining the same function for lightings. In the process of decision making on the type of light bulbs applied on the building, firstly, the lifespans of the bulbs are considered, along with the prices of each type of bulb. This is to estimate the number of light bulbs needed in a fixed period in the future, with a foreseeable amount of expenses that will be spent on this aspect. The following consideration is the cost per bulb on power usages (in kWh). As a long-term application, the power usages' costs of light bulbs will cause a significant effect on the expenses continuously, which is, the higher the cost, the larger the estimate of the final cost of power usages it will be, depending on the period of light bulbs application. There are 889 fixtures in total in the building, which increases the effect of power usages even more by demanding higher power for lightings. Taking every possible consideration into account, we have chosen LED over incandescent lights. For more detailed comparisons between LED and incandescent light, see Appendix B, page 62, for cost saved by LED over incandescent light [60].

### 2.2.2 Building Energy Management

The total cost of the BEM system is estimated at \$657,500. This cost is comprised of material and labour costs, for the three BEM sub-systems: Solar Generation, Electrical Infrastructure/Controls, and VRF HVAC.



The material costs for the solar generation system add up to \$66,300, comprising of the solar panels, the racking system, the inverters, the combiner box, and a crane rental. The labour costs for solar generation add up to \$9,300, comprising of all electrician installation costs. The use of a solar generation system exhibits the concept of value engineering; the production of energy will offset energy costs in the long-term, because significantly less energy will need to be purchased from the grid. The solar generation system also significantly increases the environmental sustainability of the facility, due to the added renewable energy generation.

The material costs for the electrical infrastructure and controls system add up to \$65,000, comprising of the wireless temperature sensors, energy consumption/production sensors, circuit breakers and panels, step-down transformers, automatic transfer switches, wiring, receptacles, and an off-grid emergency generator. The labour costs are \$70,300, comprising of all electrician installation costs. The electrical controls system also exhibits the concept of value engineering. The wireless temperature sensors serve the function of adjusting the facility temperature using the BAS, to avoid the over-consumption of HVAC electricity for temperature regulation. Additionally, the energy consumption production sensors will inform users of how much energy is being consumed in different building zones, as well as the amount of energy generated by the solar PV arrays. These features will help to reduce cost in the long-term as energy is saved.

Finally, the material costs for the VRF HVAC system add up to \$173,600, comprising of the indoor and outdoor units, the single port selector boxes, and the piping. The labour costs for the system add up to \$273,000, which is a very significant cost in the BEM budget. Although this cost is very high, the VRF HVAC system provides several benefits. Specifically, it allows the heating/cooling system to be completely electric, eliminating the reliance on natural gas and fossil fuels. It also allows for a unique and customizable heating/cooling system that will improve the quality of experience for building residents.

### 2.2.3 Smart Building Design

Based on the quantity of SBD system components required for the residence, the estimated total cost is \$785,200. The total labour cost and the total operations and maintenance cost were calculated as \$156,900 and \$19,900, respectively. The O&M costs are assumed to be constant for all five SBD systems, and is based on Schneider Electric's BAS preventative maintenance costs [61]. However, there may be added cost over the building life cycle from inflation rates of material costs, availability of materials, and transportation costs. Given our limited knowledge in SBD, we anticipate costs to increase but remain within budget as more specific, and complex system components would be needed for full-scale implementation.

Regardless of the current estimate, there are potential areas for value engineering. This can be implemented by modifying construction methods, designs and materials for assembling and constructing SBD systems. For example, T-tapping has been proposed for the NFS2-640 fire alarm system [62]. This method involves connecting both red and black wires for ordering each device on the circuit. It can reduce as much as 30% in labour and materials costs yet connect more devices to the same circuit for accurate zoning. In addition, there is a potential to pre-fabricate certain parts such as pre-wire the multi-criteria detectors' bases and plug-in detectors at final installation. From a sustainability standpoint, there are three reasons for incorporating BAS for the UofT campus residence. Firstly, having a networked controls design amongst Lighting, BEM and SBD will ensure that system information is readily available. Secondly, having the ability to access the BAS remotely will allow for quicker problem diagnosis, and improved



service levels for occupants and building owners. Lastly, as bulk and data tagging of devices are carried out by tag-based navigation, the commissioning and maintenance process can be easily transferred from contractors to building operators.

## BIM and Construction Documents

2.3 The Building Information Modelling Team (BIM) integrates all of the prior sub team's fixtures and appliances within the central Revit model. The BIM team divided the other sub team's work into 3 proposed drawing sets – Lighting from the Lighting team, Systems from the Smart Building Design team and Power from the Building Energy Management team. Through attending the monthly Revit trainings and tutorials, sufficient knowledge was acquired to aide us in the creation of the following shop drawings.

For each of these sub-grouped systems, appropriate Revit family models were either made or found online to represent the aforementioned teams' innovative systems. Using Revit, shop drawings were for the building's power supply and distribution system, the basement electrical room, the various control systems, access and security systems, information and communication systems, interior and lighting plans.

A lighting schedule and symbolic legend table was created for the representation of these items. Moreover, the BIM team also created site context around the building's proposed location to create renderings.



## Net-Zero Recommendations

2.4 When considering the possibility of a net-zero facility, cost and other feasibility metrics must be taken into account. For this project, due to the high electricity demand, largely caused by the VRF HVAC system, the rooftop solar system proposed in our design is not sufficient for achieving a net-zero energy building. However, it should be noted that in the location of the proposed building (Ontario, Canada), the grid’s electricity supply is mostly made up of carbon-free or renewable energy sources like nuclear and hydro-electricity [63]. Therefore, the use of electricity for heating in Ontario (which largely reduces natural gas dependency) is a very effective method of reducing the carbon footprint of a building.

However, when considering how to adjust the recommended building design to achieve net-zero, the goal is to produce an equal amount of energy as is demanded. Table 2.5 summarizes the energy demand for the currently proposed system, as well as how much energy is being produced by the proposed rooftop solar system. A more detailed breakdown of the energy demand calculations is included in Appendix C, page 69.

Table 2.5: Current Proposed System Annual Energy Demand

Sub-System	Estimated Annual Energy Demand (kWh)
Lighting	55,323
Building Energy Management	434,549
Smart Building Design	5,457
<b>Total</b>	<b>495,328</b>
Estimated Annual Solar Energy Supply (kWh)	39,055

As demonstrated above, there is a total of 465,273 kWh per year of energy demand that is not offset by the existing rooftop solar system. In the proposed system, the space on the roof that is occupied by solar panels is at the maximum capacity to comply with building codes; however, space on the ground and external building platforms could be used to increase the space for solar panels. To reach net-zero with the existing energy demand, an additional 1,243 of the Seraphim 315W solar panels is required. This would cost an estimated additional \$213,000 for the panels, \$213,000 for the racking system, and \$225,600 for inverters. Only these components have been included in this estimation because they are the most expensive. Overall, reaching net zero with exclusively a larger solar system would cost an additional \$650,000, however not fitting in the lot’s space capacity, and thus not being practically feasible.

It is recommended that other solutions be explored for approaching a net-zero facility. For example, building enclosure features such as additional insulation and multi-pane windows can vastly reduce the energy required for building heating and cooling. Additionally, the University of Toronto has some renewable energy production systems in place or in development, such as solar energy generation and geexchange [64]. It is recommended that these resources be utilized for some of the energy demand of the building, to leverage existing renewable generation infrastructure provided by the University.





#### 2.4.1 Addressing Customer Needs

The net-zero recommendations work to meet customer needs, particularly the need for sustainability. Specifically, a net-zero facility contributes to eliminating carbon emissions produced by the building. This is because all of the appliances (including the all-electric VRF HVAC system) are natural-gas free, and the production of electricity from the augmented solar PV system allows for all required electricity to come from a renewable energy source. Although most of the electricity grid in Ontario produces renewable or clean (nuclear) energy, the augmented solar PV system ensures that all energy is coming from a renewable source.

Other customers' needs as stated in the Occupant Survey are addressed through the standard (non-Net-Zero) proposed design, and these benefits are also included within the net-zero recommended design. The customer needs addressed by the standard proposed design is discussed in the following sections:

- Lighting: 2.1.1 and 2.5.1
- Building Energy Management: 2.1.2
- Smart Building Design: 2.1.3 and 2.5.3

#### 2.4.2 Life Cycle Cost Savings

With the implementation of the net-zero facility recommendation, Life Cycle Cost (LCC) impacts are significant and should be noted. Although the net-zero recommendation results in no cost associated with purchasing energy, the capital cost required for such a large investment in solar generation results in a much higher LCC for the net-zero recommended system than the originally proposed system. However, it should be noted that energy demand savings from building envelope retrofits have not been considered in this analysis. The total LCC cost for the originally proposed system is approximately \$1,225,000 (see Appendix C, page 69), while the net-zero recommended system's LCC cost is approximately \$2,000,000 (see Appendix C, 70).

Some considerations should be made when evaluating this LCC comparison. First, the cost of renewable generation equipment, such as solar PV systems, has been and will continue to decrease, leading to a lower capital cost for the net-zero system in the future [65]. Additionally, the capital cost can be reduced by federal or provincial grants and loans that exist for on-site renewable generation, which has yet to be explored when evaluating net-zero LCC. Finally, considering a holistic approach to this evaluation, the non-monetary value of achieving a net-zero facility and contributing to climate change mitigation cannot be ignored. This endeavour would achieve social and environmental benefits and praise that should be strived towards.

The life cycle costs of the standard proposed design are discussed in the following sections:

- Lighting: 2.1.1.4
- Building Energy Management: 2.1.2.4
- Smart Building Design: 2.1.3.6



## Final Recommendation

### 2.5.1 Lighting

To summarize, all light fixtures installed are LED lights, with the public areas connected to the KNX automated system. The upfront cost of the lighting system was calculated to be \$307,300, which includes the temporary lighting, all lighting material and labour cost. Through the product's life cycle, KNX systems will be cheaper than conventional lighting systems due to the energy savings it offers. The maintenance cost will be removed and only arise when the time comes to completely replace all lights and update the system [14]. The implementation of KNX can reduce lighting energy use by 60% [14].

Focusing on direct benefits for the residents, brighter lights are more effective in increasing both pleasure and arousal in elderly people that were induced into a sad mood compared to neutral lighting [66]. According to an article from the national library of medicine, maintenance of exposure to bright light would lead to improved mood, alertness and performance [66]. Lights activate the pineal gland to suppress the release of melatonin. Melatonin is crucial in maintaining the body's internal clock. When melatonin level reaches a high level, the body would be drowsy and sleepy. While low levels would result in a state of alertness. Correctly maintaining a lighting level would induce the required amounts of alertness for the individual. Timely exposure to artificial bright light is beneficial in improving sleep and circadian rhythms. Moreover, studies show that cycling lighting results in improved sleep [67].

Through the Power Over Ethernet (POE) within the KNX system, the designed system can improve user experience by allowing students to remotely control and monitor the lights in their room using phones and tablets. Brightness in the common areas can also be adjusted using the control panel to meet their studying or relaxation needs, improving the overall living experience at the resident.

### 2.5.2 Building Energy Management

Overall, the Building Energy Management (BEM) subsystem comprises of a rooftop solar PV system for renewable generation and electrical control systems for energy efficiency comprising of wireless temperature control sensors and energy consumption sensors. The system's upfront cost is approximately \$657,500, with an LCC of approximately \$615,500 and annual O&M costs of approximately \$80,000.

Some recommendations have also been made with regards to modifications and additions to the BEM system design that can contribute to achieving of a net-zero facility. These recommendations include expanding the solar PV system to include solar panels on the ground-level lot areas of the property and introducing more energy-saving measures as a retrofit to the building design, to offset the energy demand of the building, not already offset by the existing solar generation system.

The solar PV system produces nearly 40kW of power, which contributes to cost savings from electrical bills and the sustainability of the facility design with regard to energy consumption. However, the solar PV system is not expected to meet the electrical demands of the whole facility, and thus is grid-tied to maintain connection to the electrical grid.

The wireless temperature sensors are placed throughout the building and are integrated with the Smart Building Design system's Honeywell BAS. These sensors work to intelligently modify building temperature in response to the environment. Finally, the energy production and



consumption sensors included in the electrical control systems serve the function of informing building users of the energy produced by the solar PV system in real time, as well as a comparison between the energy produced and consumed in the facility.

### 2.5.3 Smart Building Design

To summarize, the SBD systems have a total upfront project cost of \$613,760, an LCC of \$766,600 and present worth of \$152,800. For consolidated list of above-mentioned technologies, see Appendix D, page 79. There are several advantages to incorporating the SBD technologies. Security systems seek to achieve 24/7 surveillance, prevent burglaries, pinpoint the location of fire situations earlier, and maintain integrity between the system components. Access Controls will facilitate flexible and secure credential types to maintain security levels throughout the residence. The proposed communication systems will ensure students have access to critical information and have stable Wi-Fi connection for completing university studies. Hands-free controls will enhance the dorm living experience by considering post-Covid nuances. Ultimately, the inclusion of BAS will influence the students' dorm living habits and reduce their energy usage when systems are not in use, thereby lowering O&M costs. More importantly, being able to monitor all technical systems with BAS will lead to higher cost savings and fewer system failures due to the ability to predict maintenance cycles more promptly. Thus, we believe that these niche solutions will satisfy the needs of future UofT students.

## 3 Estimate, Schedule, and other Construction Considerations

### 3.1 Cost Estimate

The total construction cost of the University of Toronto Residence Hall is estimated to be \$2,741,000 CAD, which converts to 2,234,000 USD. The preliminary estimation of the indirect costs, which includes the material and labour, can be found in Table 3.1 and the indirect costs in Table 3.2. The detailed cost estimation of the three technical teams can be found in Appendix F, pg 86.

The material cost has been estimated through quotation requests from several vendors that supplied the items outlined by the three technical teams in Appendix F, pg 86. The labour cost has been calculated by the construction wage rates in the Greater Toronto Area and the unit production time of each material that was quoted through the suppliers and local NECA contractors. Since the University of Toronto pays union wages for its construction employees, all labour hourly rates have been collected through the Statistics Canada Department, the City of Toronto Fair Wage Schedule for ICI work, and [68][69][70]. For the professions that the union wage was not available, the union wage is estimated to be approximately \$5 higher than non-union wage in Ontario [71]. Additionally, a 10% vacation and sick days and \$10 Worker Fringe Benefits has been added to the base wage based on the City of Toronto Fair Wage Schedule for ICI work [69]. The detailed hourly wages for all workers can be found in Appendix F, pg 86. General conditions and assumptions of the estimate are as follows:

1. All costs are in Canadian Dollars (CAD), and the quotes that have been received in USD have been converted to CAD for coherence.
2. All workers required to work on the weekends will be paid over-time (1.5 times the regular hourly wage) [72].



Table 3.1: Direct Cost Estimate of the University of Toronto Residence Hall Electrical Systems

**Direct Cost**

<b>System</b>	<b>Materials Cost</b>	<b>Labour Cost</b>	<b>Subtotal</b>
<b>1.0 Lighting</b>	<b>\$145,200</b>	<b>\$162,100</b>	<b>\$307,300</b>
<b>2.0 Smart Building Design</b>	<b>\$628,300</b>	<b>\$156,900</b>	<b>\$785,200</b>
2.1 Security System	\$114,800	\$26,600	\$141,400
2.2 Access Control System	\$117,100	\$95,600	\$212,700
2.3 Building Automation System	\$242,000	\$20,700	\$262,700
2.4 A/V System	\$62,500	\$11,200	\$73,700
2.5 Hands-Free Control System	\$91,900	\$2,800	\$94,700
<b>3.0 Building Energy Management</b>	<b>\$304,900</b>	<b>\$352,600</b>	<b>\$657,500</b>
3.1 HVAC	\$173,600	\$273,000	\$446,600
3.2 Electrical Infrastructure	\$65,000	\$70,300	\$135,300
3.3 Energy Source	\$66,300	\$9,300	\$75,600
<b>Total Direct Cost</b>	<b>\$1,078,400</b>	<b>\$671,600</b>	<b>\$1,750,000</b>

Table 3.2: Indirect Cost Estimate of the University of Toronto Residence Hall Electrical Systems

**Indirect Cost**

<b>Cost Description</b>	<b>Percentage of Direct Cost</b>	<b>Subtotal</b>
1.0 Overhead and Profit	10%	\$175,000
2.0 Insurance and Liability	3%	\$52,500
3.0 Contingency	10%	\$175,000
4.0 Tools *	4%	\$26,900
5.0 Design Fee	8%	\$140,000
6.0 Labour and Weather Escalation *	4%	\$26,900
7.0 Building Permit Fees	\$27.16 Per m <sup>2</sup>	\$31,200
8.0 Material Delivery and Handling	5%	\$87,500
9.0 Office Trailers, Equipment and Supplies	2%	\$35,000
10.0 HST	13%	\$227,500
11.0 Inspection *	2%	\$13,500
<b>Indirect Cost</b>		<b>\$991,000</b>
<b>Total Construction Cost</b>		<b>\$2,741,000</b>

\*Estimated based on the *total labour cost* in Table 3.1.

## Shop Drawings

The shop drawings that were created composes together the variety of systems and interlinked communication. Considerations such as communication between systems and clashes were considered when placing the Revit families. Observed below are three extracts from the drawings.

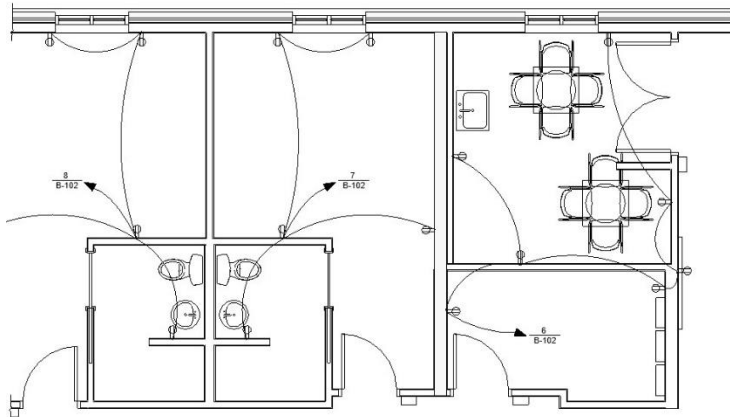


Figure 3.1. Example of model power circuit rooms

This drawing identifies the manners in which the BEM team’s power system was put together. Considerations were taken based on the distribution loads of a residential building such as a larger usage in the common areas and specifically after hours. Therefore, each room is composed of five to six receptacles on its own circuit to the main distribution panel.

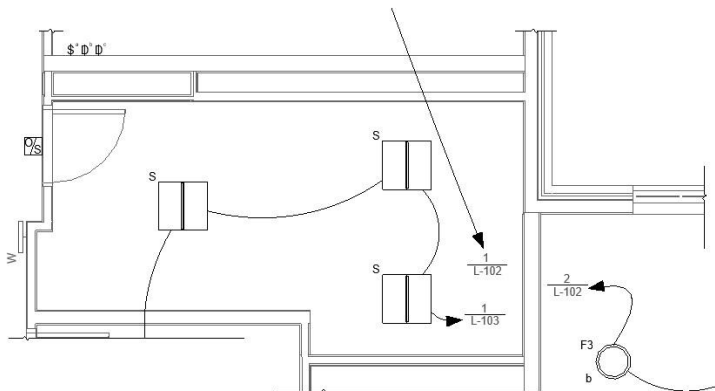


Figure 3.2. Example of lighting control panels in usage

The main distribution panel also connects the nine-lightings panel per floor. Considerations were particularly made for user comfort and convenience in this section. As switches are placed lower in consideration of those less abled. Dimmer switches were also used in rooms particularly to allow for more customised control, as students often having conflicting schedules but also to encourage the usage of windows the southernly oriented building.



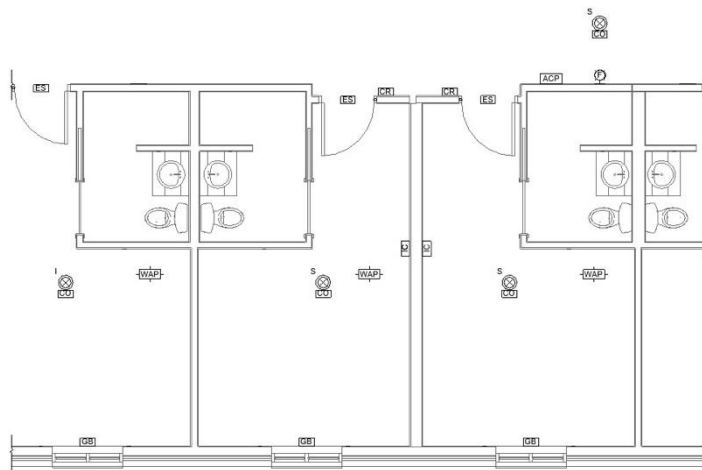


Figure 3.3. An excerpt on the appliances from the Smart Building Design Team

Last the main plan drawings are the systems plans which entails a variety of appliances, ranging from fire alarm systems to security devices, such as IP cameras and electrical strikes. The organisation of this system was derived with a reflection and study of university residences. Prioritising the safety of all residences but also retaining a welcoming façade. Examples of this can be observed through the usage of hand free controls, in acknowledgement of the recent pandemic.

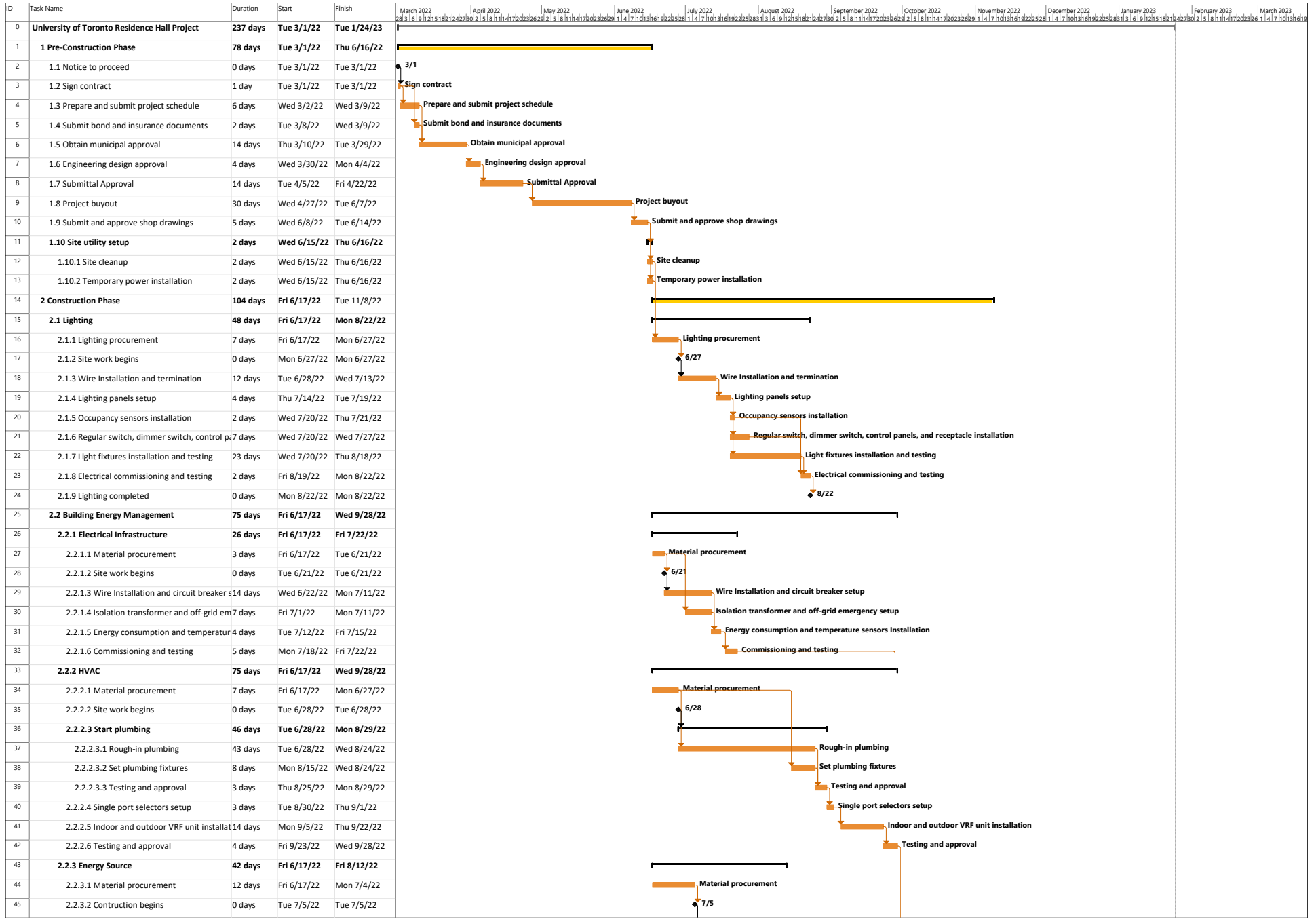
### 3.3 Gantt Chart Schedule

The construction schedule has been set to start in the beginning of March 2021 to decrease any weather disruptions to the project timeline. As a result, the construction phase starts in June and ends by November. The project closeout finishes by February to allow for the residence hall to be fully furnished by the start of the new academic year in September. The project will take 237 days, from the beginning of March 2022 until the end of January 2023.

The crew consists of 20 electricians, 5 plumbers, 5 telecommunication technicians, 5 fire alarm technicians, 2 HVAC technicians, 2 locksmiths, 1 Crane operator. However, all the workers are scheduled to work within different systems for the duration of the project. They work for 7 hours a day except electricians who work 6.5 hours a day, not including 1.5 hours of meal and rest breaks based on the Toronto Fair Wage Schedule for ICI [69]. Workers are not scheduled to work on the weekends. However, they may be required to work to maintain the timeline of the project. All workers follow a standard work schedule between the hours of 7:00am to 3:30pm.

The wiring and conduit installation for Lighting and BEM and piping for BEM simultaneously start in the beginning of the construction phase as it is required for the other tasks to commence. Tasks such as fixture, solar panel, and BAS installation. Most of the Smart Building Design systems tasks also occur in the last one third of the construction phase as they require a shorter amount of time to complete.

The detailed project schedule can be found in the next two pages. The duration of each task has been estimated by taking into account the unit production time, quantity of the item, and the number of workers assigned to it.



Project: University of Toronto R  
Date: Thu 4/29/21

Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Manual Progress
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Progress	

Page 1

ID	Task Name	Duration	Start	Finish
46	2.2.3.3 Material hoisting	3 days	Wed 7/6/22	Fri 7/8/22
47	2.2.3.4 Roof racking system installation	14 days	Mon 7/11/22	Wed 7/27/22
48	2.2.3.5 Roof module installation	7 days	Fri 7/22/22	Fri 7/29/22
49	2.2.3.6 Microinverter and combiner box installation	7 days	Mon 8/1/22	Tue 8/9/22
50	2.2.3.7 Testing and approval	3 days	Wed 8/10/22	Fri 8/12/22
51	2.3 Building Energy Management Completed	0 days	Wed 9/28/22	Wed 9/28/22
52	2.4 Smart Building Smart	61 days	Mon 8/15/22	Mon 11/7/22
53	2.4.1 Access Control System	26 days	Mon 8/15/22	Mon 9/19/22
54	2.4.1.1 Material procurement	5 days	Mon 8/15/22	Fri 8/19/22
55	2.4.1.2 Visitor management system installation	2 days	Mon 8/22/22	Tue 8/23/22
56	2.4.1.3 Mechanical and magnetic door lock installation	9 days	Wed 8/24/22	Mon 9/5/22
57	2.4.1.4 Integrated security system installation	7 days	Tue 9/6/22	Wed 9/14/22
58	2.4.1.5 Testing and approval	3 days	Thu 9/15/22	Mon 9/19/22
59	2.4.2 Security System	17 days	Mon 9/12/22	Tue 10/4/22
60	2.4.2.1 Material procurement	5 days	Mon 9/12/22	Fri 9/16/22
61	2.4.2.2 Fire alarm system installation	5 days	Mon 9/19/22	Fri 9/23/22
62	2.4.2.3 Security alarm system installation	5 days	Mon 9/19/22	Fri 9/23/22
63	2.4.2.4 CCTV camera setup	2 days	Mon 9/26/22	Tue 9/27/22
64	2.4.2.5 Testing and approval	5 days	Wed 9/28/22	Tue 10/4/22
65	2.4.3 A/V System	16 days	Mon 9/12/22	Mon 10/3/22
66	2.4.3.1 Material procurement	5 days	Mon 9/12/22	Fri 9/16/22
67	2.4.3.2 Passive Antenna System installation	3 days	Mon 9/19/22	Wed 9/21/22
68	2.4.3.3 Wireless intercom system installation	3 days	Thu 9/22/22	Mon 9/26/22
69	2.4.3.4 Wifi setup	5 days	Thu 9/22/22	Wed 9/28/22
70	2.4.3.5 TV and projector setup	3 days	Thu 9/22/22	Mon 9/26/22
71	2.4.3.6 Testing and approval	3 days	Thu 9/29/22	Mon 10/3/22
72	2.4.4 Hands Free Control System	7 days	Mon 8/15/22	Tue 8/23/22
73	2.4.4.1 Material procurement	4 days	Mon 8/15/22	Thu 8/18/22
74	2.4.4.2 Openpath door and lock installation	2 days	Fri 8/19/22	Mon 8/22/22
75	2.4.4.3 Smart Laundry Installation	2 days	Fri 8/19/22	Mon 8/22/22
76	2.4.4.4 Testing and approval	1 day	Tue 8/23/22	Tue 8/23/22
77	2.4.5 Building Automation System	26 days	Mon 10/3/22	Mon 11/7/22
78	2.4.5.1 Material procurement	2 days	Mon 10/3/22	Tue 10/4/22
79	2.4.5.2 Building automation system installation	9 days	Fri 10/7/22	Wed 10/19/22
80	2.4.5.3 HVAC controller setup	5 days	Thu 10/20/22	Wed 10/26/22
81	2.4.5.4 Connect ciper controller	5 days	Thu 10/27/22	Wed 11/2/22
82	2.4.5.5 Analytics platform installation	5 days	Thu 10/20/22	Wed 10/26/22
83	2.4.5.6 Testing and approval	3 days	Thu 11/3/22	Mon 11/7/22
84	3 Smart Building Smart Completed	0 days	Mon 11/7/22	Mon 11/7/22
85	4 Project Closeout	56 days	Tue 11/8/22	Tue 1/24/23
86	4.1 Punchlist	6 days	Tue 11/8/22	Tue 11/15/22
87	4.2 Final inspection and testing	30 days	Wed 11/16/22	Tue 12/27/22
88	4.3 Final engineering acceptance	14 days	Fri 12/30/22	Wed 1/18/23
89	4.4 Post construction cleanup	3 days	Thu 1/19/23	Mon 1/23/23
90	4.5 Project completion	0 days	Tue 1/24/23	Tue 1/24/23



Project: University of Toronto R  
Date: Thu 4/29/21

Summary	Inactive Milestone	Milestone	Duration-only	Start-only	External Milestone	Manual Progress
Split	Inactive Summary	Milestone	Manual Summary Rollup	Finish-only	Deadline	Progress
Milestone	Inactive Task	Milestone	Manual Summary	External Tasks	Progress	



## 4 Interaction with the NECA Community

### NECA Trainings

Throughout the course of the ECIC design process, our team members attended the online NECA trainings. These trainings provided us with useful knowledge about Revit and estimation and also inspired us with innovations in the electrical contracting field. Unfortunately, our team had trouble confirming our attendance through the surveys on the NECA Learning Center, so a table of the the attended videos has been added in Appendix A in Table 7.1 Log of NECA Training Sessions, pg 53, for reference.

### Interactions with NECA contractors

This information has been summarized in Section 4.2 Interactions with NECA contractors, but it is repeated here along with images of our meetings as a part of our community interaction summary.

To develop and refine our ECIC proposal, our chapter worked with both CECA and NECA contracting members. As the University of Toronto is a Canadian university based in the City of Toronto, our first contact was an email conversation with Gregg Witty who is with the CECA Toronto Chapter. We worked with Gregg to ensure we had all the proper items needed to be able to participate in the ECIC, such as our NECA net accounts. After this correspondence, Gregg referred us to Michael Parkes, a NECA contractor, and his team who provided us invaluable guidance throughout the ECIC process.

Our first contact with Michael was a virtual introductory meeting between him and our Communications Coordinator, Sarah De Sousa. This helped us develop a guide for what meetings we would need with Michael and his team in the future and helped provide us with a better understanding of the ECIC and what we needed to accomplish. Following this, our team had a virtual meeting with Michael and his team, including Brian Rittenhouse, Brian Shaffer, and Rob Miller, where they gave us an introduction to construction drawings as this was an area we recognized we lacked knowledge as seen in Figure 4.1. Our next virtual meeting with Michael and Rob was our preliminary proposal presentation, where our sub-teams presented on what they planned to propose for the ECIC. At the end of the presentations, Michael and Rob then provided feedback which allowed us to finetune our designs. Our last virtual meeting, again with Michael and Rob, was a discussion regarding project management where we received advice and feedback on our estimation and schedules as seen in Figure 4.2.

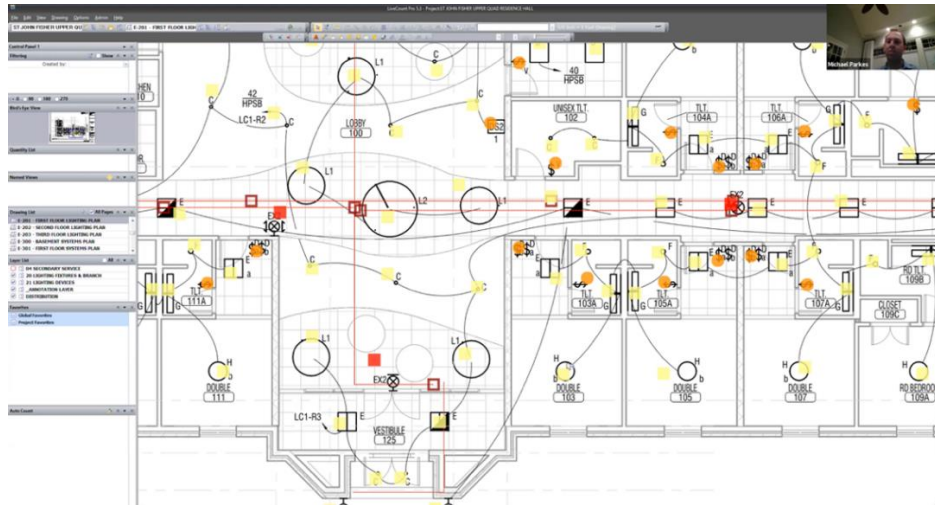


Figure 4.1: Intro to Construction and Electrical Drawings Meeting

Item #	Description	Quantity	Unit	Price	Total Cost	Notes
2	40-inch TVs	10	Pcs	\$270	\$2,700	Telecommunication Technician
3	Epson Home Cinema 2200 (Projector)	1	Pcs	\$1,300	\$1,300	Telecommunication Technician
4	Heavy TV Wall Mount	10	Pcs	\$65	\$650	Telecommunication Technician
5	Rangemaster P13 Br	10	Pcs	\$48	\$480	Telecommunication Technician
6	Passive Distributed Antenna System	1	Pcs	\$42,160	\$42,160	Telecommunication Technician
<b>B&amp;S Subtotal</b>						
<b>\$49,210</b>						
<b>AV System</b>						
1	Wireless Intercom System	85	Pcs	\$38	\$3,230	Telecommunication Technician
2	Projector and Screen	1	Pcs	\$1,300	\$1,300	Telecommunication Technician
3	TV Screen	10	Pcs	\$270	\$2,700	Telecommunication Technician
4	Wall Mount	10	Pcs	\$65	\$650	Telecommunication Technician
5	Super Computer	10	Pcs	\$48	\$480	Telecommunication Technician
6	Power Supply	10	Pcs	\$14	\$140	Electrician
7	SD Card	10	Pcs	\$4	\$40	
8	Display Software	120	Pcs	\$5	\$600	Telecommunication Technician
9	Sound System	3	Pcs	\$655	\$1,965	Telecommunication Technician
10	Ethernet					
11	VoIP Installation	1	Pcs	\$1,499	\$1,499	Telecommunication Technician
12	VoIP Access Point	31	Pcs	\$179	\$5,509	Telecommunication Technician
13	Passive Distributed Antenna System	3	Pcs	\$42,160	\$126,480	Telecommunication Technician
<b>AV System Subtotal</b>						
<b>\$141,415</b>						
<b>Hands-Free Control System</b>						
1	Automatic Soling Door Operator	12	Pcs	\$2,365	\$28,380	Electrician
2	No Touch Wave to Open Switch	12	Pcs	\$142	\$1,704	Electrician
3	Ladder	3	Pcs	\$127	\$381	Chief Labourer
4	Laundry Machine Interface	10	Pcs	\$136	\$1,360	
5	Laundry Master	3	Pcs	\$217	\$651	
<b>Hands-Free Control System Subtotal</b>						
<b>\$37,045</b>						
<b>Smart Building Design Subtotal</b>						
<b>448,970</b>						

Figure 4.2: Project Management Discussion

Throughout this process, we also kept in touch with Gregg and Michael through email correspondence for check-ins to ensure we were on track and to ask various questions regarding our designs. Michael and Rob also reviewed our final proposal and provided us with feedback to help us develop a stronger presentation. The help that Gregg, Michael, and his team provided us during the ECIC experience was invaluable and we are incredibly grateful for their guidance and support.

Appendix I

## 5 Campus/Local Media Engagement

Engagement we undertook throughout the ECIC design process can be found in Campus/Local Media Engagement Support Items, pg 103. This is where links to our Instagram posts and our article posted to the Civil & Mineral Engineering at the University of Toronto departmental website can be found.





## 6 References

- [1] “Recommended Lighting Levels in Buildings,” Archtoolbox.com, Mar-2021. [Online]. Available: <https://www.archtoolbox.com/materials-systems/electrical/recommended-lighting-levels-in-buildings.html>. [Accessed: 18-Apr-2021].
- [2] Acuity Brands, Visual Interior Tool. [Online]. Available: <https://www.visual-3d.com/tools/interior/>. [Accessed: 18-Apr-2021].
- [3] “EMERGENCY LIGHT & EXIT SIGN REQUIREMENTS”, Ocrm.net, 2021. [Online]. Available: <https://www.ocrm.net/wp-content/uploads/2013/03/EMERGENCY-LIGHT-AND-EXIT-SIGN-REQUIREMENTS2.pdf>. [Accessed: 12- Apr- 2021].
- [4] “Products Guide Lighint Control,” Apr-2013. [Online]. Available: [https://download.schneider-electric.com/files?p\\_enDocType=Catalog&p\\_File\\_Name=1200CT0701.pdf&p\\_Doc\\_Ref=1200CT0701](https://download.schneider-electric.com/files?p_enDocType=Catalog&p_File_Name=1200CT0701.pdf&p_Doc_Ref=1200CT0701). [Accessed: 10-Apr-2021].
- [5] “ISO/IEC 14543-3-10:2020,” Mar-2020. [Online]. Available: <https://www.iso.org/standard/59865.html#hbj>. [Accessed: 10-Apr-2021].
- [6] "Solutions", Knxforleed.com, 2021. [Online]. Available: <https://knxforleed.com/en/solutions.html>. [Accessed: 30- Apr- 2021].
- [7] “Lighting Control Systems,” Lighting Control System, 2016. [Online]. Available: [https://www.eldoled.com/cms\\_file.php?fromDB=9692&forceDownload](https://www.eldoled.com/cms_file.php?fromDB=9692&forceDownload). [Accessed: 10-Apr-2021].
- [8] “Energy Efficiency with KNX,” KNX.org, [Online], Available: [https://www.knxcz.cz/images/clanky/Energy-Efficiency-With-KNX\\_en.pdf](https://www.knxcz.cz/images/clanky/Energy-Efficiency-With-KNX_en.pdf), [Accessed: 10-Apr-2021].
- [9] “Toronto, Ontario, Canada – Sunrise, Sunset, and Daylength, April 2021,” timeanddate.com, 2021. [Online]. Available: <https://www.timeanddate.com/sun/41oront/41oronto>. [Accessed: 18-Apr-2021].
- [10] “Recommended Light Levels,” NOAA, [Online], Available: [https://www.noao.edu/education/QLTkit/ACTIVITY\\_Documents/Safety/LightLevels\\_outdoor+indoor.pdf](https://www.noao.edu/education/QLTkit/ACTIVITY_Documents/Safety/LightLevels_outdoor+indoor.pdf) [Accessed: 18-Apr-2021].



- [11] The Green Age , “Do dimmer switches save energy?,” TheGreenAge, 05-Aug-2014. [Online]. Available: <https://www.thegreenage.co.uk/do-dimmer-switches-save-energy/>. [Accessed: 18-Apr-2021].
- [12] R. Mullen and K. Tran, “Education for Sustainable Living Program (ESLP),” ESLP. [Online]. Available: [https://www.ioes.ucla.edu/wp-content/uploads/ART-2009-Green\\_Living\\_Project-Energy.pdf](https://www.ioes.ucla.edu/wp-content/uploads/ART-2009-Green_Living_Project-Energy.pdf). [Accessed: 18-Apr-2021].
- [13] Toronto Hydro, “Residential electricity rates,” Residential electricity rates – Toronto Hydro, Feb-2021. [Online]. Available: <https://www.torontohydro.com/for-home/rates>. [Accessed: 18-Apr-2021].
- [14] M. Bendtsen, “Key Benefits of KNX Automation for Commercial Buildings – BEMI Automation | BEMI Smart-Home”, BEMI Automation | BEMI Smart-Home, 2019. [Online]. Available: <https://www.bemi.fi/key-benefits-of-knx-automation-for-commercial-and-industrial-buildings/>. [Accessed: 10- Apr- 2021].
- [15] M. Shams, “How long do LED lights really last?,” Hyperikon, 05-Dec-2019. [Online]. Available: <https://www.hyperikon.com/blog/how-long-do-led-lights-really-last/>. [Accessed: 11-Apr-2021].
- [16] Sustainable City University of New York, NY Solar Map, 2016. [Online]. Available: <https://nysolarmap.com/>. [Accessed: 15-Apr-2021].
- [17] Google Maps, 2021. Mirvish Village, 1:1.500. Google Maps [online] Available through: Google Maps  
<<https://www.google.com/maps/place/60+Sussex+Ave,+Toronto,+ON+M5S+1J8/>>  
[Accessed 21 March 2021].
- [18] Labella Associates PC. (2018, June 12). *Roof Plan, St. John Fisher College* (Drawing no. A105) [Construction drawing]. <https://www.labellapc.com/>
- [19] J. Keith, “Increasing Solar Panel Efficiency and Output Power,” ElectroSchematics.com, 23-Jan-2015. [Online]. Available: <https://www.electroschematics.com/maximizing-solar-panel-efficiency-and-output-power/>. [Accessed: 18-Apr-2021].
- [20] D. D. Rooij, “Solar Panel Angle: how to calculate solar panel tilt angle?,” Manage risks and maximize ROI for your PV and energy storage projects, 27-Jul-2020. [Online].



- Available: <https://sinovoltaics.com/learning-center/system-design/solar-panel-angle-tilt-calculation/#:~:text=The%20optimum%20tilt%20angle%20is,34%20%2B%2015%20%3D%2049%20%2B0>. [Accessed: 18-Apr-2021].
- [21] T. Townsend, L. Powers, and J. Newmiller, “Measuring and modeling the effect of snow on photovoltaic system performance,” ResearchGate, Jun-2018. [Online]. Available: [https://www.researchgate.net/publication/251963305\\_Measuring\\_and\\_modeling\\_the\\_effect\\_of\\_snow\\_on\\_photovoltaic\\_system\\_performance](https://www.researchgate.net/publication/251963305_Measuring_and_modeling_the_effect_of_snow_on_photovoltaic_system_performance). [Accessed: 17-Mar-2021].
- [22] Natural Resources Canada, “Solar Ready Technical Specifications.” CanmetENERGY/Housing, Buildings and Communities, 2020. [Online]. Available: [https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/SolarReadyGuidelines\\_en.pdf](https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/SolarReadyGuidelines_en.pdf). [Accessed: 15-Apr-2021].
- [23] A. Sendy, “Pros and cons of string inverters vs microinverters,” Solar Reviews, 20-Nov-2020. [Online]. Available: <https://www.solarreviews.com/blog/pros-and-cons-of-string-inverter-vs-microinverter#string-inverter-disadvantages>. [Accessed: 27-Apr-2021].
- [24] K. Pickerel, “What are the different types of solar mounting systems for roofs?,” *Solar Power World*, 20-Dec-2018. [Online]. Available: <https://www.solarpowerworldonline.com/2017/02/different-types-solar-mounting-systems-roofs/>. [Accessed: 26-Mar-2021].
- [25] “Appliance Usage ,” *Burlington Hydro*. [Online]. Available: <https://www.burlingtonhydro.com/power-to-serve/residential/appliance-usage.html>. [Accessed: 10-Apr-2021].
- [26] “S4 MLO Panel boards by Siemens 1200A,” *Breaker Outlet*, 2020. [Online]. Available: <https://breakeroutlet.com/breaker-panels/panel-boards/1200-amp/s4-mlo-panel-boards-by-siemens-1200a/>. [Accessed: 10-Apr-2021].
- [27] “NFPA 70”, *National Electrical Code*, 2020. [Online]. Available: <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70> . [Accessed: 10-Apr-2021].
- [28] *Sense.com*, 15-Apr-2021. [Online]. Available: <https://sense.com/buy>. [Accessed: 18-Apr-2021].



- [29] V. R. F. -, "VRF Heat Recovery System: VRF Wizard: Variable Refrigerant Flow Air Conditioning," *Variable Refrigerant Flow Air Conditioning*, 23-Nov-2017. [Online]. Available: <https://vrfwizard.com/vrf-heat-recovery-system/>. [Accessed: 12-Apr-2021].
- [30] "What is a Heat Recovery VRF System," *Air Conditioning & Heating*, 24-Jan-2017. [Online]. Available: [https://www.361degrees.co.uk/resources/news/2015/11/20/what-is-a-heat-recovery-vrf-system#:~:text=The%20term%20Heat%20Recovery%20Variable,indoor%20heating%20Fcooling%20units\).&text=Simultaneously%20heating%20and%20cooling%20to%20different%20rooms%20or%20areas](https://www.361degrees.co.uk/resources/news/2015/11/20/what-is-a-heat-recovery-vrf-system#:~:text=The%20term%20Heat%20Recovery%20Variable,indoor%20heating%20Fcooling%20units).&text=Simultaneously%20heating%20and%20cooling%20to%20different%20rooms%20or%20areas.). [Accessed: 12-Apr-2021].
- [31] B. Thornton and A. Wagner, "Variable Refrigerant Flow Systems," 2012.
- [32] M. Luke, "How a Variable Refrigerant Flow System Can Save Your Clients Money," *HVAC News Blog*, 21-Oct-2019. [Online]. Available: [http://news.carrierenterprise.com/how-a-vrf-system-can-save-your-clients-money/#:~:text=A%20variable%20refrigerant%20flow%20\(VRF,worth%20the%20long%20term%20payoff](http://news.carrierenterprise.com/how-a-vrf-system-can-save-your-clients-money/#:~:text=A%20variable%20refrigerant%20flow%20(VRF,worth%20the%20long%20term%20payoff.). [Accessed: 12-Apr-2021].
- [33] "Surveillance," *Wikipedia*, 14-Apr-2021. [Online]. Available: [https://en.wikipedia.org/wiki/Surveillance#:~:text=Surveillance%20cameras%20are%20video%20cameras%20used%20for%20the,by%20a%20security%20guard%20or%20law%20enforcement%20officer](https://en.wikipedia.org/wiki/Surveillance#:~:text=Surveillance%20cameras%20are%20video%20cameras%20used%20for%20the,by%20a%20security%20guard%20or%20law%20enforcement%20officer.). [Accessed: 18-Apr-2021].
- [34] D. Crimmins, "What is a Fire Alarm System? (Fire Detection System) | RealPars", *RealPars*, 2021. [Online]. Available: <https://realpars.com/fire-alarm-system/>. [Accessed: 11-Feb- 2021].
- [35] *Project Profile: Towson University*, 1st ed. Northford: Honeywell Inc., 2020.
- [36] "Ontario Fire Code", *Ontario.ca*, 2013. [Online]. Available: <https://www.ontario.ca/laws/regulation/070213>. [Accessed: 11- Feb- 2021].
- [37] "Flame-Retardant Cable vs. Fire-Rated/Resistive Cable", *Anixter*, 2021. [Online]. Available: [https://www.anixter.com/en\\_us/resources/literature/wire-wisdom/flame-retardant-cable-vs--fire-rated-resistive-cable.html](https://www.anixter.com/en_us/resources/literature/wire-wisdom/flame-retardant-cable-vs--fire-rated-resistive-cable.html). [Accessed: 11- Feb- 2021].
- [38] *SECTION 13850 (28 31 00) FIRE DETECTION AND ALARM SYSTEM*. Northford: Honeywell Inc., 2014.



- [39] "CX-ED1079 Series: 'Universal' Gr. 1 Electric Strikes - Camden Door Controls", *Camdencontrols.com*, 2021. [Online]. Available: [https://www.camdencontrols.com/category/Electrified\\_Locks\\_Relays\\_and\\_Timers/Electric\\_Strikes/products/CX\\_ED1079L](https://www.camdencontrols.com/category/Electrified_Locks_Relays_and_Timers/Electric_Strikes/products/CX_ED1079L). [Accessed: 17- Apr- 2021].
- [40] "WIN-PAK® - Integrated Security Solution | Access Control Solutions | Access Control Systems | Honeywell Commercial Security", *Security.honeywell.com*, 2019. [Online]. Available: <https://www.security.honeywell.com/product-repository/winpak>. [Accessed: 18- Apr- 2021].
- [41] "OmniClass™ 2.0 | Readers | Access Control Systems | Honeywell Commercial Security", *Security.honeywell.com*, 2014. [Online]. Available: <https://www.security.honeywell.com/product-repository/omniclass>. [Accessed: 18- Apr- 2021].
- [42] AX3000 Whole Home Mesh Wi-Fi 6 System- DecoX60 [ Online ]  
Available:[https://www.tp-link.com/hk/home-networking/deco/deco-x60/v1%20\(3-pack\)/](https://www.tp-link.com/hk/home-networking/deco/deco-x60/v1%20(3-pack)/)  
[Accessed: 18th April 2021]
- [43] "T15 Home Theater and Music Bookshelf Speaker", *Polkaudio.com*, 2021. [Online]. Available: <https://www.polkaudio.com/en/bookshelf-speakers/t15#Support>. [Accessed: 18- Apr- 2021].
- [44] HOSMART, "Wireless Intercom System Hosmart 1/2 Mile Long Range 7-Channel Security Wireless Intercom System for Home or Office [4 Stations Black]," *Amazon.ca: Electronics*, 26-Nov-2016. [Online]. Available: [https://www.amazon.ca/Wireless-Intercom-Hosmart-7-Channel-Security/dp/B01MXBRW71/ref=sr\\_1\\_14?dchild=1&keywords=wireless%2Bintercom%2Bsystem%2B6%2Bpack&qid=1615078425&sr=8-14&th=1](https://www.amazon.ca/Wireless-Intercom-Hosmart-7-Channel-Security/dp/B01MXBRW71/ref=sr_1_14?dchild=1&keywords=wireless%2Bintercom%2Bsystem%2B6%2Bpack&qid=1615078425&sr=8-14&th=1). [Accessed: 08-Apr-2021].
- [45] Clip Art Library, "Collection of Laptop Cliparts (54) - Laptop Cliparts #157908," *Free Laptop Cliparts, Download Free Clip Art, Free Clip Art on Clipart Library*, 201AD. [Online]. Available: <http://clipart-library.com/laptop-cliparts.html>. [Accessed: 08-Apr-2021].
- [46] Raspberry Pi Foundation, "Raspberry Pi 3 Model B+," *Canakit*, 201AD. [Online]. Available: <https://www.canakit.com/raspberry-pi-3-model-b-plus.html?cid=cad&src=raspberrypi>. [Accessed: 08-Apr-2021].
- [47] TCL, "TCL 40' Class 3-Series HD LED Smart Android TV - 40S334-CA: Amazon.ca: Electronics," *TCL 40" Class 3-Series HD LED Smart Android TV - 40S334-CA*, 18-Nov-2020. [Online]. Available: <https://www.amazon.ca/TCL-40S325-CA-1080p-Smart-Television/dp/B08NTXR2XL?th=1>. [Accessed: 08-Apr-2021].
- [48] EPSON, "Home Cinema 2200 3LCD Full HD 1080p Projector," *Home Cinema 2200 3LCD Full HD 1080p Projector | Streaming Entertainment | Projectors | For Home | Epson Canada*.





[Online]. Available: <https://epson.ca/For-Home/Projectors/Streaming-Entertainment/Home-Cinema-2200-3LCD-Full-HD-1080p-Projector/p/V11HA12020-F>. [Accessed: 08-Apr-2021].

[49] "Touchless Access Control & Automatic Door Opening Systems," *Touchless Access Control & Automatic Door Opener Technology*, 2021. [Online]. Available: <https://www.openpath.com/touchless-access-control>. [Accessed: 16-Apr-2021].

[50] "Flexible Access Control Methods," *Access Control Methods: Mobile & Encrypted Entry*, 2021. [Online]. Available: <https://www.openpath.com/access-methods>. [Accessed: 16-Apr-2021].

[51] "Mullion Door Reader," *Openpath*, 2021. [Online]. Available: <https://www.openpath.com/product/mullion-smart-reader>. [Accessed: 16-Apr-2021].

[52] S. Kloeppele, "New Hands-Free Access Control for Smartphone," *Buildings*, 26-Sep-2018. [Online]. Available: <https://www.buildings.com/articles/27900/new-hands-free-access-control-smartphone>. [Accessed: 16-Apr-2021].

[53] "Laundry Master Solution," *ITC Systems Laundry*. [Online]. Available: <https://itcsystems.com/products/hardware/laundry/>. [Accessed: 16-Apr-2021].

[54] B. Larson, "Key Technologies for Building Automation Systems", Homebase. [Online]. Available: <https://homebase.ai/connected-buildings/building-automation-systems-key-technologies/#:~:text=Building%20automation%20allows%20management%20to,managed%20from%20a%20single%20application>. [Accessed: 05- Feb- 2021].

[55] *Security and Access Control System Specification*, 2nd ed. Toronto: University of Toronto, 2015.

[56] "EBI 600", *Buildings.honeywell.com*, 2021. [Online]. Available: <https://buildings.honeywell.com/us/en/solutions/optimization/ebi-600>. [Accessed: 13- Feb- 2021].

[57] *Standard Building Automation System (BAS) Specification*. Toronto: City of Toronto, 2018, pp. Section 23 09 23.

[58] J. Young, "Achieving energy savings through building automation", *REMINET*, 2012. [Online]. Available: <https://www.reminetwork.com/articles/building-automation-can-save-energy/>. [Accessed: 16- Feb- 2021].



- [59] "Salvage Value - Learn How to Calculate an Asset's Salvage Value", *Corporate Finance Institute*. [Online]. Available: <https://corporatefinanceinstitute.com/resources/knowledge/accounting/salvage-value/>. [Accessed: 15- Apr- 2021].
- [60] "Electricity usage of a LED Light Bulb", Electricity usage of a LED Light Bulb – Energy Use Calculator, [Online]. Available: [https://energyusecalculator.com/electricity\\_ledlightbulb.htm](https://energyusecalculator.com/electricity_ledlightbulb.htm). [Accessed: 10-Apr-2021].
- [61] *Schneider Electric Pricing: Security Systems and Solutions*. New York: Schneider Electric, 2018.
- [62] "Fire Alarm System Panels: Conventional versus Addressable", *Electrical Contractor Magazine*, 2001. [Online]. Available: <https://www.ecmag.com/section/systems/fire-alarm-system-panels-conventional-versus-addressable>. [Accessed: 29- Mar- 2021].
- [63] "Power Data," *IESO*, 2021. [Online]. Available: <https://www.ieso.ca/power-data>. [Accessed: Apr-2021].
- [64] "Low-Carbon Action Plan 2019-2024," *University of Toronto*, 2019. [Online]. Available: [https://www.fs.utoronto.ca/wp-content/uploads/2019/10/2019-10-04\\_LowCarbonActionPlan\\_V22\\_Spread\\_Web.pdf](https://www.fs.utoronto.ca/wp-content/uploads/2019/10/2019-10-04_LowCarbonActionPlan_V22_Spread_Web.pdf). [Accessed: 2021].
- [65] R. Naam, "Solar's Future is Insanely Cheap (2020)," *Ramez Naam*, May-2020. [Online]. Available: <https://rameznaam.com/2020/05/14/solars-future-is-insanely-cheap-2020/>. [Accessed: 28-Apr-2021].
- [66] D. A. F. J. B. O. M. G; "Bright light during nighttime: effects on the circadian regulation of alertness and performance," *Biological signals and receptors*. [Online]. Available: <https://pubmed.ncbi.nlm.nih.gov/11025337/>. [Accessed: 10-Apr-2021].
- [67] C. L. Miller, R. White, T. L. Whitman, M. F. O'Callaghan, and S. E. Maxwell, "The effects of cycled versus noncycled lighting on growth and development in preterm infants," *Infant Behavior and Development*, 08-Apr-2002. [Online]. Available: <https://www.sciencedirect.com/science/article/abs/pii/0163638395900101>. [Accessed: 10-Apr-2021].
- [68] Government of Canada, Statistics Canada, "Construction Union Wage Rates, Monthly, Inactive," 25-Oct-2018. [Online]. Available:



<https://www150.statcan.gc.ca/t1/tb11/en/tv.action?pid=1810004601>. [Accessed: 25-Apr-2021].

[69] City of Toronto, "FAIR WAGE SCHEDULE 2016-2019 I.C.I Work", Current & Previous Fair Wage Schedules, 2017. [Online]. Available: <https://www.toronto.ca/wp-content/uploads/2017/08/8d6f-ICI-Work.pdf>. [Accessed: 25-April-2021].

[70] Government of Canada, "Job Bank", Job Bank. [Online]. Available: <https://www.jobbank.gc.ca/home>. [Accessed: 25-April-2021].

[71] "Everything About Unions," *UFCW Canada - Canada's Private Sector Union*. [Online]. Available: [http://www.ufcw.ca/index.php?option=com\\_content&view=article&id=32573&Itemid=2451&lang=en#:~:text=When%20it%20comes%20to%20pay,not%20belong%20to%20a%20union](http://www.ufcw.ca/index.php?option=com_content&view=article&id=32573&Itemid=2451&lang=en#:~:text=When%20it%20comes%20to%20pay,not%20belong%20to%20a%20union). [Accessed: 25-Apr-2021].

[72] Government of Ontario, Ministry of Labour, "Overtime Pay and Time Off In Lieu: Hours of Work and Overtime Tool," *Hours of Work and Overtime Tool | Ministry of Labour*. [Online]. Available: [https://www.labour.gov.on.ca/english/es/tools/hours/overtime\\_tutorial.php](https://www.labour.gov.on.ca/english/es/tools/hours/overtime_tutorial.php). [Accessed: 25-Apr-2021].

[73] "Smart touch free elevator technology," *Openpath*, 2021. [Online]. Available: <https://www.openpath.com/touchless-elevators>. [Accessed: 16-Apr-2021].

[74] "Enhanced security and flexibility when you need it most," *Door Lockdown System | School, Office, and Building Lockdown*, 2021. [Online]. Available: <https://www.openpath.com/lockdown>. [Accessed: 16-Apr-2021].

[75] "Keep unwanted visitors out of the office," *Tailgating Security | Door Access Control Anti-Tailgating*, 2021. [Online]. Available: <https://www.openpath.com/tailgating>. [Accessed: 16-Apr-2021].

[76] H.Robert. "RE: Openpath Security <> Responding to Your Request" Personal email (March 24, 2021)

[77] "netZtouch Laundry Master," *netZtouch Laundry Master – 18-01*. [Online]. Available: <https://portal.itcsystems.com/files/xzppmh73>. [Accessed: 16-Apr-2021].

[78] "Z90 LTE 4G Magnetic/IC/NFC Card Reader Android POS Terminal with Receipt Printer," *eBay*, 2021. [Online]. Available: [https://www.ebay.ca/itm/Z90-LTE-4G-Magnetic-IC-NFC-Card-Reader-Android-POS-Terminal-with-Receipt-](https://www.ebay.ca/itm/Z90-LTE-4G-Magnetic-IC-NFC-Card-Reader-Android-POS-Terminal-with-Receipt-Printer)



Printer/164507848981?hash=item264d6e9115%3Ag%3AZV8AAOSwCQ1frRYA. [Accessed: 16-Apr-2021].

[79] "LAUNDRY CONTROL INTERFACE 1301510501 REV C CIRCUIT BOARD RARE NEW OLD STOCK \$249," *eBay*. [Online]. Available: <https://tinyurl.com/ywaa24tc>. [Accessed: 17-Apr-2021].

[80] "WaveRider Wave controller laundry system WLAU-WC-3.0 payment processing machine," *eBay*. [Online]. Available: <https://tinyurl.com/dftk33mv>. [Accessed: 16-Apr-2021].

[81] "Improving the Length of Your Building Automation System's Useful Life", *Buildingsiot.com*, 2020. [Online]. Available: <https://www.buildingsiot.com/blog/improving-the-length-of-your-building-automation-systems-useful-life-bd#:~:text=Today%2C%20a%20typical%20building%20automation,does%20not%20become%20obsolete%20sooner>. [Accessed: 17- Apr- 2021].

[82] K. Hodgson, "The State of the Access Control Market in 2019", *SDM*, 2019.

[83] Security-Net, "What is the average life expectancy of an IP camera?", 2019.

[84]T. Velez, "What Do I Do With an Old Fire Alarm System?", *Facilitiesnet*, 2009. [Online]. Available: <https://www.facilitiesnet.com/firesafety/article/What-Do-I-Do-With-an-Old-Fire-Alarm-System--10441#:~:text=Most%20fire%20alarm%20systems%20are,no%20longer%20supports%20the%20product>. [Accessed: 17- Apr- 2021].

[85] "Glass break detector Hikvision DS-PDBG8-EG2-WE AX PRO", *Bezpeka.club*, 2021. [Online]. Available: <https://bezpeka.club/en/product/hikvision-ds-pdbg8-eg2-we/>. [Accessed: 17-Apr- 2021].

[86] R. Tatum, "Determining and Stretching the Useful Life of Controls", *Facilitiesnet*, 2010. [Online]. Available: <https://www.facilitiesnet.com/buildingautomation/article/Determining-and-Stretching-the-Useful-Life-of-Controls--12177>. [Accessed: 17- Apr- 2021].

[87] B. Chen, "If Your Wi-Fi Is Terrible, Check Your Router", *The New York Times*, 2021.

[88] "Is it time to upgrade your intercom system", *Quality Home Systems*, 2016. [Online]. Available: <https://qualityhomesystems.com/article/is-it-time-to-upgrade-your-intercom-system#:~:text=The%20average%20intercom%20system%20has,not%20sooner%2C%20and%20wears%20out>. [Accessed: 17- Apr- 2021].

[89] J. Dominic, "How Long Do Home Receivers Last?", *Home Theatre Academy*, 2021.

[90] "Is it time to upgrade your LED display?", *Samsung Insights*, 2020.



## 7 Appendix

### Appendix A Summary of NECA and University interactions

#### Interaction with University of Toronto Community

Throughout our team's design process, we have been consulting the UofT community to better understand what they want out of a dorm building and to ensure we meet University and City requirements. At the beginning of our design process, we sent out an occupancy survey to University of Toronto students asking them questions about their dorm experiences and how it could be improved. We asked questions about the lighting, thermal comfort, and electricity in their current or previous dorms in order to get a sense of what they had liked and disliked about their dorm experience. This helped us design to meet their needs, and even led us to add in some fun additions to our designs. Screenshots of the occupancy survey and the questions it contained have been included later on in Appendix A.

Another interaction we had within the University community was with our faculty advisors, Ian Sinclair and Tamer El-Diraby. We contacted them both several times throughout our design development, especially in the initial stages when we were developing our team. Ian also attended our virtual pre-proposal presentations along with Michael and his team and provided feedback to help us in our design process.

We also held several virtual meetings with Keith Foster, a Manager of Electrical Systems at the University of Toronto. Similar to our pre-proposal presentations with Michael and his team, Keith reviewed our sub-team's pre-proposal presentations and provided feedback that helped us to adjust our designs to better fit University and local codes and standards. We had two virtual meetings with Keith to go over the pre-proposal presentations, as seen in Figure 7.1 and Figure 7.2 below, in order to go into more depth regarding University requirements and to give us a chance to introduce him to our team and the ECIC. We also kept in touch with Keith throughout our design process in order to follow up on questions he was unable to answer during the meetings and other questions we had as we were developing our designs. Keith also looked over our final proposal to provide feedback and suggestions regarding how we could improve it.

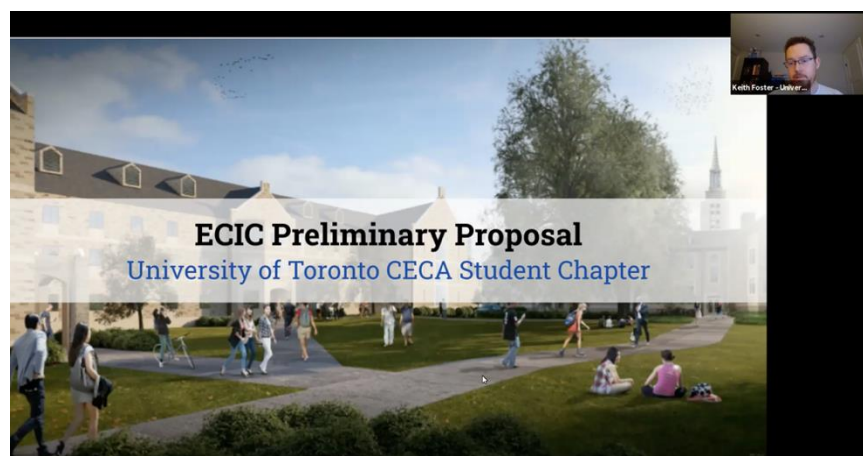


Figure 7.1: First Preliminary Proposal Meeting with Keith Foster

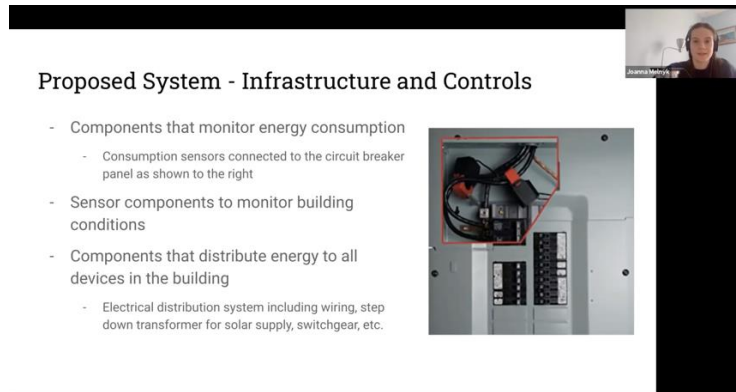


Figure 7.2: Second Preliminary Proposal Meeting with Keith

Another University employee who assisted us in the ECIC was Adrian Phillips who is a Senior Project Manager of University Planning, Design & Construction at the University of Toronto. Through email communication, Adrian helped us in the initial stages of the competition by providing us with drawing samples and connecting us with Keith Foster, mentioned previously.

Lastly, another contact that assisted us in the ECIC was Angelo Suntres who works for EllisDon in Toronto. Our team has been working with Angelo for a while as he has been a yearly judge at our fall Case Competition. The Case Competition is the competition we run to mimic the GEC (now the ECIC) to prepare students for the ECIC in the spring. We corresponded with Angelo through email where he provided us answers to the questions we had about our designs.

### **Interaction with CECA/NECA Community**

This information has been summarized in Section 4.2 Interactions with NECA contractors, but it is repeated here along with images of our meetings as a part of our community interaction summary.

To develop and refine our ECIC proposal, our chapter worked with both CECA and NECA contracting members. As the University of Toronto is a Canadian university based in the City of Toronto, our first contact was an email conversation with Gregg Witty who is with the CECA Toronto Chapter. We worked with Gregg to ensure we had all the proper items needed to be able to participate in the ECIC, such as our NECANet accounts. After this correspondence, Gregg referred us to Michael Parkes, a NECA contractor, and his team who provided us invaluable guidance throughout the ECIC process.

Our first contact with Michael was a virtual introductory meeting between him and our Communications Coordinator, Sarah De Sousa. This helped us develop a guide for what meetings we would need with Michael and his team in the future and helped provide us with a better understanding of the ECIC and what we needed to accomplish. Following this, our team had a virtual meeting with Michael and his team, including Brian Rittenhouse, Brian Shaffer, and Rob Miller, where they gave us an introduction to construction drawings as this was an area we recognized we lacked knowledge as seen in Figure 7.3. Our next virtual meeting with Michael and Rob was our preliminary proposal presentation, where our sub-teams presented on what they planned to propose for the ECIC. At the end of the presentations, Michael and Rob then provided feedback which allowed us to finetune our designs. Our last virtual meeting, again with Michael and Rob, was a discussion regarding project management where we received advice and feedback on our estimation and schedules as seen in Figure 7.4.



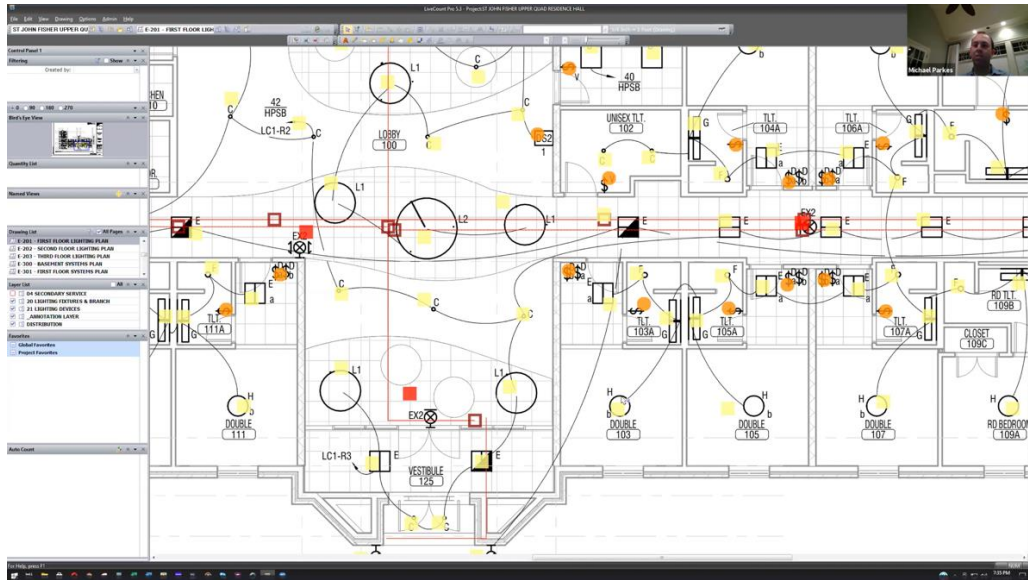


Figure 7.3: Intro to Construction and Electrical Drawings Meeting

Item	Quantity	Unit	Price	Cost	Category
40-inch TVs	10	Pcs	\$270	\$2,700	Telecommunication Technician
Epson Home Cinema 2200 (Projector)	1	Pcs	\$1,300	\$1,300	Telecommunication Technician
Tilting TV Wall mount	10	Pcs	\$65	\$650	Telecommunication Technician
Raspberry Pi 3 B+	10	Pcs	\$48	\$480	Telecommunication Technician
Passive Distributed Antenna System	1	Pcs	\$42,160	\$42,160	Telecommunication Technician
<b>AV System Subtotal</b>					
<b>AV System</b>					
Wireless Intercom System	85	Pcs	\$38	\$3,230	Telecommunication Technician
Projector and Screen	1	Pcs	\$1,300	\$1,300	Telecommunication Technician
TV Screen	10	Pcs	\$270	\$2,700	Telecommunication Technician
Wall Mount	10	Pcs	\$65	\$650	Telecommunication Technician
Super Computer	10	Pcs	\$48	\$480	Telecommunication Technician
Power Supply	10	Pcs	\$14	\$140	Electrician
SD Card	10	Pcs	\$4	\$40	
Display Software	120	Pcs	\$8	\$960	Telecommunication Technician
Sound System	3	Pcs	\$655	\$1,965	Telecommunication Technician
Ethernet					
VoIP Basestation	1	Pcs	\$1,499	\$1,499	Telecommunication Technician
VoIP Access Point	11	Pcs	\$179	\$1,969	Telecommunication Technician
Passive Distributed Antenna System	3	Pcs	\$42,160	\$126,480	Telecommunication Technician
<b>AV System Subtotal</b>					
<b>Hands-Free Control System</b>					
Automatic Spring Door Operator	12	Pcs	\$2,385	\$28,620	Electrician
No Touch Ware to Open Switch	12	Pcs	\$142	\$1,704	Electrician
Loader	3	Pcs	\$127	\$381	Civil Labour
Laundry Machine Interface	18	Pcs	\$316	\$5,688	
Laundry Master	3	Pcs	\$217	\$651	
<b>Hands-Free Control System Subtotal</b>					
<b>Smart Building Design Subtotal</b>					
<b>448,970</b>					

Figure 7.4: Project Management Discussion

Throughout this process, we also kept in touch with Gregg and Michael through email correspondence for check-ins to ensure we were on track and to ask various questions regarding our designs. Michael and Rob also reviewed our final proposal and provided us with feedback to help us develop a stronger presentation. The help that Gregg, Michael, and his team provided us during the ECIC experience was invaluable and we are incredibly grateful for their guidance and support.

### NECA Training Sessions

Below, in Table 7.1 Log of NECA Training Sessions, is a table of the NECA training sessions our team members attended. We added this here for reference since it was unclear whether our attendance was marked at these events.



Table 7.1 Log of NECA Training Sessions

Date Watched	Attendee	Subject
01/19/21	Sally Chiu	Beginner Revit Training: Part 1
01/19/21	Scott Zhu	Beginner Revit Training: Part 1
02/23/21	Scott Zhu	Beginner Revit Training: Part 2
03/16/21	Scott Zhu	Beginner Revit Training: Part 3
04/27/21	Scott Zhu	Beginner Revit Tutorial: Part 4
2/11/21	Lina Mollazadeh	Estimating Training: Part 1
2/11/21	Ashvin Baskaran	Estimating Training: Part 1
2/11/21	Zhu Yanfei	Estimating Training: Part 1
2/11/21	Michelle Leo	Estimating Training: Part 1
3/11/21	Lina Mollazadeh	Estimating Training: Part 2
4/30/21	Lina Mollazadeh	Estimating Training: Part 3
4/30/21	Jerry Lam	Estimating Training: Part 3
4/29/21	Sarah De Sousa	The Current State of Construction Technology
4/29/21	Sarah De Sousa	Innovations in Electrical Contracting
4/30/21	Sarah De Sousa	A 360° View of BIM (Building Information Modeling)

### Occupant Survey

Below in *Figure 7.5* is the Occupant Survey we sent out the University of Toronto students as well as our ECIC team. We distributed the survey on several University of Toronto Facebook pages, such as the University of Toronto Engineering Undergraduate page. Also, we encouraged our team to share it with their peers. 20 students who have experience living in campus residences responded to the survey.



Figure 7.5: Occupant Survey



## Occupant Survey

Hi! We are the UofT CECA design team and we are participating in a competition where the goal is to design a university dorm that meets student's needs. Please answer the questions below about your dorm experience to help us design an amazing dorm, it should take you around 10min and it all centers about your living experience! Thanks so much for helping!!

If you are passionate in learning more about the potential engineering solutions to improve dorm experience, let us know in the last question and we will share our findings to you!

\* Required

Email address \*

Your email

---

What dorm(s) have you lived in? (please give specifics on room size and occupancy if possible) \*

Your answer

---



## Lighting

Take a moment and think about the light in your room, have you ever felt frustrated for not getting enough light to do schoolwork? Does natural light cause glare? In this section, we will ask similar qs to help resolve these issues to max productivity and support your wellbeing!

How satisfied were you with the amount of natural lighting that you got in your room? \*

	1	2	3	4	5	
Very Unsatisfied	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very Satisfied

Memory flashback! Please tell us the number of windows in your room (their size and location) (ex. % of window to wall, any light blockage from adjacent building)

Your answer \_\_\_\_\_



How satisfied were you with the artificial lighting in your room? \*

- Not enough lighting
- Harsh lighting
- It was OK
- Too much lighting/ little control over the amount of lighting

Your sleep is not disturbed when your roommate has their light on \*

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

If it was please describe why.

Your answer \_\_\_\_\_



You are able to turn the lights on/off easily within short distance from your bed, desk, or sink \*

	1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

If true, please describe how this was possible.

Your answer \_\_\_\_\_

Please give a brief explanation on how and why natural and/or artificial lights have affected your satisfaction. \*

Your answer \_\_\_\_\_





## Thermal Comfort

This section takes you to think about the temp in your dorm. If you have additional thoughts (e.g. how the hot temp makes you feel dry in room, be sure to write them down)!

How satisfied were you with the temperature of your room? \*

	1	2	3	4	5	
Very Dissatisfied	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very Satisfied

Were you able to control the temperature in your room? \*

- Yes
- No

Would you want to be able to control the temperature of your room, if you are not currently able to?

- Yes
- No

Do you have anything else to share regarding thermal comfort while living in your dorm?

Your answer \_\_\_\_\_



## Electricity

Last section! Let us talk about the internet connection, plug loads and appliances!

How many outlets were in your room (please give best estimate) \*

Your answer \_\_\_\_\_

How satisfied were you with the number of outlets in your room? \*

1      2      3      4      5  
Not enough outlets                        More than enough outlets

How satisfied were you with the wifi connection in your room? \*

1      2      3      4      5  
Very Dissatisfied                        Very Satisfied



Did you bring any appliances into your dorm (anything that needed to be plugged in)? If yes, what were they?

Your answer \_\_\_\_\_

Are you aware of any restrictions set by the dorm for types of appliances? If yes, what were they?

Your answer \_\_\_\_\_

What was your favorite indoor place to study on campus? What features did you like most about it? (e.g. technical, social factors are all welcome)

Your answer \_\_\_\_\_

What appliances would you want a common room to have? (ex. TV, gaming console, monitor that displays events/announcements, etc.)

Your answer \_\_\_\_\_



Are there any features in other dorms that you have seen and wished your dorm had?

Your answer \_\_\_\_\_

Thanks so much for completing the form! Anything else you would like us to know?

Your answer \_\_\_\_\_

Would you like to receive a set of engineering solutions from us to improve your dorm experience? \*

- Yes
- No, it's ok :)

## Appendix B Lighting System Technical Analysis Support Items

Table 7.2: Room Breakdown and their Respective Lux Requirement [2.1.1 -1]

Room	Lux requirement	Room	Lux requirement
Bed Bedrooms	250	Study Room	400
Janitor Room	150	Storage Room	150
Washroom	200	Pump & Boiler rooms	200
Kitchen	500	Utility Rooms	200
General public rooms	200	Stairs	75
Lobby	250	Janitor Room	150



Table 7.3: Value Engineering: LED and Incandescent Lights [2.2.1 -1]

	LED	Incandescent
Lifespan in hours per bulb (minimum)	10,000	1,000
Watts (equivalent 60 watts)	10	60
Cost per bulb	\$2.50	\$1.25
Daily cost* per bulb	\$0.005	\$0.03
Annual cost* per bulb	\$1.83	\$10.95
Total fixtures	889	889
For 1 year – 8784 hours:		
Bulb needed	889	9 x 889 = 8,001 (at least 9 for 8,784 hours)
Total cost for 1 year with bulb price	889 x (1.83 + 2.50) = \$3,850.00	8,001 x (10.95 + 1.25) = \$97,620.00
For 50k hours (including 1 <sup>st</sup> year):		
Bulbs needed	5 x 889 = 4,445	50 x 889 = 44,450
Total cost for 50k hours @ \$0.10 per kWh with bulb price	4,445 x (0.005 x 10,000) + 4,445 x 2.50 = <b>\$234,000.00</b>	44,450 x (0.03 x 10,000) + 44,450 x 1.25 = <b>\$13,390,000.00</b>

\* Assuming 5 hours a day @ \$0.10 per kWh.

Table 7.4: Final Quantity of Lights with Fixture Information

Symbol	Fixture	Lumens	Watt	Final Quantity
V	Vanity lights	2,000	17	81
P	Pot lights	1,200	15	21
P	Pot lights (in dorm room)	1,200	15	170
S	strip lights	2,300	19	23
L	linear fixture	3,000	39	26
W	wall lights	1,100	15	190
F1	flush mounted – 1	1,680	21	79
F2	flush mounted – 2	2,400	39	10
F3	flush mounted – 3	2,400	39	210
F4	flush mounted – 4	3,100	29	23
EXIT	EXIT lights		4.5	18
Emergency	Emergency lights		2	13
Total				<b>864</b>

Table 7.5: Operating Cost with and without dimmer comparison



Fixture	Watt	Quantity	Operating hour without timer & dimmer (h/day)	Total demand (kWh/day)	(kWh /year)	Operating hour with timer & dimmer (h/day)	Total demand (kWh/day)	(kWh /year)
Vanity lights	17	81	4	5.5	2,010.4	4	5.5	2,010.4
Pot lights	15	21	16	5.0	1,839.6	16	5.0	1,839.6
Pot lights (in dorm room)	15	170	4	10.2	3828.1	4	10.2	3828.1
strip lights	19	23	24	10.5	3,828.1	24	5.9	2,145.3
linear fixture	39	26	24	24.3	8,882.6	24	13.6	4,978.0
wall lights	15	190	24	68.4	24,966.0	24	38.3	13,991.4
flush mounted - 1	21	79	6	10.0	3,633.2	6	10.0	3,633.2
flush mounted - 2	39	10	6	2.3	854.1	6	2.3	854.1
flush mounted - 3	39	210	6	49.1	17936.1	6	49.1	17936.1
flush mounted - 4	29	23	24	16.0	5842.9	24	9.0	3274.5
EXIT lights	4.5	18	24	1.9	709.6	24	1.9	709.6
Emergency lights	2	13	24	0.6	227.8	24	0.6	227.8
Total Demand				204.0	74453.4		151.6	55,322.9
Final Operating costs					8786			6528

Table 7.6: Wiring Estimate for the Building

Floor 1					Basement				
wire lines	length (ft)	(inch)	repetition	total (ft)	wire lines	length (ft)	(inch)	repetition	total (ft)
	219	8	1	220					





right dorm rooms	24	8	7	173	Horizontal wires (on drawing)	19	1	1	19
	22	1	4	88		20	6	1	21
left dorm rooms	141	3	1	141		19	5	1	19
	23	5	3	70		20	6	1	21
	22	8	1	23		11	10	1	12
	23	5	5	117		11	5	1	11
	9	4	1	9		19	11	1	20
left public area	15	6	1	16		19	8	1	20
	55	11	1	56		13	4	1	13
hallway	69	10	1	70		20	1	1	20
	137	11	1	138		18	11	1	19
	22	4	1	22		20	1	1	20
	29	2	1	29		19	10	1	20
	7	8	1	8	19	6	1	20	
	19	8	1	20	Vertical wires (on drawing)	24	10	1	25
	17	4	1	17		54	8	1	55
	7	6	1	8		59	0	1	59
8	2	1	8						
			Total (ft)	1,479			Total (ft)	393	
Floor 2		Floor 3 (identical as floor 2)							
wire lines	total (ft)	wire lines	total (ft)						
	1,440		1,440		FINAL LENGTH (ft)			4,751	

Table 7.7: Life Cycle Cost Analysis for lighting system

	Cost		Present Worth	Interest Rate	8.00%
Capital	-\$251,000.00	(first year cost)		Period/ life span	30
O&M	-\$13,828.00	(cost yearly)	-\$406,700		
Salvage	\$0.00	(last year cash flow)	\$0.00		
			Total	-\$657,700	



## Appendix C Building Energy Management Technical Analysis Support Items

Table 7.8: Load estimation for all building appliances

Device	Wattage (W)	Device Count	Total Wattage (W)	Average hours of operation per month	Monthly Consumption (kWh)
Air Conditioner	720	88	63,360	120	7,603,200
Dryer	5,000	45	225,000	50	11,250,000
Washer	500	45	22,500	50	1,125,000
Computer	200	60	12,000	200	2,400,000
Dishwasher	1,300	10	13,000	120	1,560,000
Fridge	1,000	3	3,000	720	2,160,000
Microwave	1,400	3	4,200	120	504,000
Television	80	12	960	192	184,320
Lightbulb	100	95	9,500	384	3,648,000
Bathroom Vent Fan	60	84	5,040	24	12,0960
<b>TOTAL</b>			<b>358,560</b>	<b>1,980</b>	<b>30,555,480</b>

Table 7.9: Load estimation and panel sizing for all building room-types and floors

Floor	Room Type		Total Wattage	Room Count
1	Double Dorm (including bathroom)	1 AC 3 light bulbs 1 bathroom vent	1,080	20
	Single Dorm (including bathroom)	1 AC 3 light bulbs 1 bathroom vent 1 television	1,160	3
	Laundry Room	15 dryers 15 washers 5 lightbulbs	83,000	1
	Kitchen	2 dishwashers 3 fridges 5 light bulbs 3 ovens	10,300	1
	Unisex Bathroom	1 bathroom fan	60	1



	RD Living Room	1 AC 2 computers 3 light bulbs	1,420	1
	<b>TOTAL FLOOR WATTAGE</b>		<b>119,860 W</b>	
	<b>FLOOR PANEL SIZE</b>		<b>999 A</b>	
2	Double Dorm (including bathroom)	1 AC 3 light bulbs 1 bathroom vent	1,080	27
	Single Dorm (including bathroom)	1 AC 3 light bulbs 1 bathroom vent 1 television	1,160	3
	Laundry Room	15 dryers 15 washers 5 lightbulbs	83,000	1
	Common Room	1 AC 15 computers 3 light bulbs	4,020	1
	Study Quiet	1 AC 15 computers 3 light bulbs	4,020	2
	<b>TOTAL FLOOR WATTAGE</b>		<b>127,700 W</b>	
<b>FLOOR PANEL SIZE</b>		<b>1,065 A</b>		
3	Double Dorm (including bathroom)	1 AC 3 light bulbs 1 bathroom vent	1,080	27
	Single Dorm (including bathroom)	1 AC 3 light bulbs 1 bathroom vent 1 television	1,160	3
	Common Room	1 AC 15 computers 3 light bulbs	4,020	1
	Study Quiet	1 AC 15 computers 3 light bulbs	4,020	2



Laundry Room	15 dryers 15 washers 5 lightbulbs	83,000	1
<b>TOTAL FLOOR WATTAGE</b>		<b>127,700 W</b>	
<b>FLOOR PANEL SIZE</b>		<b>1,065 A</b>	

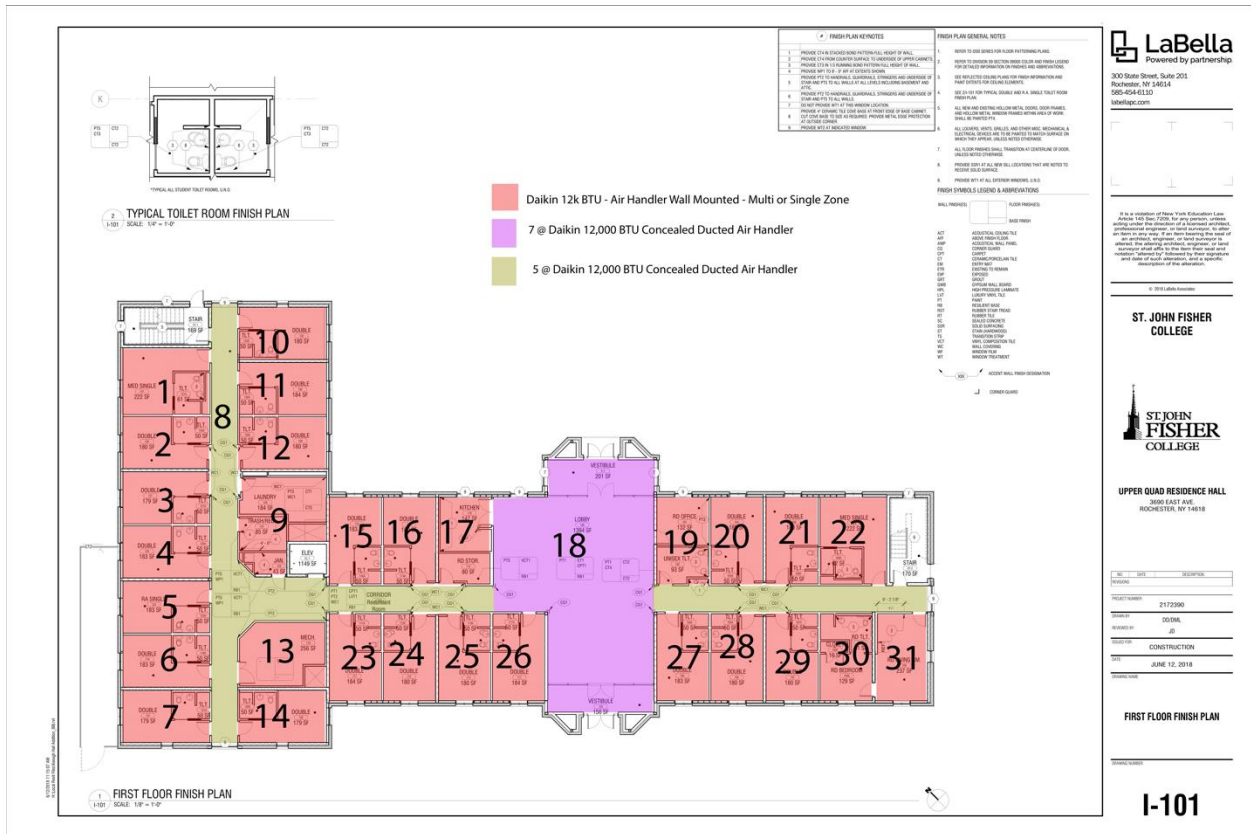


Figure 7.6: First Floor VRF Zones

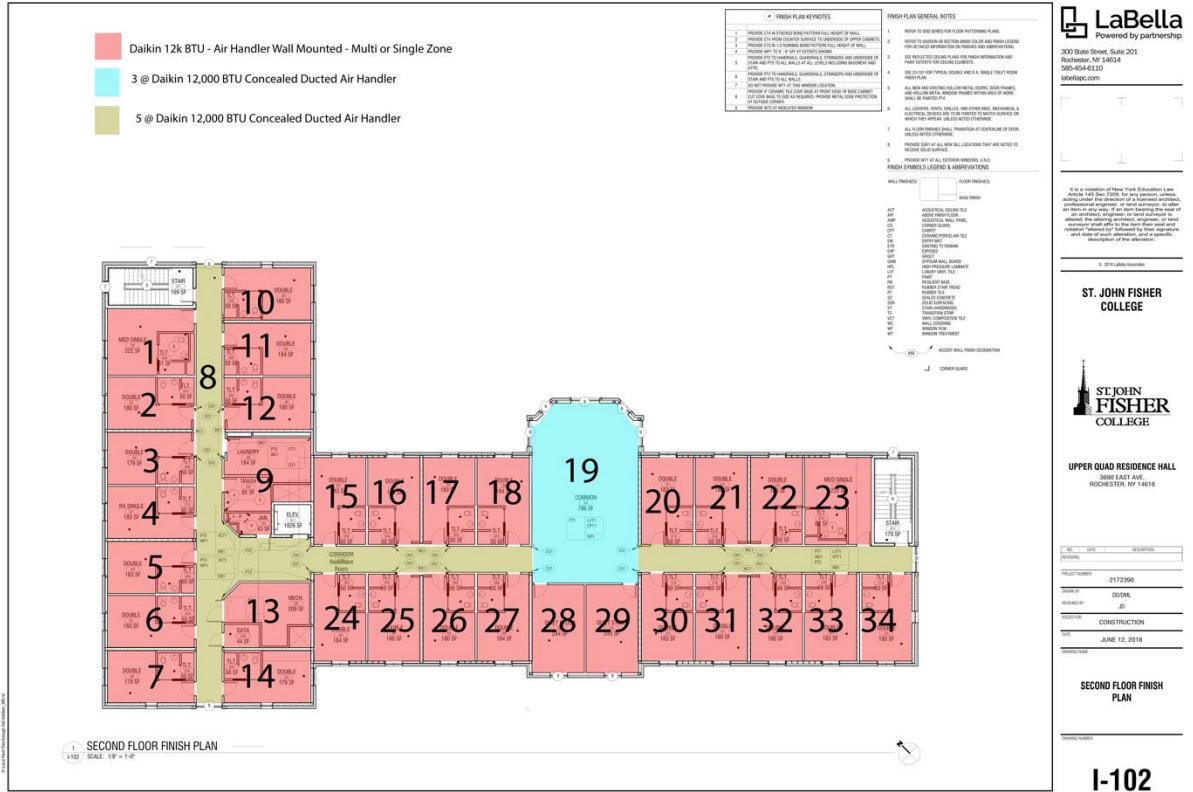


Figure 7.7: Second Floor VRF Zones

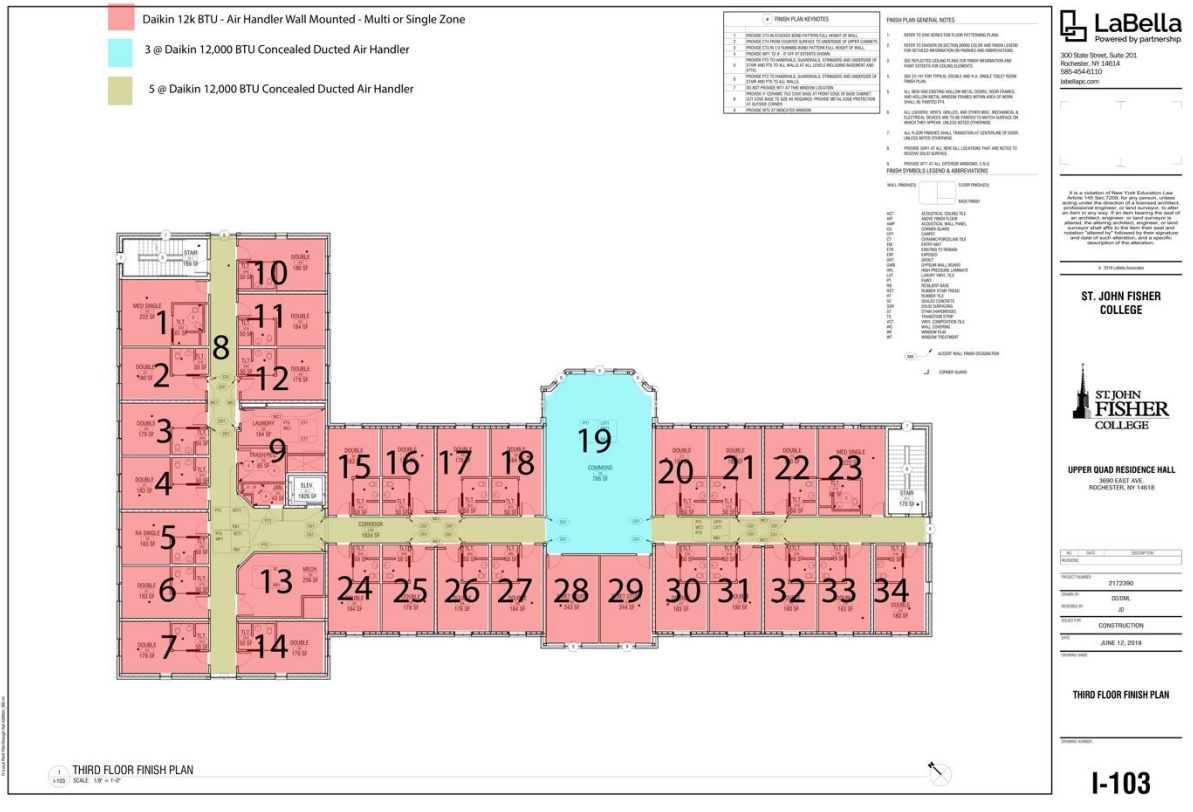


Figure 7.8: Third Floor VRF Zones

Table 7.10: BEM System Life Cycle Cost Analysis

	Cost		Present Worth	Interest Rate	8.00%
Capital	-\$304,700.00	(first year cost)		Period/ life span	30
O&M	-\$81,800.00	(cost yearly)	\$920,300.00		
Salvage	\$0.00	(last year cash flow)	\$0.00		
			Total	\$1,225,000.00	

Table 7.11: Estimation of Building Annual Energy Demand

Sub-System	Component	Count	Power (W)	Hours Use per Month	Annual Energy Demand (kWh)
BEM	VRF system (see below)	N/A	N/A	N/A	67,883.04
	Air Conditioner	88	720	120	91,238.40
	Dryer	45	5,000	50	135,000.00
	Washer	45	500	50	13,500.00
	Computer	60	200	200	28,800.00





	Dishwasher	10	1,300	120	18,720.00
	Fridge	3	1,000	720	25,920.00
	Microwave oven	3	1,400	120	6,048.00
	Television	12	80	192	2,211.84
	Lightbulb	95	100	384	43,776.00
	Bathroom vent fan	84	60	24	1,451.52
Lighting	All Lights (see Appendix B)	N/A	N/A	N/A	55,322.90
SBD	CCTV Cameras	46	13	720	5,166.72
	Projector	1	275	16	52.80
	Television	10	80	16	153.60
	Speakers	3	100	16	57.60
	OpenPath smart reader	1	3	720	25.92

Table 7.12: VRF Energy Demand Estimation

Cooling Input Power (kW)	0.092 (from Data Sheet)	Annual cooling consumption (kWh)	39,975.84
Heating Input Power (kW)	0.09 (from Data Sheet)	Annual cooling cost (\$)	\$4,717.15
Cooling Capacity (Btu/h)	18,000	Annual heating consumption (kWh)	27,907.20
Heating Capacity (Btu/h)	20,000	Annual heating cost (\$)	\$3,293.05
Capacity (tonnes)	1.5	Total Annual VRF Energy Consumption (kWh)	67,883.04
Assumed Heating Days Per Year	152	Total Annual VRF Energy Cost (\$)	\$8,010.20
Assumed Cooling Days Per Year	213		
Electricity Cost (\$/kWh)	0.118		

Table 7.13: Net-Zero System Life Cycle Cost Analysis

	Cost		Present Worth	Interest Rate	8.00%
Capital	-\$954,700.00	(first year cost)		Period/ life span	30
O&M	-\$95,500.00	(cost yearly)	\$1,075,000.00		
Salvage	\$0.00	(last year cash flow)	\$0.00		
		Total	\$2,000,000.00		



## Appendix D Smart Building Design Technical Analysis Support Items

### D.1 Honeywell IP Camera User Interface



Figure 7.9: Display panel of Honeywell HDZP252DI 25x Zoom IR WDR PTZ IP Camera

### D.2 Functionality of Multi-Criteria Detectors and Horn Strobes

Occupants can also be made aware of the residence situation by the embedded signal operations in the multi-criteria detectors. Green Flash indicates Normal Conditions. This means that the device is operational and confirms regular communication with the Fire Alarm Control Panel (FACP). However, Steady Red indicates that the Alarm condition has been detected.

As part of the fire alarm system, horn strobes are included for alerting occupants in public spaces such as stairs, and common areas. The horn strobe complies with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range as stated in the design specification (See Data Sheet, "Horn Strobes").



### D.3 Access Control Components

Integrated Security Software	Honeywell Sec. Win-Pak Integ. Security SW, Mfr#: WPS48
Control Panel	Honeywell Sec. NetAXS-123 Access Panels, Mfr#: MPA1004U-MPS
Card Reader	Honeywell Access OMNICALASS2 Smart+BLE Min Fig, Mfr#: OM32BHOND
Credential	Honeywell Access OMNICALASS 16K PVC Card, HID Prox, 16 App Areas, 34-bit, Mfr#: OKH2N26
Visitor Management System	Honeywell Access Visitor Manager Ver 4.0 Express Edit Kit, Mfr#: LWVMSKEX
Push to Exit Button	Honeywell Access PIR/REQUEST EXIT KIT, Mfr#: EGRESSK1
Electric Strike	Camden 'Universal' Electric Strike for Narrow Stile Aluminum Door Frames, Mfr#: CX-ED1079DL
Magnetic Lock	Camden CX-92 Series Double Door Magnetic Locks, Mfr#: CX-92S-12TDS
Push Bar Exit	Rofu 9500 Series Micro-Switch Bar, Mfr#: 9500-36 Micro-Switch Bar US28
Mechanical Door Lock	Honeywell Straight Entry Door Lever, Satin Nickel, Mfr#: 8104301
Ethernet Cable	CAT5 Cable 20ft

Figure 7.10: Components of the Access Controls Solutions (Screenshot from PM Material List)

### D.4 Definitions of Fail Safe and Fail Secure Mechanisms

- 1) Fail Safe - lock when they are supplied with power installed in the common area and dorm room entry doors to comply with the building codes and fire regulations that call for people to be able to exit at any time, even in the event of a power outage;
- 2) Fail Secure - unlock when supplied with power. Fail Safe locks are Fail Secure locks are wired in data and technical rooms due to the need to remain locked all times, even in case of emergencies - they are equipped with electrified Push to Exit buttons to allow people to exit quickly in case of fire.

### D.5 Advantages for Setting Up Mesh Network System

- Do not require a cabled connection, unlike access points
- Better bandwidth between nodes compared to half on range extenders
- Can be extended by adding more nodes, currently there is no limit to the number of nodes you can add
- Dedicated bandwidth for communications between main router and node as well as node to node
- With dedicated bandwidth for router-to-node and node-to-node, client end points enjoy better bandwidth be it 2.4GHz or 5Hz.
- Signal and traverse from node to node allowing for wider and further coverage
- No cabling between nodes and main router
- Easy to setup with mobile friendly app
- Automatically or manually choose the best WiFi channel and radio frequency to use to avoid crowded bands
- Keep a good wireless signal throughout the school building



- Higher models include Multi-User Multiple Input Multiple Output (MU-MIMO) technology for simultaneous serving of multiple wireless clients
- Some model allows for prioritisation of bandwidth for certain devices on the network

#### D.6 Installation Steps of Orbi Wi-Fi 6 System

Nine nodes will be evenly distributed on each floor (1st floor to 3rd floor). For the basement floor, there will be relatively fewer nodes which is 6 nodes. In total, there will be 33 nodes for the whole building. These nodes provide a maximum of 1500 connected devices available and a coverage area of 58000 square feet. The installation steps is as follows:

1. Connect Orbi to your cable modem and power on both devices, ensuring that the devices are equi-distant throughout the floor plan.
2. Once hardware set-up is complete, download and launch the Orbi app; follow the in-app directions to finish the setup steps for the Wifi and SSID password.
3. Notify occupants to download the Deco app and connect to the WiFi network

#### D.7 Intercom System Model



Figure 7.11: The HOSMART Wireless Intercom System (4 pc.) [44]

#### D.8 Digital Signage Connections

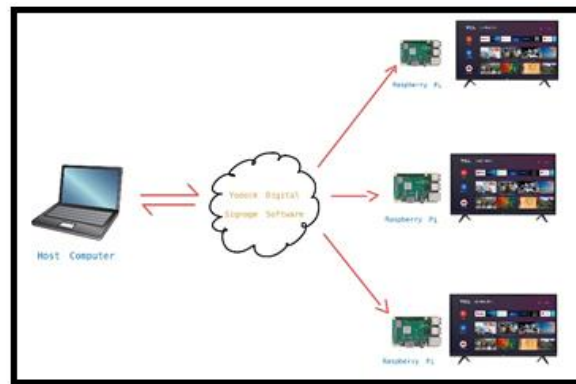


Figure 7.12: Diagram showcasing how the Digital Signage system works with 3 TVs. [44,45,46]



### D.9 Projector Model



Figure 7.13: The Epson Home Cinema 2200 [48]

### D.10 Openpath Hands Free Control

#### Elevator Integration

- Openpath’s contactless elevator configuration is ideal for large buildings with automated elevators, such as high-rise commercial office spaces or multi-family residential buildings. Use a bespoke integration with braXos elevator security systems and Openpath’s open API to create a contactless user experience. Openpath’s integration with braXos works by virtually mapping elevator relays with APIs and destination dispatch platforms, and controlling access to floors with Openpath [73].
- What is needed: Openpath Access Control System, braXos Openpath Connector and braXos Steward middleware product

#### Lockdown

- Flexible Lockdown solution provides the ability to activate or revert lockdown plans from any remote device, including a mobile phone, or third-party trigger
- Customize office or school lockdown plans for any emergency, including active shooter, natural disasters, and unsolicited visitors
- Through Openpath's third-party video management system integrations, provide real-time video feed from all the relevant cameras, enabling first responders to act accordingly [74].

#### Tailgating

- Openpath, together with Camio and/or Density, support deployment models across buildings and offices of all shapes and sizes. This offers a proactive approach to tailgating vulnerabilities, keeping employees safe without adding friction.
- Visual monitoring of every entry and exit across all of your locations to quickly resolve or investigate security concerns and questions.
- Users can instantly be notified of any potential tailgating security breaches and address them just as quickly [75].

### D.11 Calculation for Openpath [76]



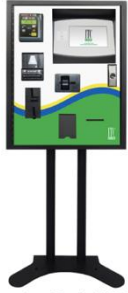
Table 7.14: Calculations for determining the Openpath Wave Entry Solution

	Price Range (USD)	Value Used for Calculation (USD)	Calculation
Door	\$700 - \$3000 per door	\$1900 per door	\$1900*12 [doors] = \$22800



<b>Hardware Wiring Cost</b>	\$1000 - \$3000 per door	\$1850 per door	\$1850*12 [doors] = \$22200
<b>Software Cost</b>	\$26 for first 2, \$20 for first 8, then \$7 per entry door per month	As indicated in Price Range column	(\$20*8 + \$7*4)*12 [months] = \$2256
<b>User Cost</b>	First 500 users free, 13 cents/user/month afterwards	\$0	\$0
			<b>Total: \$47,256 USD = \$59,244 CAD</b>

**D.12 netZtouch Laundry Master Component Description and Price**

Component Name	Product Picture	Description	Qty	Price
<b>Laundry Master [77]</b>		Master transmits transaction information to an account-based system, such as the ITC Systems' netZcore Commerce Solution to update the account over a TCP/IP network. The 7830 Laundry Master accepts magnetic stripe, barcoded or contactless account cards to operate the machines	1*3 = 3	217 CAD [78]
<b>Laundry Machine Interface</b>	 4130W Interface	Model 4130W communicates via a Wireless connection with the Laundry Master (one interface per laundry machine)	6/room*3 rooms = 18	316 CAD [79]
<b>Loader</b>	 Loader Model 7880 (shown here with base)	ITC Systems' 7880 netZtouch Loader allows clients to add value to their online account or card at any time using credit/debit cards, bills, or coins. Both Loaders have the option for a card dispenser and receipt printer.	1*3 = 3	127 CAD [80]





**D.13 SBD Life Cycle Cost Analysis**

Table 7.15: Calculations for Present Worth and LCC of SBD Systems [81-90]

Interest Rate	8.00%	need to find source	<b>BAS</b>
Period/ life span	12.5	Be aware of different spans for different components/ systems	
**Inflation not accounted for			
	Cost		Present Worth
Capital	-\$225,267.00	(first year cost)	
O&M	-\$3,979.86	(cost yearly)	\$30,738.30
Salvage	\$0.00	(last year cash flow)	\$0.00
<b>LCC</b>			<b>\$256,005.30</b>

Interest Rate	8.00%	need to find source	<b>Access Controls</b>
Period/ life span	17.5	Be aware of different spans for different components/ systems	
**Inflation not accounted for			
	Cost		Present Worth
Capital	-\$119,370.45	(first year cost)	
O&M	-\$3,979.86	(cost yearly)	\$36,810.40
Salvage	\$0.00	(last year cash flow)	\$0.00
<b>LCC</b>			<b>\$156,180.85</b>

Interest Rate	8.00%	need to find source	<b>Cameras</b>
Period/ life span	8	Be aware of different spans for different components/ systems	
**Inflation not accounted for			
	Cost		Present Worth
Capital	-\$31,788.12	(first year cost)	
O&M	-\$1,326.62	(cost yearly)	\$7,623.61
Salvage	\$0.00	(last year cash flow)	\$0.00
<b>LCC</b>			<b>\$39,411.73</b>

Interest Rate	8.00%	need to find source	<b>Fire Alarm System</b>
Period/ life span	12.5	Be aware of different spans for different components/ systems	
**Inflation not accounted for			
	Cost		Present Worth
Capital	-\$75,865.73	(first year cost)	
O&M	-\$1,326.62	(cost yearly)	\$10,246.10
Salvage	\$0.00	(last year cash flow)	\$0.00



**LCC** \$86,111.83

Interest Rate 8.00% need to find source **Glass Break Detector**  
 Period/ life span 5 Be aware of different spans for different components/ systems

\*\*Inflation not accounted for

	Cost		Present Worth
Capital	-\$7,097.36	(first year cost)	
O&M	-\$1,326.62	(cost yearly)	\$5,296.81
Salvage	\$0.00	(last year cash flow)	\$0.00

**LCC** \$12,394.17

Interest Rate 8.00% need to find source **Hands-free Controls**  
 Period/ life span 20 Be aware of different spans for different components/ systems

\*\*Inflation not accounted for

	Cost		Present Worth
Capital	-\$91,877.50	(first year cost)	
O&M	-\$3,979.86	(cost yearly)	\$39,074.85
Salvage	\$0.00	(last year cash flow)	\$0.00

**LCC** \$130,952.35

Interest Rate 8.00% need to find source **Wi-Fi System**  
 Period/ life span 4 Be aware of different spans for different components/ systems

\*\*Inflation not accounted for

	Cost		Present Worth
Capital	-\$48,627.11	(first year cost)	
O&M	-\$795.97	(cost yearly)	\$2,636.36
Salvage	\$0.00	(last year cash flow)	\$0.00

**LCC** \$51,263.47

Interest Rate 8.00% need to find source **Intercom System**  
 Period/ life span 20 Be aware of different spans for different components/ systems



\*\*Inflation not accounted for

	Cost	Present Worth
Capital	-\$3,825.00 (first year cost)	
O&M	-\$795.97 (cost yearly)	\$7,814.97
Salvage	\$0.00 (last year cash flow)	\$0.00

LCC \$11,639.97

Interest Rate 8.00% need to find source **Polk Sound System**  
 Period/ life span 20 Be aware of different spans for different components/ systems

\*\*Inflation not accounted for

	Cost	Present Worth
Capital	-\$3,531.00 (first year cost)	
O&M	-\$795.97 (cost yearly)	\$7,814.97
Salvage	\$0.00 (last year cash flow)	\$0.00

LCC \$11,345.97

Interest Rate 8.00% need to find source **Signage+Projector**  
 Period/ life span 8.5 Be aware of different spans for different components/ systems

\*\*Inflation not accounted for

	Cost	Present Worth
Capital	-\$6,510.00 (first year cost)	
O&M	-\$795.97 (cost yearly)	\$4,777.09
Salvage	\$0.00 (last year cash flow)	\$0.00

LCC \$11,287.09

TOTAL LCC \$766,592.73

TOTAL PW \$152,833.46

BAS [81]	10-15 years
Access Controls [82]	15-20 years
Cameras [83]	6-10 years
Fire Alarm System [84]	10-15 years
Glass break detectors [85]	5 years
Hands-free controls [86]	20 years
Wi-Fi System [87]	3-4 years
Intercom System [88]	20 years
Sound System [89]	5 years
Digital Signage + Projector [90]	7-10 years



**D.14 Advantages of Final SBD Recommendations**

<b>System</b>	<b>Proposed Technologies</b>	<b>Advantages</b>
<b>Security System</b>	<ul style="list-style-type: none"> <li>☐ 25x Zoom IR WDR PTZ IP Cameras HDZP252DI</li> <li>☐ Honeywell 5853 Ademco Wireless Glass Break Detector</li> <li>☐ Honeywell Notifier: Intelligent Addressable Fire Alarm System</li> </ul>	<ul style="list-style-type: none"> <li>☐ 24/7 surveillance</li> <li>☐ Prevents burglaries</li> <li>☐ Pinpoints exact location of smoke/heat/CO</li> <li>☐ Two loop connection maintains circuit integrity</li> </ul>
<b>Access Controls</b>	<ul style="list-style-type: none"> <li>☐ Honeywell WIN-PAK® 4.8 INTEGRATED SECURITY SOLUTION</li> <li>☐ Honeywell NetAXS-123 controller</li> <li>☐ Honeywell OmniClass2 Smart Mobile-Ready Mini-Mullion Reader</li> <li>☐ Honeywell LobbyWorks® Visitor Management System</li> <li>☐ Camden CX-ED1079DL 'Universal' grade 1 ANSI strike / CX-92S-12TDS Surface mount double door magnetic lock</li> </ul>	<ul style="list-style-type: none"> <li>☐ Fast installation</li> <li>☐ Easily managed</li> <li>☐ Flexible credential types</li> <li>☐ Secure</li> </ul>
<b>Communication Systems</b>	<ul style="list-style-type: none"> <li>☐ Hosmart Wireless Intercom System</li> <li>☐ Epson Home Cinema Projector w/ 100" VIVO Projector Screen</li> <li>☐ Yodeck based Distributed Video Displays</li> <li>☐ Distributed Antenna System</li> <li>☐ Polk Audio 5.1 w/ Subwoofer</li> </ul>	<ul style="list-style-type: none"> <li>☐ Contactless deliveries/ mail to the student's dorm</li> <li>☐ Direct communication with security desk for emergencies</li> <li>☐ Messages/ Announcements shared throughout the residence</li> <li>☐ Stable wifi connection</li> <li>☐ High sound quality, theatre experience</li> </ul>
<b>Hands-free Controls</b>	<ul style="list-style-type: none"> <li>☐ OpenPath</li> <li>☐ ITC System: NetZtouch Laundry Solution</li> </ul>	<ul style="list-style-type: none"> <li>☐ Ease of access to high traffic areas</li> <li>☐ Better occupant ID recognition</li> <li>☐ Seamless dorm living experience</li> </ul>



<b>BAS</b>	<ul style="list-style-type: none"><li>☐ Honeywell EBI</li><li>☐ WEBs-N4 Analytics Platform</li><li>☐ Ciper Model 50 Controller</li><li>☐ WEB-8000 controller</li><li>☐ Notifier Web Server</li></ul>	<ul style="list-style-type: none"><li>☐ Monitors HVAC, Lighting, Security and Access Controls systems on single data analytics platform</li><li>☐ Provides alarms, trends, reports on Honeywell and 3rd party systems</li><li>☐ Applicable to dormitory setting</li></ul>
------------	--	---

## Appendix E Building Information Modelling

(next page)

### Lighting Devices

	<p><b>Switch Notation</b></p> <p>F1 - Lighting Type # - Denotes Switch Connection</p> <p>VISA Lighting 39W Surface Moutned Light</p>
	<p><b>Switch Notation</b></p> <p>F2 - Lighting Type # - Denotes Switch Connection</p> <p>VISA Lighting 29W Flush Moutned Light</p>
	<p><b>Switch Notation</b></p> <p>F3 - Lighting Type # - Denotes Switch Connection</p> <p>Progress Lighting 21W Flush Moutned Light</p>
	<p><b>Switch Notation</b></p> <p>F4 - Lighting Type # - Denotes Switch Connection</p> <p>LiveX Lighting 39W Flush Moutned Light</p>
	<p><b>Switch Notation</b></p> <p>P - Lighting Type # - Denotes Switch Connection</p> <p>Philips 15W Recess Moutned Light</p>
	VISA 39W Surface Mounted Linear Light, Wired To Emergency Panels
	VISA 19W Recess Mounted Strip Light
	<p><b>Switch Notation</b></p> <p>V - Lighting Type # - Denotes Switch Connection</p> <p>VISA 17W Wall Mounted Vanity Light</p>
	VISA 15W Wall Mounted Light

### Emergency Lighting

	<p><b>Symbol Notation</b></p> <p>➡ - Signage Direction ⬆ - Denotes Exit Arrows and Exit Direction</p> <p>Marz 4.5W Long Lasting and Rechargeable Exit Sign</p>
	Ware Light 2W Long Lasting and Rechargeable Emergency Light, 90 Minute Illumination

### Lighting Controls

	<p><b>Switch Notation</b></p> <p># - Denotes Lighting Connection</p> <p>3 Way Toggle Switch</p>
	<p><b>Switch Notation</b></p> <p># - Denotes Lighting Connection</p> <p>Dimmer Switch</p>
	Occupancy Sensor Switch, Ceiling Mounted

Legend Table

### Circuit Panels

	<p><b>Circuit Notation</b></p> <p>1 - Circuit Number A - Panel Board Type - L for Lighting/B for Eelectrical ### - Panel Number</p> <p>May Also be Denoted as <input type="text"/></p>
	Fixed Type 15kVA Isolation Transformer/Single Phased

### Control Boards

	Access Control Panel, Distributed at Intervals of Four Access Controls
	Cipher Model 50 Controller, Building Automated Thermostatic Control
	<p><b>Board Notation</b></p> <p>L - Board Type - L for Lighting/A for Access/S for Security CP - --- # - Board Number</p> <p>WEB-800 Controller, Building Automated Lighting Control</p>
	<p><b>Board Notation</b></p> <p>A - Board Type - L for Lighting/A for Access/S for Security CP - --- # - Board Number</p> <p>WEB-800 Controller, Building Automated Access Control</p>
	<p><b>Board Notation</b></p> <p>S - Board Type - L for Lighting/A for Access/S for Security CP - ---</p> <p>WEB-800 Controller, Building Automated Security Control</p>
	Temperature & Pressure Sensors, Surface Wall Mounted

### Security Systems

	Glass Break Detector, Surface Wall Mounted
	CCTV Camera, 25x Zoom, 360° Rotary Axis, Ceiling Mounted

### Communication Systems

	Wireless Access Point
	Wireless Intercom System, 1/2 Mile Long Range, 7 Channels

### Access Controls

	OpenPath Controls, Hands-Free Control, Emergency Lockdown Enabled
	Honeywell Omniclass 2.0 Card Reader, Hands-Free Controls
	Push to Exit Button
	Camden CX Universal Electrical Strike, Fail Safe Operation
	Camden CX 600 lbs Magnetic Double Door Lock

### Fire Alarm System

	Honeywell Notifier Intelligent Fire Alarm Control Panel, Surface Mounted
	Firefighter's Handset
	Fire Alarm Speaker/Strobe, Wall Mounted
	Honeywell Multicriteria Detector - Gas, Smoke, Heat, Relay Base, Ceiling Mounted
	Honeywell Multicriteria Detector - Gas, Smoke, Heat, Isolator Base, Ceiling Mounted
	Honeywell Multicriteria Detector - Gas, Smoke, Heat, Low Frequency Sounder Base, Ceiling Mounted
	Honeywell Multicriteria Detector - Gas, Smoke, Heat, Mounted Base, Ceiling Mounted
	Fire Alarm Manual Pull Station

### Power Distribution

	RONA Tamper Resistant Duplex Receptacle
	Technology Research Solar Panel Automatic Transfer Switch

REV.	DESCRIPTION	Date:

DATE: 30/04/2021  
DRAWN BY: Zhiyuan Zhu  
CHECKED BY:

TITLE:  
**Legend Table**

SHEET NUMBER:  
**Legend 1**





## Lighting Fixture Schedule

Count	Manufacturer	Catalog Number	Description	Wattage	Lamp	Voltage	Apparent Load
13	Chloride	LEDR-2	Compact LED Emergency Unit				2 VA
198	Philips	RS140B	Curuline Recessed Spot				15 VA
186	Visa Lighting	CM2082-W	33" x 4-3/4" Vanity Light	7 W		120 V	16 VA
81	Visa Lighting	CB6456	33" x 4-3/4" Vanity Light	7 W		120 V	16 VA
79	Visa Lighting	CM11022	5-1/2" x 17-3/8" Flush Light	11 W		120 V	12 VA
13	Visa Lighting	CM2082-W	23-4/5" x 23-4/5" Strip Light	13 W		120 V	19 VA
26	Visa Lighting	CM2106-T	72" x 6-7/8" Linear Light	13 W		120 V	24 VA
34	Visa Lighting	CM1972	18" x 7-5" Flush Lighting	38 W		120 V	39 VA
214	Visa Lighting	CM11022	18" Shallow Bowl (LED)	39 W		120 V	21 VA
10	Visa Lighting	CM1972-W	16" x 7-5" 3 Bulb Flush Lighta	39 W			29 VA

PROJECT INFORMATION

REV#	DESCRIPTION	DATE

PROJECT NUMBER: CC U of T. 0001

DATE: \_\_\_\_\_  
 DRAWN BY: \_\_\_\_\_  
 CHECKED BY: \_\_\_\_\_

TITLE:  
**Unnam  
 ed**

SHEET NUMBER:  
**Level 1**



1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8

PROJECT INFORMATION	PROJECT NUMBER: ECL1011-001
REV:	DESCRIPTION: Date:

DATE: 30/04/2021  
DRAWN BY: Zhiyuan Zhu  
CHECKED BY:

TITLE:  
B-100s  
Schedule

SHEET NUMBER:  
Panel Schedule

<b>Branch Panel: B-101</b>												
Location: LAUNDRY 122				Volts: 120/208 Wye				A.I.C. Rating:				
Supply From: Transformer1				Phases: 3				Mains Type:				
Mounting: Surface				Wires: 4				Mains Rating: 100 A				
Enclosure: Type 1									MCB Rating: 1 A			
Notes:												
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT		
1	Lighting Panels Floor 1 (1-3)	20 A	3	1616...	900 VA		1	20 A	Receptacle	2		
3	--	--	--		420 VA	900 VA	1	20 A	Receptacle	4		
5	--	--	--		120 VA	900 VA	1	20 A	Receptacle	6		
7	Receptacle	20 A	1	900 VA	540 VA		1	20 A	Receptacle	8		
9	Receptacle	20 A	1		900 VA	900 VA	1	20 A	Receptacle	10		
11	Receptacle	20 A	1			1260...	900 VA	1	20 A	Receptacle	12	
13										14		
15										16		
17										18		
19										20		
21										22		
23										24		
25										26		
27										28		
29										30		
31										32		
33										34		
35										36		
37										38		
39										40		
41										42		
				Total Load:	3955 VA	3120 VA	3180 VA					
				Total Amps:	33 A	26 A	27 A					
Legend:												
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals								
Other	355 VA	100.00%	355 VA	Total Conn. Load:	10255 VA							
Receptacle	8100 VA	100.00%	8100 VA	Total Est. Demand:	10255 VA							
Lighting	1801 VA	100.00%	1801 VA	Total Conn.:	26 A							
				Total Est. Demand:	26 A							
Notes:												

<b>Branch Panel: B-102</b>												
Location: RD STOR. 111				Volts: 120/208 Wye				A.I.C. Rating:				
Supply From: Transformer1				Phases: 3				Mains Type:				
Mounting: Surface				Wires: 4				Mains Rating: 100 A				
Enclosure: Type 1									MCB Rating: 1 A			
Notes:												
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT		
1	Lighting Panels Floor 1 (4-6)	20 A	3	2267...	900 VA		1	20 A	Receptacle	2		
3	--	--	--		0 VA	900 VA	1	20 A	Receptacle	4		
5	--	--	--		0 VA	900 VA	1	20 A	Receptacle	6		
7	Receptacle	20 A	1	900 VA	900 VA		1	20 A	Receptacle	8		
9	Receptacle	20 A	1		900 VA	900 VA	1	20 A	Receptacle	10		
11	Receptacle	20 A	1			1260...	900 VA	1	20 A	Receptacle	12	
13										14		
15										16		
17										18		
19										20		
21										22		
23										24		
25										26		
27										28		
29										30		
31										32		
33										34		
35										36		
37										38		
39										40		
41										42		
				Total Load:	4966 VA	2700 VA	3060 VA					
				Total Amps:	42 A	23 A	26 A					
Legend:												
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals								
Other	1861 VA	100.00%	1861 VA	Total Conn. Load:	10726 VA							
Receptacle	8460 VA	100.00%	8460 VA	Total Est. Demand:	10726 VA							
Lighting	412 VA	100.00%	412 VA	Total Conn.:	30 A							
				Total Est. Demand:	30 A							
Notes:												

<b>Branch Panel: B-103</b>												
Location: RD OFFICE 108				Volts: 120/208 Wye				A.I.C. Rating:				
Supply From: Transformer1				Phases: 3				Mains Type:				
Mounting: Surface				Wires: 4				Mains Rating: 100 A				
Enclosure: Type 1									MCB Rating: 1 A			
Notes:												
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT		
1	Lighting Panels Floor 1 (7-9)	20 A	3	1110...	1080...		1	20 A	Receptacle	2		
3	--	--	--		0 VA	1260...	1	20 A	Receptacle	4		
5	--	--	--		0 VA	900 VA	1	20 A	Receptacle	6		
7	Receptacle	20 A	1	900 VA	900 VA		1	20 A	Receptacle	8		
9	Receptacle	20 A	1		900 VA	900 VA	1	20 A	Receptacle	10		
11	Receptacle	20 A	1			900 VA	1080...	1	20 A	Receptacle	12	
13										14		
15										16		
17										18		
19										20		
21										22		
23										24		
25										26		
27										28		
29										30		
31										32		
33										34		
35										36		
37										38		
39										40		
41										42		
				Total Load:	3990 VA	3060 VA	2680 VA					
				Total Amps:	33 A	26 A	24 A					
Legend:												
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals								
Other	518 VA	100.00%	518 VA	Total Conn. Load:	8930 VA							
Receptacle	8820 VA	100.00%	8820 VA	Total Est. Demand:	8930 VA							
Lighting	592 VA	100.00%	592 VA	Total Conn.:	28 A							
				Total Est. Demand:	28 A							
Notes:												





1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8

REV:	DESCRIPTION:	Date:

DATE: 30/04/2021

DRAWN BY: Zhiyuan Zhu

CHECKED BY:

TITLE:

B-200s  
Schedule

SHEET NUMBER:

Panel Schedule

<b>Branch Panel: B-201</b>												
Location: LAUNDRY 224			Volts: 120/208 Wye			A.I.C. Rating:						
Supply From: Transformer2			Phases: 3			Mains Type:						
Mounting: Surface			Wires: 4			Mains Rating: 100 A						
Enclosure: Type 1						MCB Rating: 1 A						
Notes:												
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT		
1	Receptacle	20 A	1	900 VA	1579...		3	20 A	Lighting Panels Floor 2 (1-3)	2		
3	Receptacle	20 A	1		900 VA	0 VA	--	--		4		
5	Receptacle	20 A	1			900 VA	0 VA	--		6		
7	Receptacle	20 A	1	900 VA	540 VA		1	20 A	Receptacle	8		
9	Receptacle	20 A	1		1260...	900 VA	1	20 A	Receptacle	10		
11	Receptacle	20 A	1			900 VA	900 VA	1	20 A	Receptacle	12	
13	Receptacle	20 A	1	540 VA	900 VA		1	20 A	Receptacle	14		
15	Receptacle	20 A	1		540 VA					16		
17										18		
19										20		
21										22		
23										24		
25										26		
27										28		
29										30		
31										32		
33										34		
35										36		
37										38		
39										40		
41										42		
				<b>Total Load:</b>	5359 VA	3600 VA	2700 VA					
				<b>Total Amps:</b>	46 A	31 A	23 A					
Legend:												
<b>Load Classification</b>		<b>Connected Load</b>	<b>Demand Factor</b>	<b>Estimated Demand</b>	<b>Panel Totals</b>							
Other		425 VA	100.00%	425 VA								
Receptacle		10080 VA	99.60%	10040 VA	<b>Total Conn. Load:</b>			11659 VA				
Lighting		1154 VA	100.00%	1154 VA	<b>Total Est. Demand:</b>			11619 VA				
					<b>Total Conn.:</b>			32 A				
					<b>Total Est. Demand:</b>			32 A				
Notes:												

<b>Branch Panel: B-202</b>												
Location: DATA 220			Volts: 120/208 Wye			A.I.C. Rating:						
Supply From: Transformer2			Phases: 3			Mains Type:						
Mounting: Surface			Wires: 4			Mains Rating: 100 A						
Enclosure: Type 1						MCB Rating: 1 A						
Notes:												
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT		
1	Lighting Panels Floor 2 (4-6)	20 A	3	1326...	900 VA		1	20 A	Receptacle	2		
3	--	--	--		0 VA	900 VA		1	20 A	Receptacle		
5	--	--	--			0 VA	900 VA	1	20 A	Receptacle		
7	Receptacle	20 A	1	900 VA	900 VA		1	20 A	Receptacle	8		
9	Receptacle	20 A	1		900 VA	900 VA	1	20 A	Receptacle	10		
11	Receptacle	20 A	1			900 VA	900 VA	1	20 A	Receptacle		
13	Receptacle	20 A	1	900 VA	900 VA		1	20 A	Receptacle	14		
15	Receptacle	20 A	1		900 VA					16		
17										18		
19										20		
21										22		
23										24		
25										26		
27										28		
29										30		
31										32		
33										34		
35										36		
37										38		
39										40		
41										42		
				<b>Total Load:</b>	5826 VA	3600 VA	2700 VA					
				<b>Total Amps:</b>	50 A	31 A	23 A					
Legend:												
<b>Load Classification</b>		<b>Connected Load</b>	<b>Demand Factor</b>	<b>Estimated Demand</b>	<b>Panel Totals</b>							
Other		960 VA	100.00%	960 VA								
Receptacle		10800 VA	96.30%	10400 VA	<b>Total Conn. Load:</b>			12126 VA				
Lighting		366 VA	100.00%	366 VA	<b>Total Est. Demand:</b>			11726 VA				
					<b>Total Conn.:</b>			34 A				
					<b>Total Est. Demand:</b>			33 A				
Notes:												

<b>Branch Panel: B-203</b>												
Location: COMMONS 200			Volts: 120/208 Wye			A.I.C. Rating:						
Supply From: Transformer2			Phases: 3			Mains Type:						
Mounting: Surface			Wires: 4			Mains Rating: 100 A						
Enclosure: Type 1						MCB Rating: 1 A						
Notes:												
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT		
1	Lighting Panels Floor 2 (7-9)	20 A	3	1244...	900 VA		1	20 A	Receptacle	2		
3	--	--	--		0 VA	900 VA	1	20 A	Receptacle	4		
5	--	--	--			0 VA	720 VA	1	20 A	Receptacle		
7	Receptacle	20 A	1	900 VA	900 VA		1	20 A	Receptacle	8		
9	Receptacle	20 A	1		900 VA	900 VA	1	20 A	Receptacle	10		
11	Receptacle	20 A	1			900 VA	900 VA	1	20 A	Receptacle		
13	Receptacle	20 A	1	900 VA	900 VA		1	20 A	Receptacle	14		
15										16		
17										18		
19										20		
21										22		
23										24		
25										26		
27										28		
29										30		
31										32		
33										34		
35										36		
37										38		
39										40		
41										42		
				<b>Total Load:</b>	5744 VA	2700 VA	2520 VA					
				<b>Total Amps:</b>	48 A	23 A	21 A					
Legend:												
<b>Load Classification</b>		<b>Connected Load</b>	<b>Demand Factor</b>	<b>Estimated Demand</b>	<b>Panel Totals</b>							
Other		618 VA	100.00%	618 VA								
Receptacle		9720 VA	100.00%	9720 VA	<b>Total Conn. Load:</b>			10964 VA				
Lighting		626 VA	100.00%	626 VA	<b>Total Est. Demand:</b>			10964 VA				
					<b>Total Conn.:</b>			30 A				
					<b>Total Est. Demand:</b>			30 A				
Notes:												





1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8

PROJECT INFORMATION	PROJECT NUMBER: ECCL01F1-0001	
REV:	DESCRIPTION:	Date:

DATE: 30/04/2021  
DRAWN BY: Zhiyuan Zhu  
CHECKED BY:

TITLE:  
B-300s  
Schedule

SHEET NUMBER:  
Panel Schedule

Branch Panel: B-301											
Location: LAUNDRY 328				Volts: 120/208 Wye				A.I.C. Rating:			
Supply From: Transformer3				Phases: 3				Mains Type:			
Mounting: Surface				Wires: 4				Mains Rating: 100 A			
Enclosure: Type 1				MCB Rating: 1 A							
Notes:											
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT	
1	Lighting Panels Floor 3 (1-3)	20 A	3	1537...	900 VA			1	20 A	Receptacle	2
3	--	--	--		0 VA	900 VA		1	20 A	Receptacle	4
5	--	--	--		0 VA	900 VA		1	20 A	Receptacle	6
7	Receptacle	20 A	1	900 VA	900 VA			1	20 A	Receptacle	8
9	Receptacle	20 A	1		900 VA	900 VA		1	20 A	Receptacle	10
11	Receptacle	20 A	1			900 VA	900 VA	1	20 A	Receptacle	12
13	Receptacle	20 A	1	1260...				1	20 A	Receptacle	14
15											16
17											18
19											20
21											22
23											24
25											26
27											28
29											30
31											32
33											34
35											36
37											38
39											40
41											42
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals							
Other	425 VA	100.00%	425 VA								
Receptacle	9360 VA	100.00%	9360 VA	<b>Total Conn. Load:</b> 10897 VA							
Lighting	1113 VA	100.00%	1113 VA	<b>Total Est. Demand:</b> 10897 VA							
				<b>Total Conn.:</b> 30 A							
				<b>Total Est. Demand:</b> 30 A							

Branch Panel: BEM302											
Location: COMMONS 300				Volts: 120/208 Wye				A.I.C. Rating:			
Supply From: Transformer3				Phases: 3				Mains Type:			
Mounting: Surface				Wires: 4				Mains Rating: 100 A			
Enclosure: Type 1				MCB Rating: 1 A							
Notes:											
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT	
1	Lighting Panels Floor 3 (4-6)	20 A	3	1326...	900 VA			1	20 A	Receptacle	2
3	--	--	--		0 VA	900 VA		1	20 A	Receptacle	4
5	--	--	--		0 VA	900 VA		1	20 A	Receptacle	6
7	Receptacle	20 A	1	900 VA	900 VA			1	20 A	Receptacle	8
9	Receptacle	20 A	1		900 VA	900 VA		1	20 A	Receptacle	10
11	Receptacle	20 A	1			900 VA	900 VA	1	20 A	Receptacle	12
13	Receptacle	20 A	1	720 VA	900 VA			1	20 A	Receptacle	14
15	Receptacle	20 A	1		900 VA	720 VA		1	20 A	Receptacle	16
17											18
19											20
21											22
23											24
25											26
27											28
29											30
31											32
33											34
35											36
37											38
39											40
41											42
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals							
Other	960 VA	100.00%	960 VA								
Receptacle	11340 VA	94.09%	10670 VA	<b>Total Conn. Load:</b> 12666 VA							
Lighting	366 VA	100.00%	366 VA	<b>Total Est. Demand:</b> 11996 VA							
				<b>Total Conn.:</b> 35 A							
				<b>Total Est. Demand:</b> 33 A							

Branch Panel: B-303											
Location: COMMONS 300				Volts: 120/208 Wye				A.I.C. Rating:			
Supply From: Transformer3				Phases: 3				Mains Type:			
Mounting: Surface				Wires: 4				Mains Rating: 100 A			
Enclosure: Type 1				MCB Rating: 1 A							
Notes:											
CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT	
1	Lighting Panels Floor 3 (7-9)	20 A	3	1757...	900 VA			1	20 A	Receptacle	2
3	--	--	--		496 VA	720 VA		1	20 A	Receptacle	4
5	--	--	--			0 VA	900 VA	1	20 A	Receptacle	6
7	Receptacle	20 A	1	900 VA	900 VA			1	20 A	Receptacle	8
9	Receptacle	20 A	1		900 VA	900 VA		1	20 A	Receptacle	10
11	Receptacle	20 A	1			900 VA	900 VA	1	20 A	Receptacle	12
13	Receptacle	20 A	1	900 VA	900 VA			1	20 A	Receptacle	14
15											16
17											18
19											20
21											22
23											24
25											26
27											28
29											30
31											32
33											34
35											36
37											38
39											40
41											42
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals							
Other	894 VA	100.00%	894 VA								
Receptacle	9720 VA	100.00%	9720 VA	<b>Total Conn. Load:</b> 11975 VA							
Lighting	1361 VA	100.00%	1361 VA	<b>Total Est. Demand:</b> 11975 VA							
				<b>Total Conn.:</b> 33 A							
				<b>Total Est. Demand:</b> 33 A							



## **Appendix F** Detailed Cost Estimate

(Next page)

**Lighting**

**Direct Cost**

Material Cost						Labour Cost					
Item #	Item description	Qty.	Unit	Unit Price (\$/unit)	Total Cost of Materials (\$)	Type of Worker	Number of Workers	Hourly Wage (\$/hr)	Total Time	Unit Production Hour (hr/unit)	Total Cost of Labour (\$)
1	Vanity Lights	81	Pcs	\$239	\$19,359	Electrician	3	\$85	81	1	\$6,885
2	Strip Lights	21	Pcs	\$80	\$1,680	Electrician	1	\$85	21	1	\$1,785
3	Flush Mounted Lights 1	79	Pcs	\$24	\$1,896	Electrician	3	\$85	79	1	\$6,715
4	Flush Mounted Lights 2	10	Pcs	\$90	\$900	Electrician	2	\$85	10	1	\$850
5	Wrap/linear Fixture	26	Pcs	\$219	\$5,694	Electrician	2	\$85	26	1	\$2,210
6	Wall Lights	190	Pcs	\$60	\$11,400	Electrician	6	\$85	190	1	\$16,150
7	Pot Lights	194	Pcs	\$60	\$11,640	Electrician	7	\$85	291	1.5	\$24,735
8	Track Lights	56	Pcs	\$70	\$3,920	Electrician	3	\$85	84	1.5	\$7,140
9	Exit Lights	18	Pcs	\$89	\$1,595	Electrician	1	\$85	18	1	\$1,530
10	Flush Mounted Lights 3	210	Pcs	\$38	\$8,030	Electrician	3	\$85	210	1	\$17,850
11	Flush Mounted Lights 4	34	Pcs	\$63	\$2,154	Electrician	3	\$85	34	1	\$2,890
12	Emergency Lights	13	Pcs	\$17	\$221	Electrician	1	\$85	13	1	\$1,105
13	Dimmer Switch	140	Pcs	\$40	\$5,600	Electrician	3	\$85	70	0.5	\$5,950
14	Standard Switch	23	Pcs	\$16	\$368	Electrician	1	\$85	5.75	0.25	\$489
15	Switch Wall Plate	23	Pcs	\$5	\$121	Electrician	1	\$85	2.3	0.1	\$196
16	Trouchsreen Control	2	Pcs	\$2,953	\$5,906	Electrician	1	\$85	3	1.5	\$255
17	KNX Brightness Senors	12	Pcs	\$59	\$710	Electrician	1	\$85	12	1	\$1,020
18	KNX Occupancy Sensors	78	Pcs	\$49	\$3,848	Electrician	1	\$85	78	1	\$6,630
19	DALI Gateway (Actuator)	6	Pcs	\$410	\$2,460	Electrician	1	\$85	6	1	\$510
20	KNX Touch Control Panal	3	Pcs	\$820	\$2,459	Electrician	1	\$85	4.5	1.5	\$383
21	KNX MCB	36	Pcs	\$55	\$1,976	Electrician	2	\$85	54	1.5	\$4,590
22	KNX Line Coupler	4	Pcs	\$301	\$1,204	Electrician	1	\$85	4	1	\$340
23	KNX Controller	4	Pcs	\$537	\$2,148	Electrician	1	\$85	6	1.5	\$510
24	KNX IP Gateway	1	Pcs	\$101	\$101	Electrician	1	\$85	1	1	\$85
25	Wiring + Conduit	4751	1 Ft	\$475	\$4,513	Electrician	7	\$85	570.12	0.12	\$48,460
26	DALI USB Interface	1	Pcs	\$244	\$244	Electrician	1	\$85	1	1	\$85
27	DALI Gateway Emergency Lighting	3	Pcs	\$621	\$1,864	Electrician	2	\$85	3	1	\$255
28	Timer Controller Component	12	Pcs	\$696	\$8,349	Electrician	1	\$85	12	1	\$1,020
29	IP Router	12	Pcs	\$839	\$10,071	Electrician	1	\$85	12	1	\$1,020
30	Lighting Panel-200A	3	Pcs	\$496	\$1,202	Electrician	1	\$85	3	1	\$255
31	Lighting Panel-100A	1	Pcs	\$319	\$1,202	Electrician	1	\$85	1	1	\$85
32	Lighting Panel-50A	1	Pcs	\$387	\$1,202	Electrician	1	\$85	1	1	\$85
32	Temporary Lighting	42160	1 Ft^2	\$1	\$21,080	Included in Material Cost					
Lighting Material Cost Subtotal					\$145,200	Lighting Labour Cost Subtotal					\$162,100
<b>Total Lighting Direct Cost</b>											<b>\$307,300</b>



**Smart Building Design**

**Direct Costs**

Material Cost						Labour Cost					
Item #	Item description	Qty.	Unit	Unit Price (\$/unit)	Total Cost of Materials (\$)	Type of Woker	Number of Workers	Hourly Wage (\$/hr)	Total Time	Unit Production Hour (hr/unit)	Total Cost of Labour (\$)
<b>Security System</b>											
1	CCTV Cameras	46	Pcs	\$691	\$31,789	Electrician	5	\$85	69	1.5	\$5,865
2	Glass Break Detector	79	Pcs	\$90	\$7,105	Fire Alarm Technician	2	\$43	79	1	\$3,397
3	Fire Alarm Control Panel	1	Pcs	\$2,407	\$2,407	Fire Alarm Technician	1	\$43	10	10	\$430
4	Isolation module	8	Pcs	\$62	\$497	Fire Alarm Technician	2	\$43	8	1	\$344
5	Wall Horn/ Strobe	11	Pcs	\$86	\$949	Fire Alarm Technician	1	\$43	11	1	\$473
6	Pull Station	8	Pcs	\$100	\$800	Fire Alarm Technician	2	\$43	8	1	\$344
7	Multi-Criteria Detector	127	Pcs	\$255	\$32,356	Fire Alarm Technician	5	\$43	190.5	1.5	\$8,192
8	Mounting Base	34	Pcs	\$794	\$26,979	Electrician	5	\$85	34	1	\$2,890
9	Isolator Base	3	Pcs	\$60	\$181	Electrician	1	\$85	3	1	\$255
10	Low Frequency Sounder Base	79	Pcs	\$140	\$11,021	Fire Alarm Technician	3	\$43	79	1	\$3,397
11	Relay Base	11	Pcs	\$62	\$677	Electrician	1	\$85	11	1	\$935
Security System Material Cost Subtotal					\$114,800	Security System Labour Cost Subtotal					\$26,600
<b>Access Control System</b>											
1	Integrated Security Software	1	Pcs	\$1,437	\$1,437	Telecommunication Technician	2	\$45	80	80	\$3,600
2	Control Panel	25	Pcs	\$2,199	\$54,982	Electrician	5	\$85	250	10	\$21,250
3	Card Reader	103	Pcs	\$256	\$26,328	Electrician	5	\$85	206	2	\$17,510
4	Credential	600	Pcs	\$22	\$13,284	Telecommunication Technician	5	\$45	600	1	\$27,000
5	Visitor Management System	1	Pcs	\$988	\$988	Telecommunication Technician	1	\$45	12	12	\$540
6	Push to Exit Button	15	Pcs	\$186	\$2,789	Electrician	2	\$85	30	2	\$2,550
7	Electric Strike	100	Pcs	\$124	\$12,401	Electrician	5	\$85	150	1.5	\$12,750
8	Magnetic Lock	2	Pcs	\$377	\$755	Locksmith	1	\$43	3	1.5	\$129
9	Push Bar Exit	4	Pcs	\$170	\$680	Electrician	1	\$85	6	1.5	\$510
10	Mechanical Door Lock	113	Pcs	\$30	\$3,425	Locksmith	2	\$43	226	2	\$9,718
Access Control Material Cost Subtotal					\$117,100	Access Control Labour Cost Subtotal					\$95,600
<b>Building Automation System</b>											
1	Analytics Platform	1	Pcs	\$3,035	\$3,035	Telecommunication Technician	1	\$45	16	16	\$720
2	HVAC Controller	17	Pcs	\$937	\$15,936	Electrician	2	\$85	68	4	\$5,780
3	Ciper Model Controller	10	Pcs	\$1,000	\$10,000	Electrician	3	\$85	80	8	\$6,800
4	Conductor/Cable	18	Pcs	\$122	\$2,202	Electrician	3	\$85	36	2	\$3,060
5	BAS System	5	Pcs	\$42,160	\$210,800	BAS Technician	3	\$85	50	10	\$4,250
BAS Material Cost Subtotal					\$242,000	BAS Labour Cost Subtotal					\$20,700
<b>A/V System</b>											
1	Wireless Intercom System	85	Pcs	\$45	\$3,825	Telecommunication Technician	4	\$45	127.5	1.5	\$5,738
2	Projector and Screen	1	Pcs	\$1,300	\$1,300	Telecommunication Technician	1	\$45	6	6	\$270
3	TV Screen	10	Pcs	\$270	\$2,700	Telecommunication Technician	2	\$45	30	3	\$1,350

4	Wall Mount	10	Pcs	\$65	\$650	Telecommunication Technician	2	\$45	20	2	\$900
5	Super Computer	10	Pcs	\$48	\$480	Telecommunication Technician	2	\$45	10	1	\$450
6	Power Supply	10	Pcs	\$14	\$140	Electrician	1	\$85	10	1	\$850
7	SD Card	10	Pcs	\$4	\$40						
8	Display Software	120	Pcs	\$10	\$1,200			N/A			
9	Sound System	3	Pcs	\$1,177	\$3,531	Telecommunication Technician	2	\$45	9	3	\$405
10	Ethernet	6	Pcs	\$289	\$1,736	Telecommunication Technician	1	\$45	12	2	\$540
11	Wifi Basestation	5	Pcs	\$1,578	\$7,892	Telecommunication Technician	1	\$45	10	2	\$450
12	Passive Distributed Antenna System	1	Pcs	\$39,000	\$39,000	Telecommunication Technician	2	\$45	5	5	\$225
AV System Material Cost Subtotal					\$62,500	AV System Material Labour Subtotal					\$11,200
<b>Hands-Free Control System</b>											
1	OpenPath System	1	Pcs	\$85,158	\$85,158	Electrician	2	\$85	5	5	\$425
2	Loader	3	Pcs	\$127	\$381	Electrician	1	\$85	6	2	\$510
3	Laundry Machine Interface	18	Pcs	\$316	\$5,688	Electrician	2	\$85	18	1	\$1,530
4	Laundry Master	3	Pcs	\$217	\$651	Electrician	1	\$85	3	1	\$255
Hands-Free Control System Material Cost Subtotal					\$91,900	Hands-Free Control System Material Labour Subtotal					\$2,800
Smart Building Design Material Cost Subtotal					\$628,300	Smart Building Design Labour Cost Subtotal					\$156,900
<b>Total Smart Building Design Direct Cost</b>											<b>\$785,200</b>

### Building Energy Management

#### Direct Costs

Material Cost						Labour Cost					
Item #	Item description	Qty.	Unit	Unit Price (\$/unit)	Total Cost of Materials (\$)	Type of Woker	Number of Workers	Hourly Wage (\$/hr)	Total Time	Unit Production Hour (hr/unit)	Total Cost of Labour (\$)
<b>HVAC</b>											
1	Single Port Selector	85	Pcs	\$550	\$46,750	Electrician	1	\$85	21.25	0.25	\$1,806
2	VRF Outdoor Unit	1	Pcs	\$1,600	\$1,600	HVAC Technician	1	\$69	6	6	\$414
3	VRF Indoor Unit	85	Pcs	\$1,000	\$85,000	HVAC Technician	1	\$69	170	2	\$11,730
4	Pipes	20076	Ft*2	\$2	\$40,152	Plumbers	5	\$86	3,011.40	0.15	\$258,980
HVAC Material Cost Subtotal					\$173,600	HVAC Labour Cost Subtotal					\$273,000
<b>Electrical Infastructure</b>											
1	Wireless Temperature Sensors	30	Pcs	\$48.36	\$1,451	Electrician	1	\$85	15	0.5	\$1,275
2	Circuit Breaker	94	Pcs	\$174.64	\$16,416	Electrician	3	\$85	47	0.5	\$3,995
3	Isolation Transformer	3	Pcs	\$2,710.41	\$8,131	Electrician	2	\$85	12	4	\$1,020
4	Automatic Transfer Switch	1	Pcs	\$875.45	\$875	Electrician	1	\$85	3	3	\$255
5	Electrical Wiring	4751	Ft	\$0.66	\$3,136	Electrician	6	\$85	570.12	0.12	\$48,460
6	Receptacles	549	Pcs	\$1.78	\$977	Electrician	2	\$85	54.9	0.1	\$4,667
7	Breaker Panel	9	Pcs	\$500.00	\$4,500	Electrician	1	\$85	72	8	\$6,120
8	Energy Consumption/Production Sensors	94	Pcs	\$309.00	\$29,046	Electrician	1	\$85	47	0.5	\$3,995
9	Off-Grid Emergency Generator	1	Pcs	\$431.71	\$432	Electrician	1	\$85	6	6	\$510
Electrical Infastructor Material Cost Subtotal					\$65,000	Electrical Infastructor Labour Cost Subtotal					\$70,300
<b>Energy Source</b>											
1	Seraphim 315W Panel	93	Pcs	\$171	\$15,936	Electrician	2	\$85	46.5	0.5	\$3,953
2	RNG-175W Panel	24	Pcs	\$210	\$5,040	Electrician	2	\$85	12	0.5	\$1,020
3	Roof Racking System	1	Pcs	\$22,500	\$22,500	Electrician	2	\$85	12	12	\$1,020
4	Microinverter	117	Pcs	\$165	\$19,305	Electrician	2	\$85	29.25	0.25	\$2,486
5	Combiner Box	1	Pcs	\$1,012	\$1,012	Electrician	1	\$85	3	3	\$255
6	Crane Rental	7	Hours	\$352	\$2,464	Crane Operator	1	\$78	7	1	\$546
Energy Source Material Cost Subtotal					\$66,300	Energy Source Labour Cost Subtotal					\$9,300
Building Energy Managment Materials Cost Subtotal					\$304,900	Building Energy Managment Materials Cost Subtotal					\$352,600
<b>Total Building Energy Management Direct Cost</b>											<b>\$657,500</b>

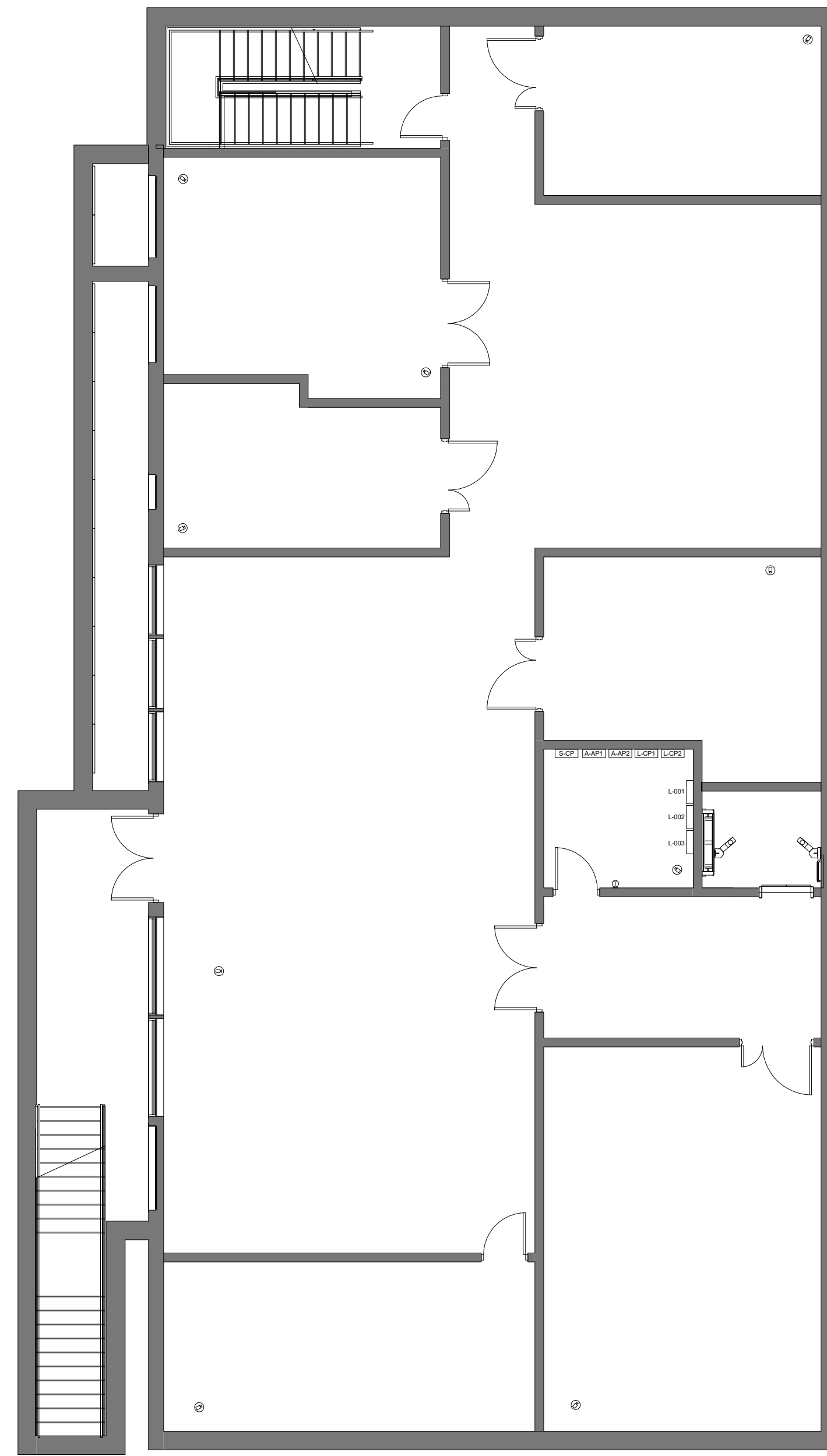
### Detailed Union Wages with Selected Pay Supplements

Occupation	Non Union Base Wage	Union Base Wage (2018)	Union Base Wage (2021)	Vacation and sick day Pay (%10)	Fringe Benefits (\$10)	Total Gross Wage
Electrician	N/A	\$64	\$69	\$7	\$10	\$85
Fire Alarm Technician	\$25	N/A	\$30	\$3	\$10	\$43
Telecommunications Technician	\$26	N/A	\$31	\$3	\$10	\$45
Crane operator	N/A	\$58	\$60	\$6	\$10	\$75
HVAC Technician	\$49	N/A	\$54	\$5	\$10	\$69
Plumber	N/A	\$65.41	\$69	\$7	\$10	\$86
Locksmith	\$25	N/A	\$30	\$3	\$10	\$43



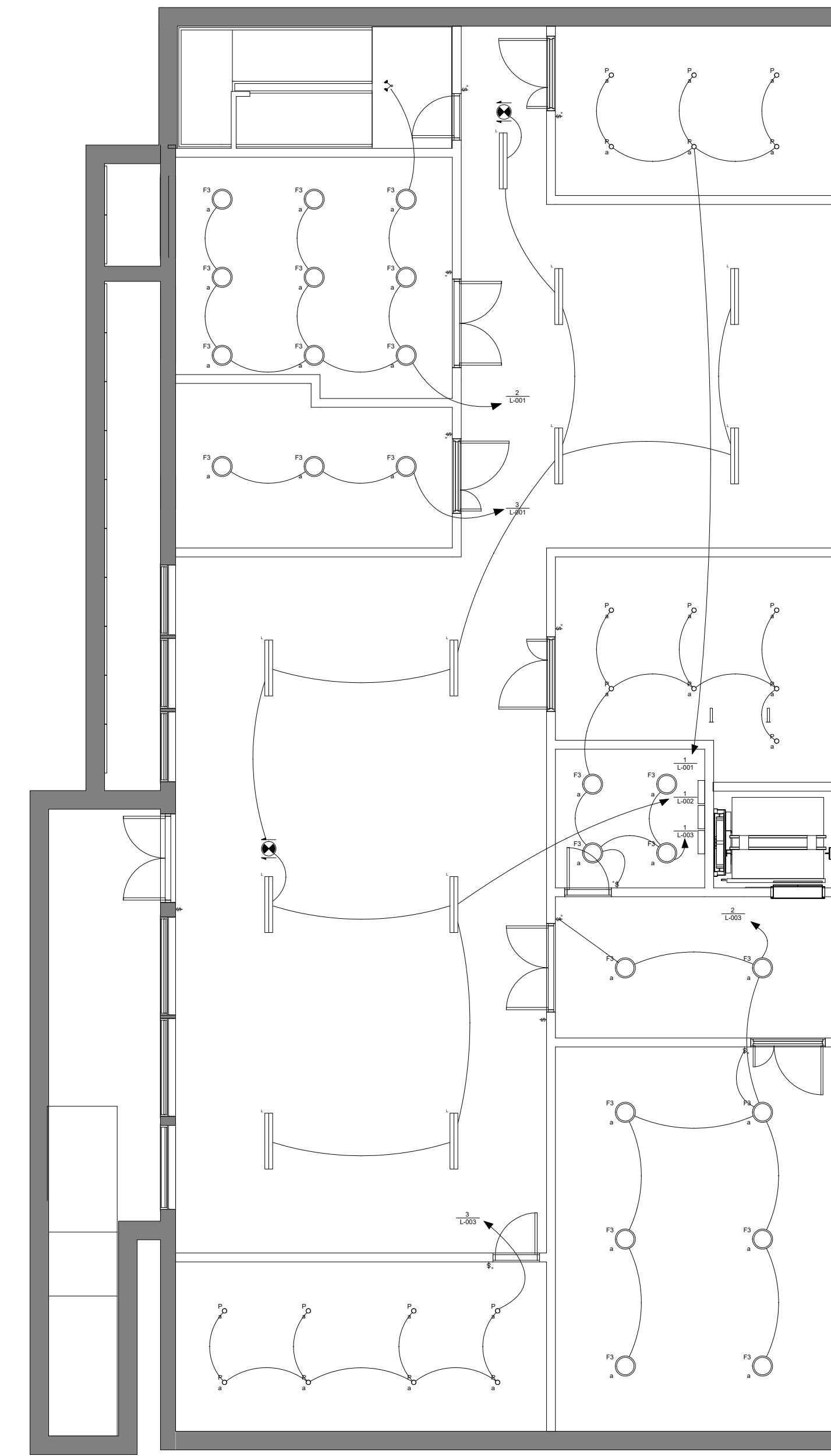
## **Appendix G** Shop Drawings

(next page)



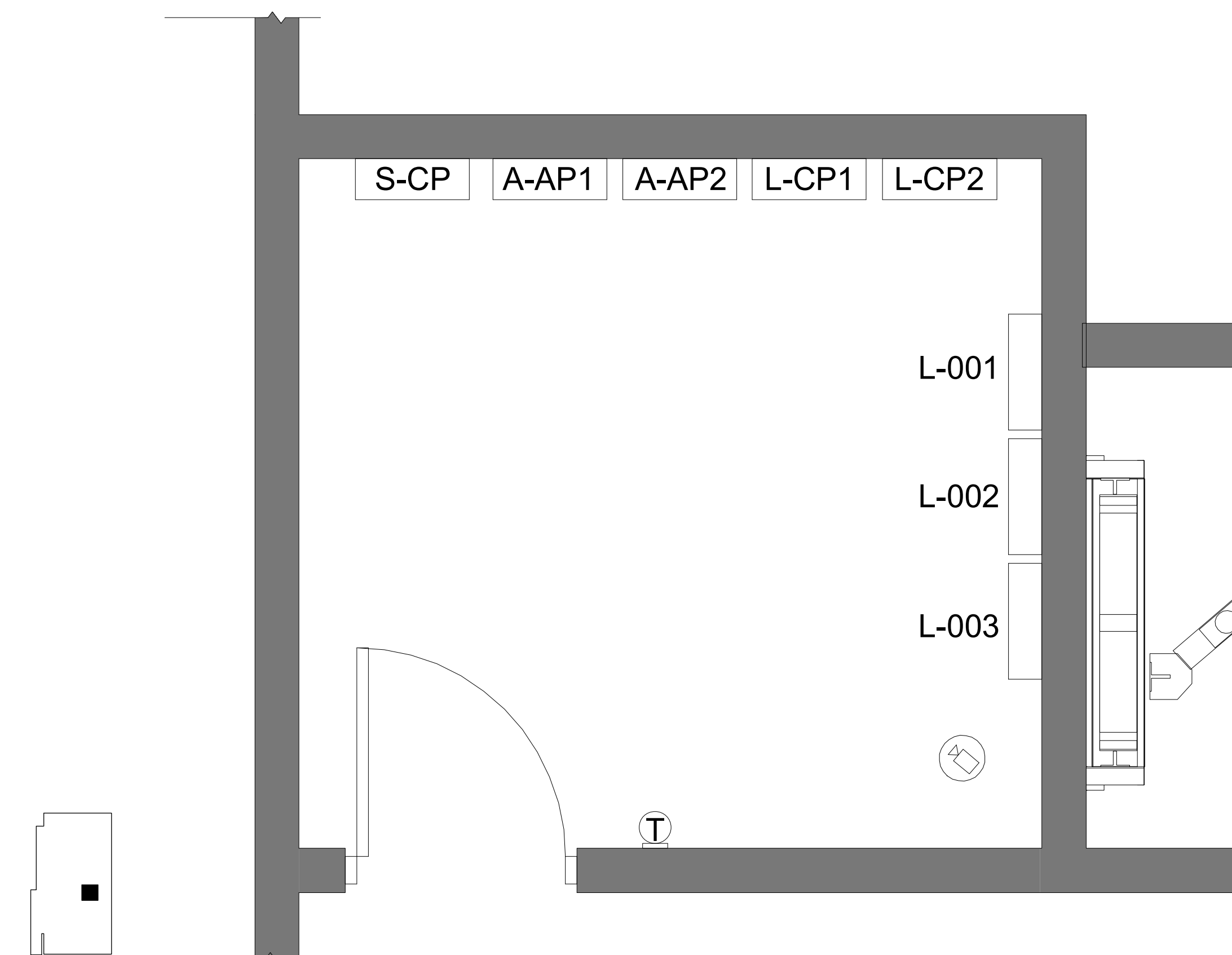
Basement Systems Plan

SCALE: 1/8 IN:1



Basement Lighting Plan

SCALE: 1/8 IN:1



Basement Electrical Room Callout



1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8

REV	DESCRIPTION	Date

DATE: 30/04/2021  
DRAWN BY: Zhiyuan Zhu  
CHECKED BY:

TITLE:  
**Basement Plans**

SHEET NUMBER:  
**Level 0**

PROJECT INFORMATION  
PROJECT NUMBER: CCL101T-001

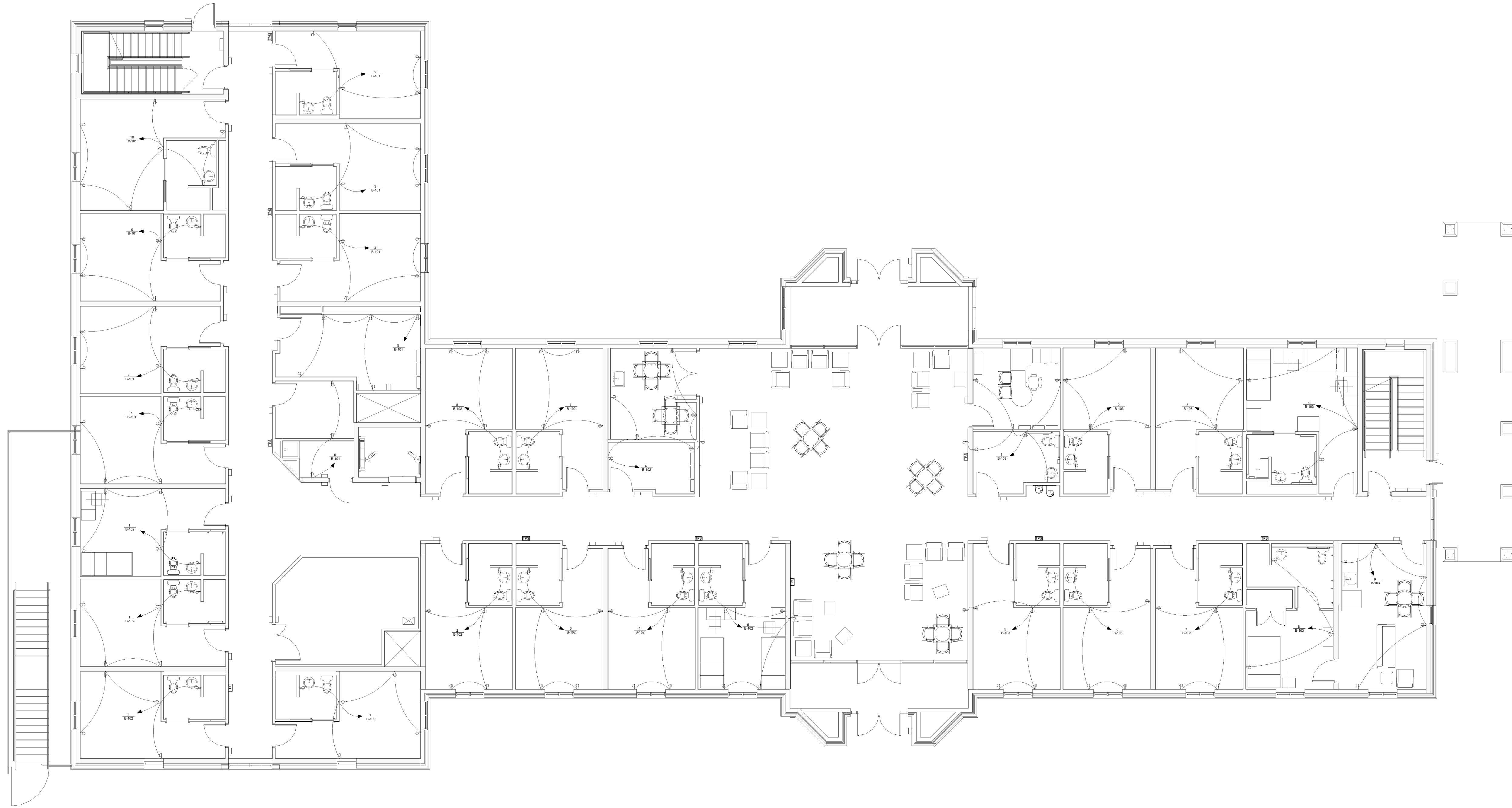




1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8



Level 1

SCALE: 1/8 IN:1

REVISION  
INFORMATION

REV	DESCRIPTION	Date

DATE: 30/04/2021

DRAWN BY: Zhiyuan Zhu

CHECKED BY:

TITLE:  
**Power  
First  
Floor**

SHEET NUMBER:

**Level  
BEM1**

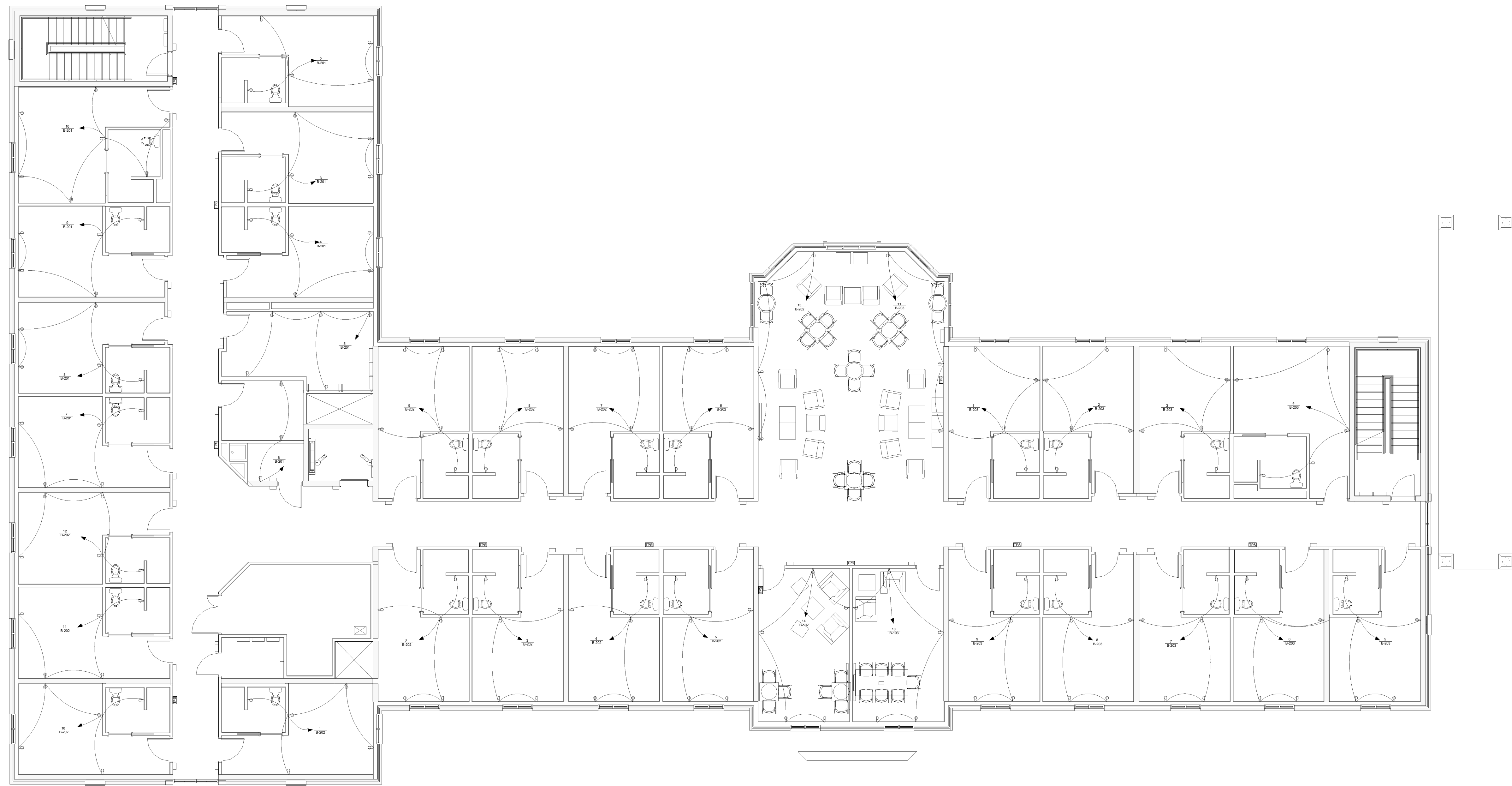
PROJECT NUMBER: CC10171\_001



1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8



Level 2

SCALE: 1/8 IN:1

REVISION

REV.	DESCRIPTION	Date

DATE: 30/04/2021

DRAWN BY: Zhiyuan Zhu

CHECKED BY:

TITLE:  
Power  
Second  
Floor

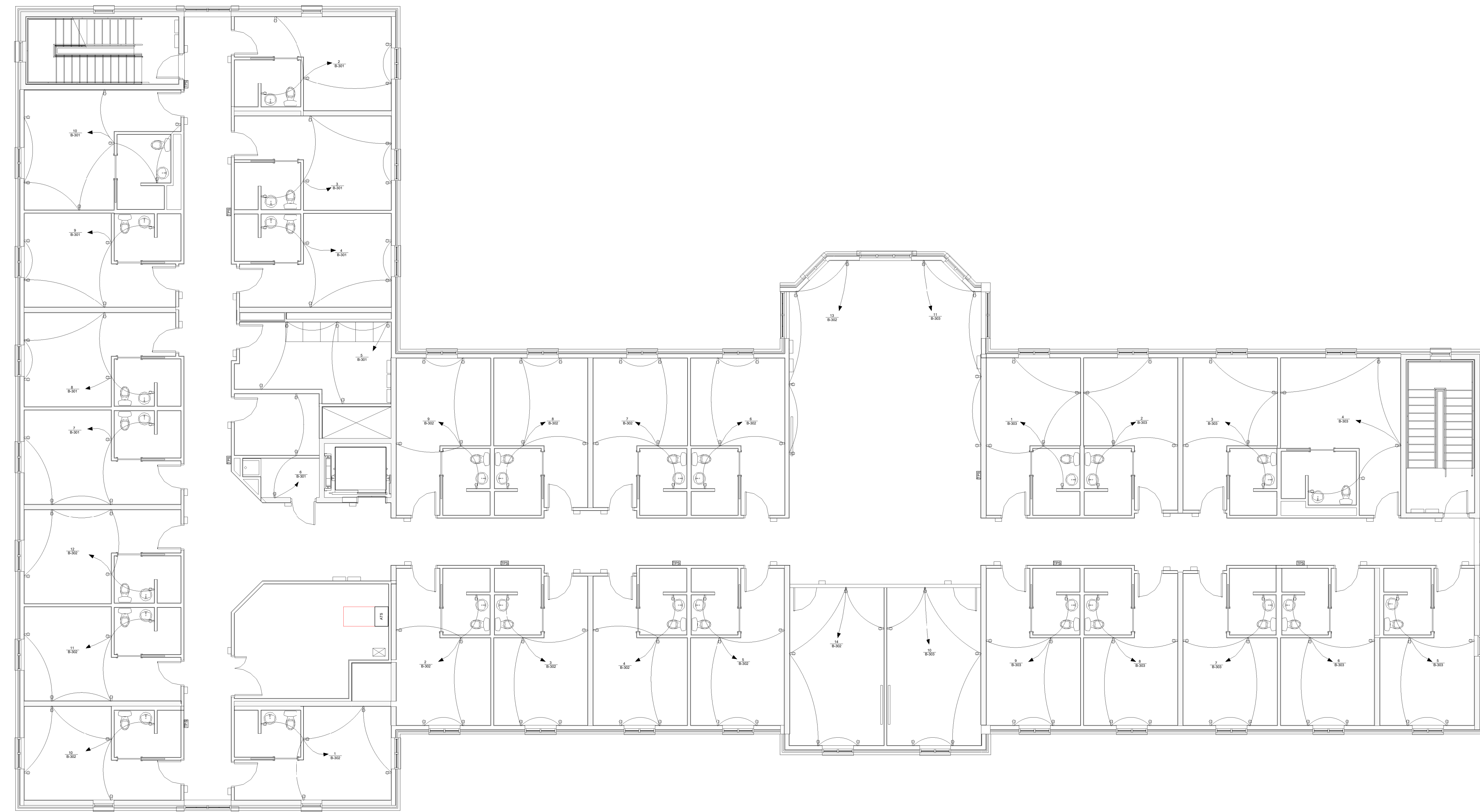
SHEET NUMBER:  
**Level  
BEM2**

PROJECT NUMBER: CC (L) F1 - 001



1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca



Level 3

SCALE: 1/8"=1'

**St. John Fisher's College**  
**60 Sussex Ave, Toronto**  
**ON, M5S 1J8**

REVISION

REV	DESCRIPTION	Date

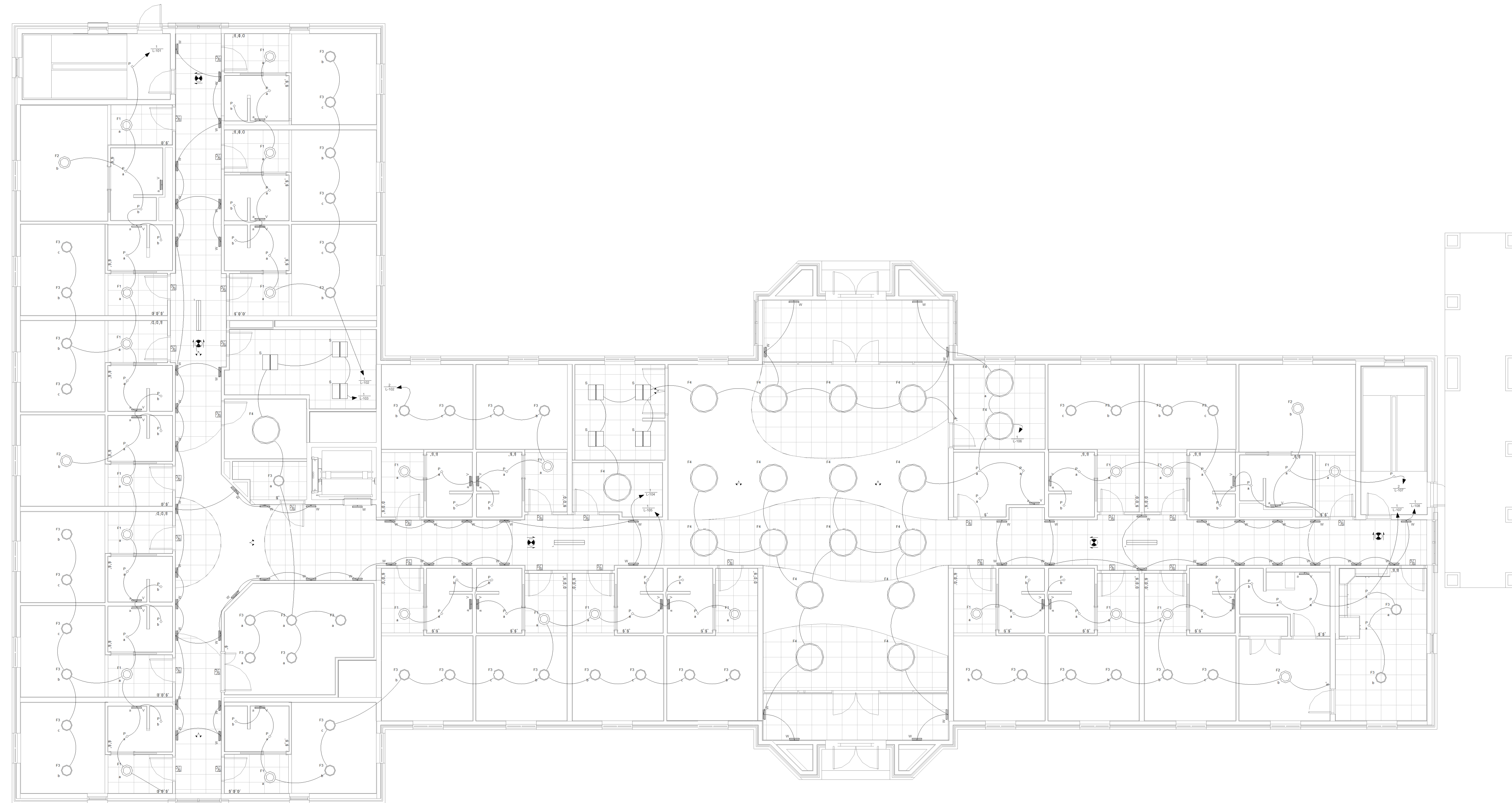
DATE: 30/04/2021  
DRAWN BY: Zhiyuan Zhu  
CHECKED BY:

TITLE:  
**Power  
Third  
Floor**

SHEET NUMBER:  
**Level  
BEM3**

PROJECT NUMBER: CC-01-F1-001





Level 1

SCALE: 1/8 IN:1



1 King's College Circle  
 Toronto, ON  
 M5S 1A8

email: [ceca.uoft@g.skule.ca](mailto:ceca.uoft@g.skule.ca)

St. John Fisher's College  
 60 Sussex Ave, Toronto  
 ON, M5S 1J8

PROJECT INFORMATION  
 PROJECT NUMBER: CCC-01-F-001

REV.	DESCRIPTION	Date

DATE: 30/04/2021  
 DRAWN BY: Zhiyuan Zhu  
 CHECKED BY:

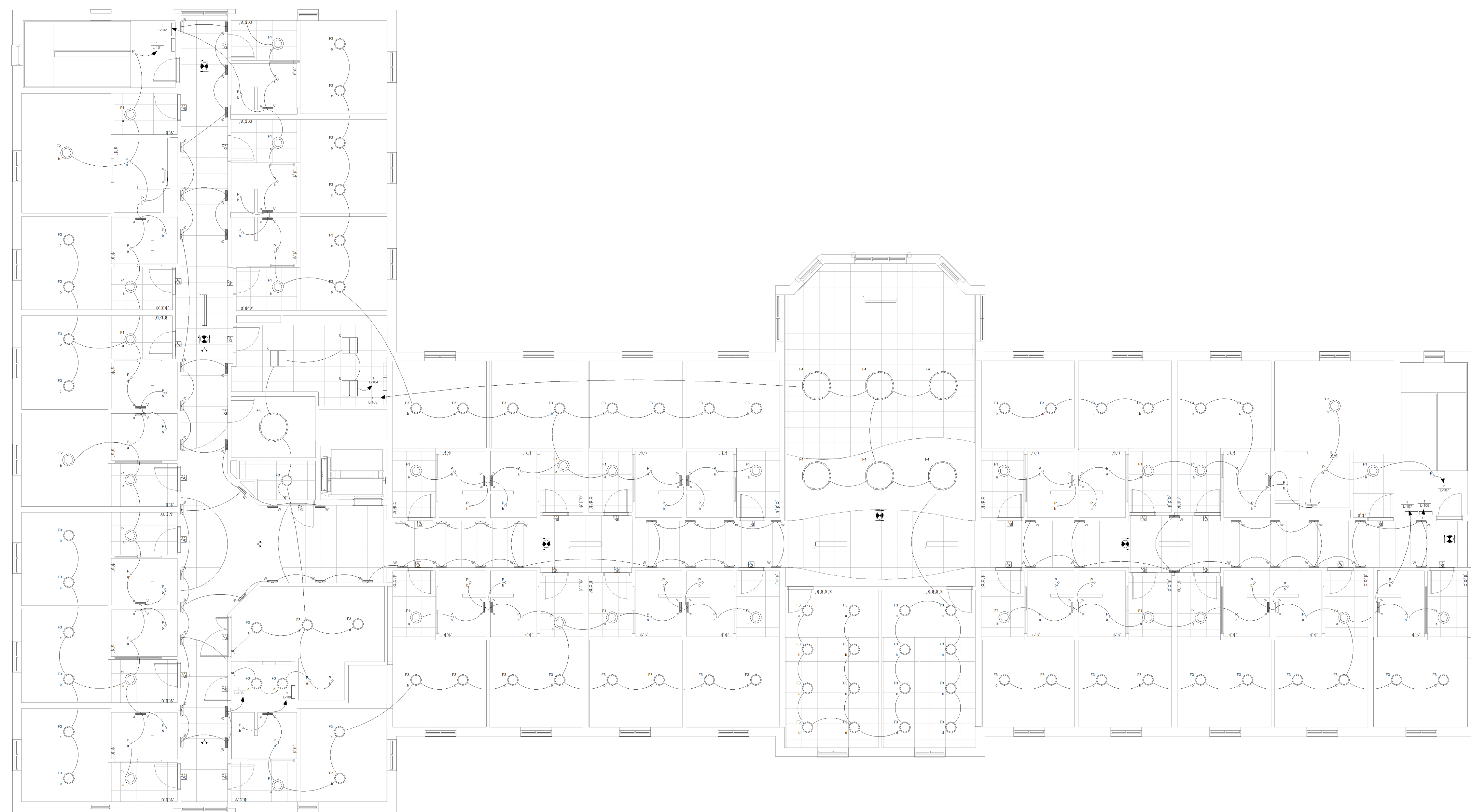
TITLE:  
 Lighting  
 First  
 Floor

SHEET NUMBER:  
**Level  
 L01**



1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca



Level 2

SCALE: 1/8 IN:1

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8

REVISION  
INFORMATION

REV.	DESCRIPTION	Date

PROJECT NUMBER: CC (L) F 1 - 001

DATE: 30/04/2021

DRAWN BY: Zhiyuan Zhu

CHECKED BY:

TITLE:  
Lighting  
Second  
Floor

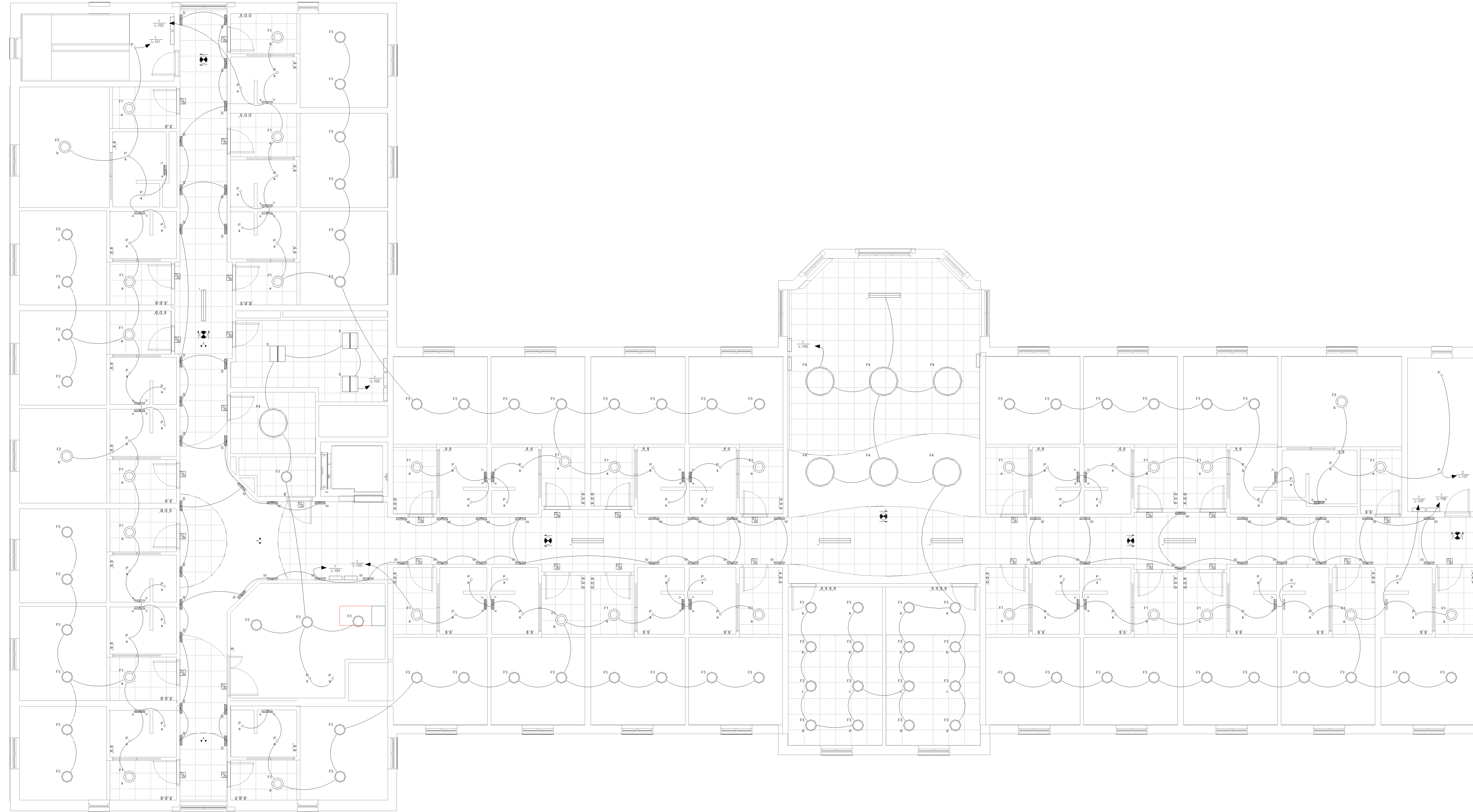
SHEET NUMBER:  
**Level  
L02**



1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8



Level 3

SCALE: 1/8 IN:1

REVISION  
INFORMATION

REV.	DESCRIPTION	Date

DATE: 30/04/2021  
DRAWN BY: Zhiyuan Zhu  
CHECKED BY:

TITLE:  
Lighting  
Third  
Floor

SHEET NUMBER:  
Level  
L03

PROJECT NUMBER: CC (L) F1\_001





1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8



Level 1

SCALE: 1/8 IN=1

REVISIONS

REV.	DESCRIPTION	Date

DATE: 30/04/2021

DRAWN BY: Zhiyuan Zhu

CHECKED BY:

TITLE:  
Systems  
First  
Floor

SHEET NUMBER:

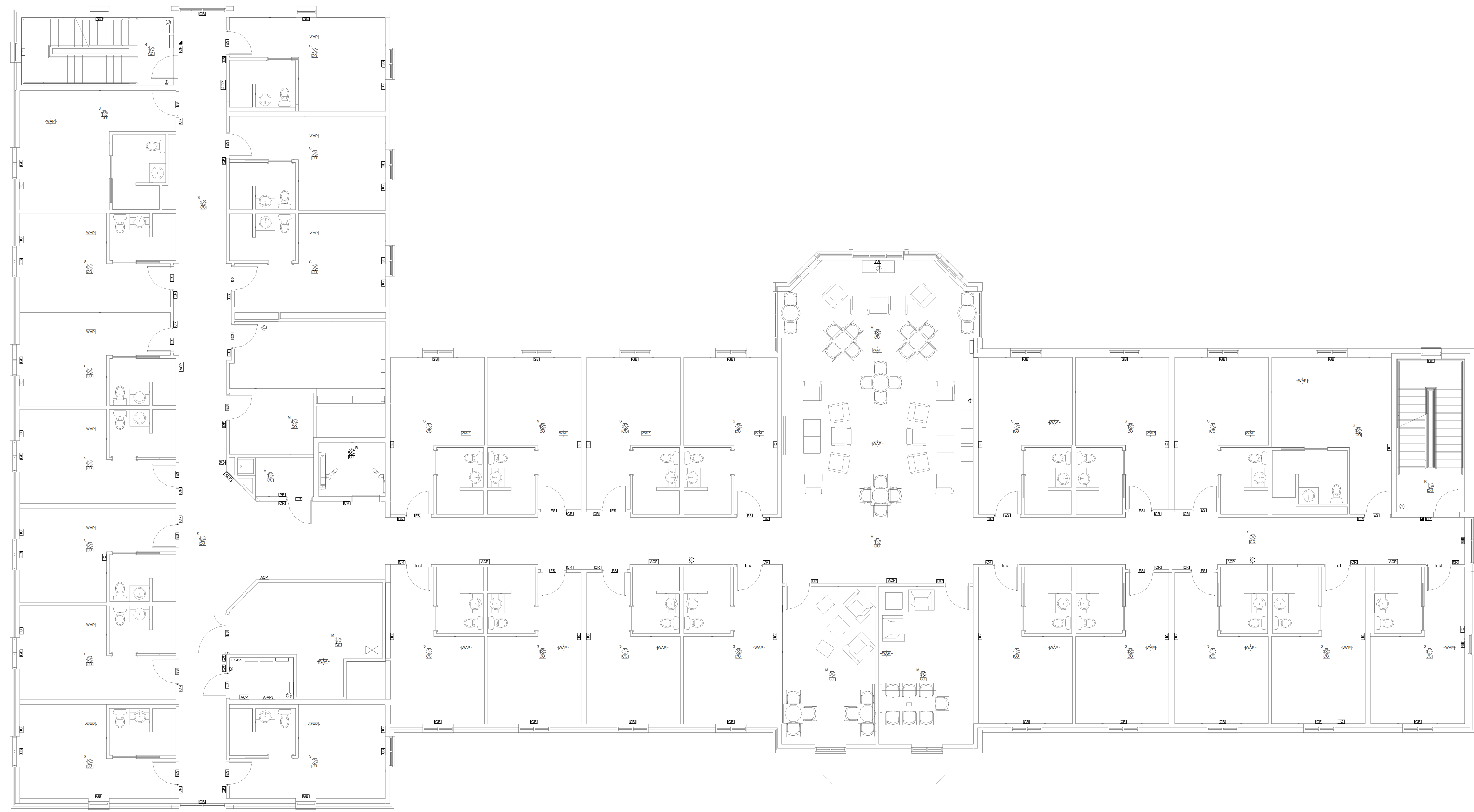
Level  
SBD1

PROJECT NUMBER: CC10111.0001



1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca



Level 2

SCALE: 1/8 IN:1

REVISIONS

REV.	DESCRIPTION	Date

DATE: 30/04/2021

DRAWN BY: Zhiyuan Zhu

CHECKED BY:

TITLE:  
Systems  
Second  
Floor

SHEET NUMBER:

Level  
SBD2

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8

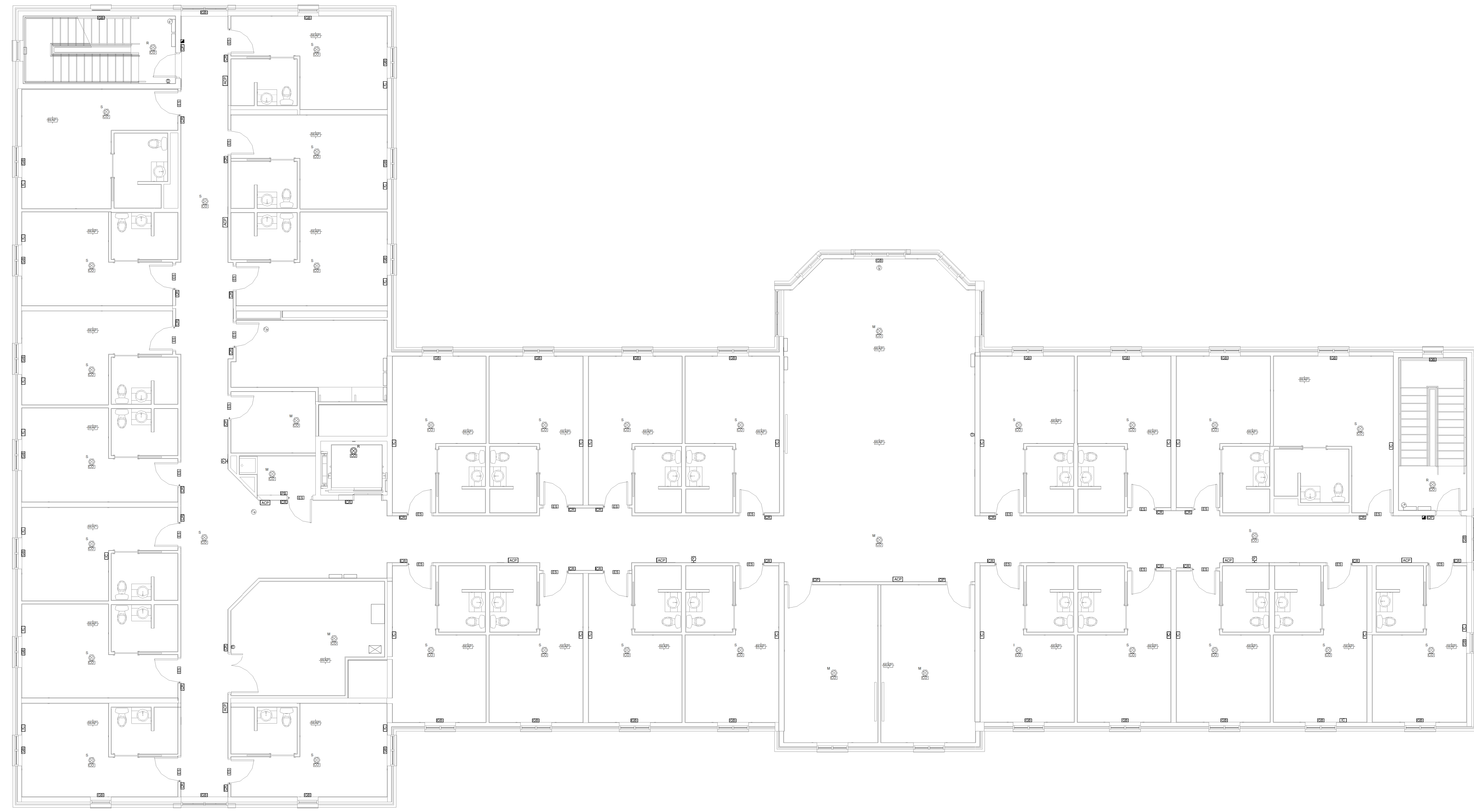
PROJECT NUMBER: CC14011\_001



1 King's College Circle  
Toronto, ON  
M5S 1A8

email: ceca.uoft@g.skule.ca

St. John Fisher's College  
60 Sussex Ave, Toronto  
ON, M5S 1J8



Level 3

SCALE: 1/8 IN:1

REVISION  
INFORMATION

REV.	DESCRIPTION	Date

DATE: 30/04/2021  
DRAWN BY: Zhiyuan Zhu  
CHECKED BY:

TITLE:  
Systems  
Third  
Floor

SHEET NUMBER:  
LevelSB  
D3

PROJECT NUMBER: CC (S) P1.0001



## Appendix H Summary of Interactions with NECA Contractors

Name	Company	Date	Purpose	Duration	Description
Michael Parkes	O'Connell Electric Company	02/03/2021	Intro and ECIC Expectation Meeting	0.5 hr	Our communications coordinator, Sarah De Sousa, met with Michael in order to give him an introduction to our team, discuss the ECIC, and plan how to move forwards in terms of future communication. Sarah received feedback on the team's introductory progress and Sarah and Michael discussed ideas of how the team's design could progress.
Michael Parkes, Brian Rittenhouse, Brian Shaffer, Rob Miller	O'Connell Electric Company	02/23/2021	Intro to Construction and Electrical Drawings	1.5 hr	The team of electrical contractors showed the UofT ECIC participants various electrical drawings, such as Lighting plans, System plans, and power plans. They also introduced the various symbols and aspects of these drawings and provided advice on construction drawings submission for the ECIC.
Michael Parkes, Rob Miller Ian Sinclair (Faculty Advisor)	O'Connell Electric Company University of Toronto	03/08/2021	Preliminary Proposal Presentation	1.5 hr	The team leads of the UofT ECIC teams presented their innovative ideas for the ECIC to O'Connell Electric Company and our faculty advisor. The electrical contractors provided the students with helpful advise and feedback regarding their proposals.
Keith Foster (Manager of	University of Toronto	03/10/2021	Preliminary Proposal	1 hr	The team leads for the Building Energy Management sub-team and



Electrical Systems)			Presentation & Discussion		the Lighting sub-team presented their preliminary design ideas to Keith Foster, a manager of electrical utilities for UofT. He was able to provide valuable feedback about how well the team's designs would work in the context of UofT campus and suggest ways that it could better meet UofT standards.
Keith Foster (Manager of Electrical Systems)	University of Toronto	03/18/2021	Preliminary Proposal Presentation & Discussion	1 hr	The team leads for the Smart Building Design, Building Information Modelling, and Project Management sub-teams presented their preliminary design ideas to Keith Foster, a manager of electrical utilities for UofT. Similar to the previous meeting, Keith provided valuable feedback and helped the teams realize how their designs could better work in the context of UofT.
Michael Parkes, Rob Miller	O'Connell Electric Company	3/31/2021	Project Management Discussions	1.5 hr	The team lead of the Project Management team received advice and valuable feedback from the representatives of O'Connell Electric Company regarding cost estimation and scheduling.

### Appendix I Campus/Local Media Engagement Support Items

Throughout the ECIC design process, our team utilized Instagram and also published an article to connect with our student community and provide updates and information about the competition. Mahia, a project manager on our team, wrote an article about our participation in the ECIC that was published to the Civil and Mineral Engineering University of Toronto departmental website. The link and the article itself can be found below. The links to all Instagram posts made along with their subject can be seen below in Table 7.16.





Table 7.16: Instagram Posts for Campus Engagement

Date	Link	Subject
4-19-2021	<a href="https://www.instagram.com/p/CN2KF-PhstQ/">https://www.instagram.com/p/CN2KF-PhstQ/</a>	Building Information Modelling Final Proposal Designs and Testimonials
4-18-2021	<a href="https://www.instagram.com/p/CNzjRe0Bs9T/">https://www.instagram.com/p/CNzjRe0Bs9T/</a>	Project Management Final Proposal Designs and Testimonials
4-17-2021	<a href="https://www.instagram.com/p/CNw8e88h1dD/">https://www.instagram.com/p/CNw8e88h1dD/</a>	Smart Building Design Final Proposal Designs and Testimonials
4-16-2021	<a href="https://www.instagram.com/p/CNuWZnThey2/">https://www.instagram.com/p/CNuWZnThey2/</a>	Building Energy Management Final Proposal Designs and Testimonials
4-15-2021	<a href="https://www.instagram.com/p/CNsF3M6hqGe/">https://www.instagram.com/p/CNsF3M6hqGe/</a>	Lighting Final Proposal Designs and Testimonials
3-31-2021	<a href="https://www.instagram.com/p/CNGe6E9hN0V/">https://www.instagram.com/p/CNGe6E9hN0V/</a>	University Consultations
3-21-2021	<a href="https://www.instagram.com/p/CMspMUXBAiw/">https://www.instagram.com/p/CMspMUXBAiw/</a>	Project Management Pre-Proposal Designs
3-20-2021	<a href="https://www.instagram.com/p/CMpzsJPB2Jt/">https://www.instagram.com/p/CMpzsJPB2Jt/</a>	Building Information Modelling Pre-Proposal Designs
3-19-2021	<a href="https://www.instagram.com/p/CMnmnpEBz8V/">https://www.instagram.com/p/CMnmnpEBz8V/</a>	Building Energy Management Pre-Proposal Designs
3-18-2021	<a href="https://www.instagram.com/p/CMk4ycbBqfK/">https://www.instagram.com/p/CMk4ycbBqfK/</a>	Smart Building Design Pre-Proposal Designs
3-17-2021	<a href="https://www.instagram.com/p/CMiY-vhhege/">https://www.instagram.com/p/CMiY-vhhege/</a>	Lighting Pre-Proposal Designs
2-19-2021	<a href="https://www.instagram.com/p/CLeulA6hIoZ/">https://www.instagram.com/p/CLeulA6hIoZ/</a>	Building Information Modelling Sub-team Introduction
2-18-2021	<a href="https://www.instagram.com/p/CLcE-wLhwGG/">https://www.instagram.com/p/CLcE-wLhwGG/</a>	Project Management Sub-team Introduction
2-17-2021	<a href="https://www.instagram.com/p/CLZbP2cBDwK/">https://www.instagram.com/p/CLZbP2cBDwK/</a>	Building Energy Management Sub-team Introduction
2-16-2021	<a href="https://www.instagram.com/p/CLWmqHQhifZ/">https://www.instagram.com/p/CLWmqHQhifZ/</a>	Lighting Sub-team Introduction
2-15-2021	<a href="https://www.instagram.com/p/CLT-mKnhjEp/">https://www.instagram.com/p/CLT-mKnhjEp/</a>	Smart Building Design Sub-team Introduction
1-30-2021	<a href="https://www.instagram.com/p/CKrDgk8hFkQ/">https://www.instagram.com/p/CKrDgk8hFkQ/</a>	Distributing Occupant Survey
1-23-2021	<a href="https://www.instagram.com/p/CKYy5jyBnLl/">https://www.instagram.com/p/CKYy5jyBnLl/</a>	Revit Workshops Kickoff



The article published can be found at: <https://civmin.utoronto.ca/ceca-uoft-team-participates-in-the-electrical-contracting-innovation-challenge/> and is also copied below for reference.

4/27/2021

CECA U of T Team Participates in the Electrical Contracting Innovation Challenge - Department of Civil & Mineral Engineering

U of T ENGINEERING ▾



UNIVERSITY OF  
TORONTO

Engineering



Posted April 26th, 2021 by Rebecca Logan

## CECA U of T Team Participates in the Electrical Contracting Innovation Challenge

By: **Mahia Anhara** (Year 3, CivE on PEY), Co-Project Manager of CECA U of T Student Chapter



**CECA U of T** is the student chapter for the Canadian Electrical Contractors Association. Our student-led club brings together like-minded students, who are interested in finding sustainable building solutions.

We are participating in the annual international competition called the **Electrical Contracting Innovation Challenge** (ECIC), where students are challenged to design an innovative electrical system for a new residence hall on our respective university campuses that will meet the needs of the building occupants. This competition is organized by the **National Electrical Contractors Association** (NECA).

The U of T ECIC team consists of over 35 students from various programs, such as engineering and architecture. The team is further divided into five sub-teams, each focusing on a unique aspect of this competition: Lighting, Building Energy Management, Smart Building Design, Building Information Modelling, and Project Management. The sub-teams have worked very hard in the last three months to propose innovative and cost-effective electrical solutions for a potential U of T dorm.

The Lighting team has proposed 11 different fixtures of LED lights for the entire building. The lights can be dimmed and timed due to the integration of KNX building automation systems, leading to energy savings.

The Building Energy Management team has proposed rooftop solar panels for on-site electricity generation, an all-electric variant refrigerant flow (VRF) HVAC system for heating/cooling, and smart temperature meters to regulate the internal environment. These systems contribute to the sustainability and net-zero goals of the building.

The Smart Building Design (SBD) team proposed several technologies to provide residents with an enhanced occupant experience. The areas they focused on are security, access control, communication, hands-free control, and building automation systems. Examples of the SBD systems include smart card technology for accessing dorm rooms, IP





addressed security systems, wide coverage mesh router system for reliable internet connection, and various app-based touchless technologies.

The Building Information Modelling team has produced a 3D model on Revit of the electrical solutions consisting of symbolic components for over 50+ fixtures. This team has also created construction drawings and shop drawings as a part of the proposal.

The Project Management team has developed the cost estimate for the proposed systems accounting for material, labour, equipment, and indirect costs while adhering to the project budget of \$2.3 million USD. In addition, the PM team has created a detailed construction schedule for the proposed work that meets the client's timeline.

The competition has been extremely rewarding for the team. We asked some of the participants about their experience. Here are some of their answers:

*"My experience in the ECIC has been simply amazing. It was great to be part of a team that collaborated in terms of creativity, communication, and research. I gained exposure regarding the industry and learned a lot about the number of details that go into building a comfortable living environment." - Shikhar Chaurasia (Track One, 2T4)*

*"ECIC has been a challenging competition that would not succeed without supportive members and hard-working team leads. I am impressed by the commitment shown by my colleagues and I have learned much about electronics and building automation from research and discussions." - James Kwok (CivE, 2T3)*

*"Being a part of the BIM team, I learned how to use Revit to draw electrical drawings and create important elements such as lighting symbols, switches, and Revit families, etc. thanks to the informative and practical workshop sessions hosted by our Lead and CECA. I got to see how the different systems of the building come together in the model and learned how to organize them to make modelling work more efficient. It was a fun and great experience!" - Jane Gao (CivE, 2T1+ PEY)*

We would like to say thank you to every member of the CECA U of T team for all their hard work and dedication this year and ELECTRI and NECA for giving us the opportunity to participate in this rewarding competition.



4/27/2021

CECA U of T Team Participates in the Electrical Contracting Innovation Challenge - Department of Civil & Mineral Engineering



U of T ECIC team members participating in the virtual competition kickoff meeting

Editor's note: CECA U of T will submit its proposal on Friday, April 30, 2021

Posted in News, Uncategorized | Tags: CECA, CivMin, Mahia Anhara, NECA

Undergraduate Programs

Graduate Programs

Research Themes



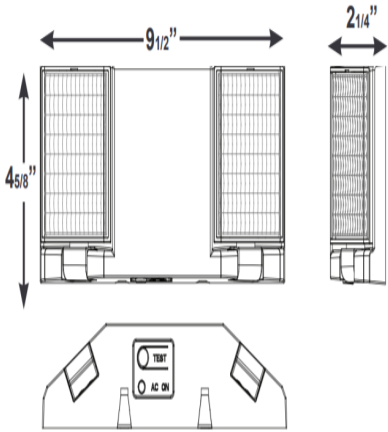

<https://civmin.utoronto.ca/ceca-uoft-team-participates-in-the-electrical-contracting-innovation-challenge/>

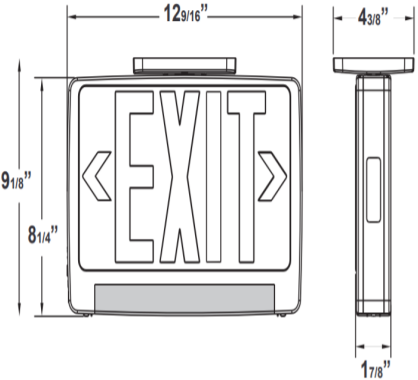

3/4

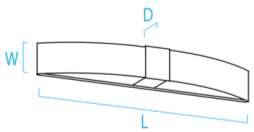
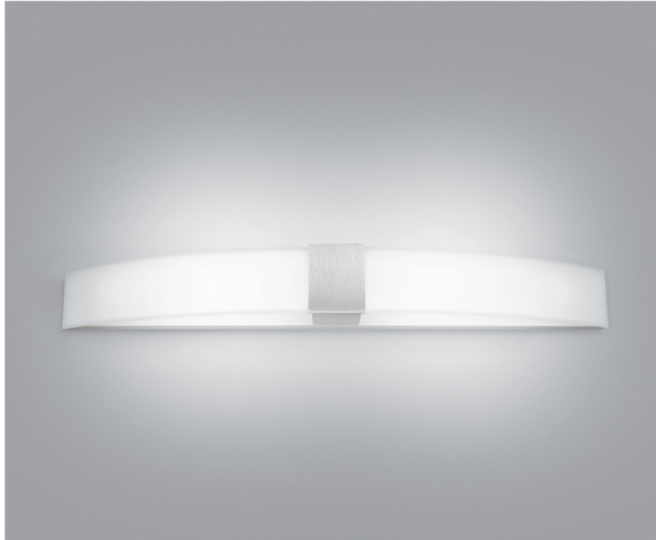


## **Appendix J** Lighting System Product Datasheets

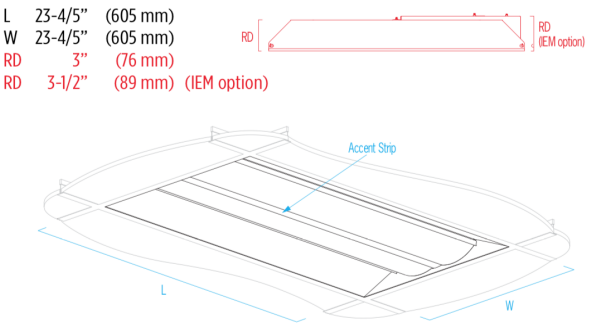

(next page)

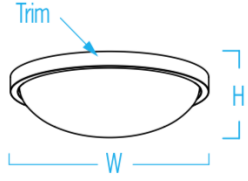

Brand	WareLight	<p>Dimensions Information:</p> 	<p>Fixture Image:</p> 
Model Code	LEDR-2		
Mounting Type	Surface/Wall/Ceiling		
Housing Material	Thermoplastic		
IP Rating (water and dust protection)	Damp rated		
Lamp Source	LED		
Beam Angle	-		
Color Temperature			
CRI			
Lens Type	Plastic	<p>Other info.</p> <ul style="list-style-type: none"> <li>• Dual 120/277 voltage.</li> <li>• Charge rate/power "ON" LED indicator light and push-to-test switch for mandated code compliance testing.</li> <li>• 3.6V long-life, maintenance-free, rechargeable NiCd battery.</li> <li>• Internal solid-state transfer switch automatically connects the internal battery to LED lamp heads for minimum 90-minute emergency illumination.</li> <li>• Fully automatic solid-state, two-rate charger initiates battery charging to recharge a discharged battery in 24 hours.</li> </ul> <p><a href="https://www.warehouse-lighting.com/products/led-thermoplastic-emergency-light-with-two-adjustable-heads">https://www.warehouse-lighting.com/products/led-thermoplastic-emergency-light-with-two-adjustable-heads</a></p>	
Reflector	N/A		
Power Consumption	2 W		
Accessories	N/A		
Cost	\$16 - \$ 21		
Remarks	Emergency light		

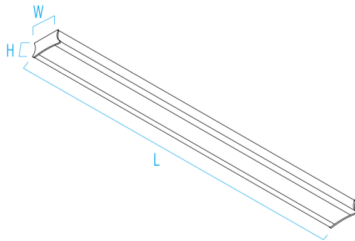

Brand	Marz Exit	Dimensions Information: 	Fixture Image: 	
Model Code	CLPU			
Mounting Type	Wall/Ceiling			
Housing Material	Thermoplastic			
IP Rating (water and dust protection)	Damp rated			
Lamp Source	LED			
Beam Angle	-			
Color Temperature				
CRI		Other info.		
Lens Type	Acrylic lens	<ul style="list-style-type: none"> <li>• Dual 120/277 voltage.</li> <li>• Charge rate/power "ON" LED indicator light and push-to-test switch for mandated code compliance testing.</li> <li>• 4.8V long-life, maintenance-free, rechargeable NiCd battery.</li> <li>• Internal solid-state transfer switch automatically connects the internal battery to LED board/light pipe for minimum 90-minute emergency illumination.</li> <li>• Fully automatic solid-state, two-rate charger initiates battery charging to recharge a discharged battery in 24 hours.</li> <li>• Remote capable standard.</li> </ul> <a href="https://www.warehouse-lighting.com/products/led-light-pipe-exit-combo-remote-capable">https://www.warehouse-lighting.com/products/led-light-pipe-exit-combo-remote-capable</a>		
Reflector	N/A			
Power Consumption	4.5 W			
Accessories	N/A			
Cost	\$70 - \$84			
Remarks	Exit light			


Brand	Visa Lighting	<b>Dimensions Information:</b> <b>DIMENSIONS</b> W = Width    H = Height    D = Depth <i>Depth is measured from wall to front of fixture.</i>  L     33"     (838 mm) W     4-3/4"   (121 mm) D     5-1/2"   (140 mm) 	<b>Fixture Image:</b> 
Model Code	CB6456		
Mounting Type	Wall mounted		
Housing Material	Plastic & metal		
IP Rating (water and dust protection)	Damp rated		
Lamp Source	LED		
Beam Angle	-		
Color Temperature	3000K		
CRI	90		
Lens Type	White acrylic		
Reflector	N/A	<b>Other info.</b> <ul style="list-style-type: none"> <li>● LED Sources are dimmable 0-10V to 1% and are 83CRI, within 3-step MacAdam</li> <li>● MVOLT fixture (accepts 120 to 277V)</li> </ul> <a href="https://www.visalighting.com/products/bowe?field_healthcare_tags_tid[]=1095">https://www.visalighting.com/products/bowe?field_healthcare_tags_tid[]=1095</a>	
Power Consumption	17W		
Accessories	N/A		
Cost	-		
Remarks	Vanity light		

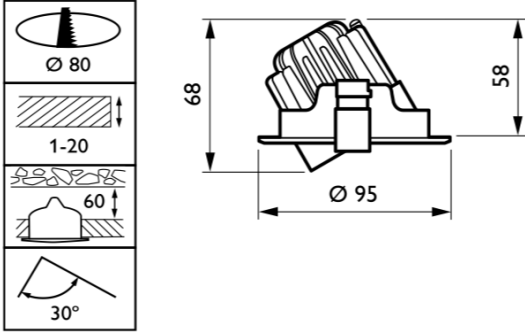



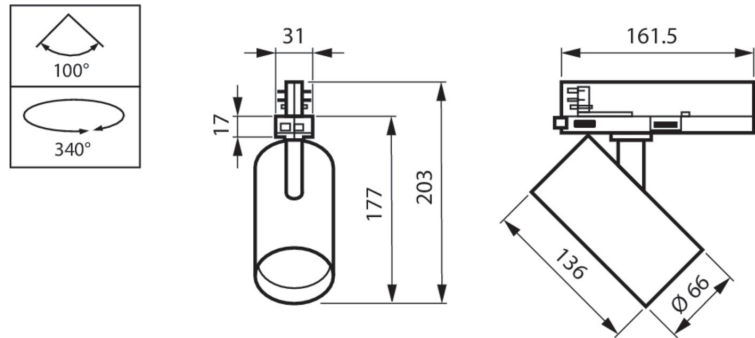

Brand	VISA Lighting	<b>Dimensions Information:</b> <b>DIMENSIONS</b> W = Width L = Length RD = Recessed Depth L 23-4/5" (605 mm) W 23-4/5" (605 mm) RD 3" (76 mm) RD 3-1/2" (89 mm) (IEM option) 	<b>Fixture Image:</b> 
Model Code	Jasper CM2082-W		
Mounting Type	Recessed		
Housing Material			
IP Rating (water and dust protection)	Damp rated		
Lamp Source	LED		
Beam Angle	-		
Color Temperature	3500K		
CRI	80		
Lens Type	acrylic		
Reflector	N/A	<b>Other info.</b> <ul style="list-style-type: none"> <li>• Multiple levels of lumen output</li> <li>• Certified to DesignLights Consortium "standard" classification • Low plenum depth enables use in "busy" recessed plenums or retrofit projects</li> <li>• Mounts to standard 15/16", 9/16", or screw-slot grid ceiling systems • Integral T-bar retaining clips</li> <li>• Integral mounting points for suspension cables (by others) to building structure</li> <li>• Optional NEC Article 410 compliant "earthquake clips" (EQC option)</li> <li>• Optional flange kit for mounting to drywall ceilings (SRI option)</li> <li>• Extruded, frosted acrylic lens with diffusing optical film</li> <li>• IEM option available (90min emergency backup pack)</li> <li>• DALI dimming option available</li> </ul> <a href="https://www.visalighting.com/products/jasper/CM2082-W">https://www.visalighting.com/products/jasper/CM2082-W</a>	
Power Consumption	19W		
Accessories	N/A		
Cost	-		
Remarks	Strip light		

Brand	VISA Lighting	<p>Dimensions Information:</p> <p><b>DIMENSIONS</b></p> <p>W = Width      H = Height</p> <p>W    17-3/8"    (441 mm)</p> <p>H    5-1/2"      (140 mm)</p> 	<p>Fixture Image:</p> 
Model Code	SOLO CM1022		
Mounting Type	Surface		
Housing Material			
IP Rating (water and dust protection)	Damp rated		
Lamp Source	LED		
Beam Angle	-		
Color Temperature	3000K		
CRI			
Lens Type	White acrylic		
Reflector	N/A	<p>Other info.</p> <ul style="list-style-type: none"> <li>• Integral power supply</li> <li>• <i>f</i> Fixture tested per LM79 standard</li> <li>• <i>f</i> Modular design for replacement of LED source and power supply <i>f</i> Easy tool-less relamping</li> <li>• <i>f</i> Mounts to standard electrical junction box (by others)</li> <li>• <i>f</i> Heavy gauge spun metal trim</li> <li>• <i>f</i> Thermally formed 1/8" thick white acrylic diffuser with matte finish <ul style="list-style-type: none"> <li>○ w UV stabler</li> <li>○ w UL-94 HB Flame Class rated</li> </ul> </li> <li>• <i>f</i> No VOC powder coat paint; Low VOC clear coat on metal finishes <i>f</i> ETL listed for damp locations. Not suited for exterior applications</li> </ul> <p><a href="https://www.visalighting.com/products/solo/CM1022">https://www.visalighting.com/products/solo/CM1022</a></p>	
Power Consumption	39W		
Accessories	N/A		
Cost	-		
Remarks	Flush mount (1)		

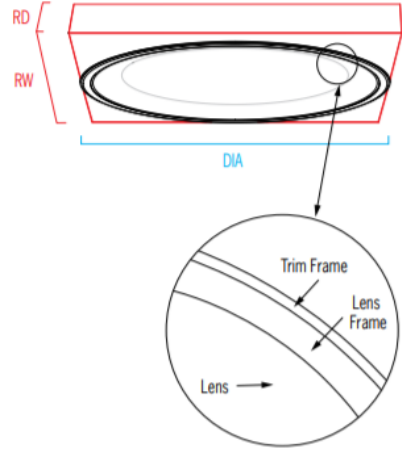

Brand	VISA Lighting	<b>Dimensions Information:</b> <b>DIMENSIONS</b> W = Width      H = Height      L = Length  W    6-7/8"    (175 mm) H    3"        (76 mm) L    72"        (1829 mm) 	<b>Fixture Image:</b> 
Model Code	CM2106-T		
Mounting Type	surface		
Housing Material			
IP Rating (water and dust protection)	damp		
Lamp Source	LED		
Beam Angle	-		
Color Temperature	2900K		
CRI	90		
Lens Type	acrylic		
Reflector	N/A	<b>Other info.</b> <ul style="list-style-type: none"> <li>● Integral driver</li> <li>● Two Channel Tunable control capability provides independent control of CCT and dimming using two separate 0-10V controllers (by others)</li> <li>● Batwing downlight distribution</li> <li>● Downlight and sidelight controlled independently for dimming (may be field wired for simultaneous control)</li> <li>● Ceiling surface mount and ceiling grid mount options</li> <li>● 90+ CRI</li> <li>● Extruded aluminum body</li> <li>● Co-extruded acrylic lenses</li> <li>● No VOC powder coat paint finish</li> <li>● ETL listed for damp locations. Not suited for exterior applications</li> </ul>	
Power Consumption	39W		
Accessories	N/A		
Cost	-		
Remarks	Linear light		
			<a href="https://www.visalighting.com/products/latitude/CM2106-T">https://www.visalighting.com/products/latitude/CM2106-T</a>

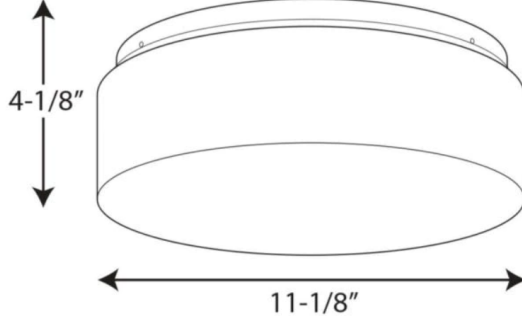

Brand	VISA Lighting	<b>Dimensions Information:</b> <b>DIMENSIONS</b> <i>Depth is measured from stem center to stem center</i> <hr/> W= Width      H = Height      D = Depth <hr/> W      17"      (432 mm) H      8-1/2"      (216 mm) D      3-3/4"      (95 mm)	<b>Fixture Image:</b> 
Model Code	CB4020		
Mounting Type	wall		
Housing Material			
IP Rating (water and dust protection)	Damp rated		
Lamp Source	LED		
Beam Angle	-		
Color Temperature	3000K		
CRI			
Lens Type	White acrylic		
Reflector	N/A	<b>Other info.</b> <ul style="list-style-type: none"> <li>● 1100 lumens</li> <li>● <i>f</i> Integral power supply</li> <li>● <i>f</i> Mounts to standard electrical junction box (by others) with provided hardware</li> <li>● <i>f</i> Heavy gauge spun metal housing</li> <li>● <i>f</i> 1/8" thick white acrylic diffuser with matte finish</li> <li>● <i>f</i> Optional specialty diffuser materials available, including some Lumicor recyclable resin materials</li> <li>● <i>f</i> No VOC powder coat paint</li> <li>● <i>f</i> ETL listed for damp locations. Not suitable for exterior applications</li> </ul> <a href="https://www.visalighting.com/products/crescent?field_mounting_tid[]=109">https://www.visalighting.com/products/crescent?field_mounting_tid[]=109</a>	
Power Consumption	15W		
Accessories	N/A		
Cost	-		
Remarks	Wall light		

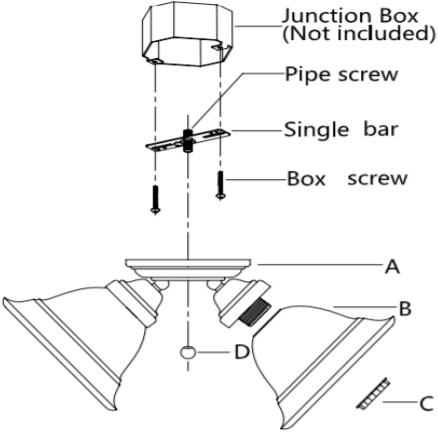

Brand	Philips	<p style="text-align: center;">Dimensions Information:</p> <p><b>Dimensional drawing</b></p>  <p>CoreLine RS140B/RS141B</p>	<p>Fixture Image:</p> 
Model Code	RS140B LED12-36-		
Mounting Type	Recessed		
Housing Material	Aluminum die cast		
IP Rating (water and dust protection)	IP65		
Lamp Source	LED		
Beam Angle	-	<p>Other info.</p> <ul style="list-style-type: none"> <li>● 1200 lumens</li> <li>● 830 warm white</li> <li>● Luminous flux tolerance +/-10%</li> <li>● Initial LED luminaire efficacy 82 lm/W</li> <li>● Control gear failure rate at median useful life 50000 h: 5%</li> <li>● Lumen maintenance at median useful life* 50000 h: L70</li> </ul> <p><a href="https://www.lighting.philips.com/api/assets/v1/file/content/fp912401483043-pss-global/912401483043_EU.en_AA.PROF.FP.pdf">https://www.lighting.philips.com/api/assets/v1/file/content/fp912401483043-pss-global/912401483043_EU.en_AA.PROF.FP.pdf</a></p>	
Color Temperature	3000K		
CRI	85		
Lens Type	Polycarbonate		
Reflector	Polycarbonate		
Power Consumption	15W		
Accessories	N/A		
Cost	-		
Remarks	Pot Light		

Brand	Philips	<p>Dimensions Information:</p> 	<p>Fixture Image:</p> 
Model Code	ST704T LED20S		
Mounting Type	Suspended		
Housing Material	Aluminum		
IP Rating (water and dust protection)	IP20		
Lamp Source	Damp		
Beam Angle	30°		
Color Temperature	4000K		
CRI	≥90	<p>Other info.</p> <ul style="list-style-type: none"> <li>• Initial luminous flux (system flux) :2000 lm</li> <li>• Luminous flux tolerance: +/-10%</li> <li>• Initial LED luminaire efficacy: 93 lm/W</li> <li>• Power supply unit</li> <li>• Driver included</li> <li>• 220 to 240V</li> </ul> <p><a href="https://www.lighting.philips.com/main/prof/indoor-luminaires/projectors/truefashion/910505100819_EU/product">https://www.lighting.philips.com/main/prof/indoor-luminaires/projectors/truefashion/910505100819_EU/product</a></p>	
Lens Type	Polymethyl methacrylate		
Reflector	N/A		
Power Consumption	15W		
Accessories	N/A		
Cost	-		
Remarks	Wall light		



Brand	VISA Lighting	<b>Dimensions Information:</b> DIA = Diameter    RD = Recessed Depth    RW = Recessed Width DIA 44-1/2" (1130 mm) RD 6" (152 mm) RW 44" (1118 mm) 	<b>Fixture Image:</b> 	
Model Code	CM1972-W			
Mounting Type	Flush			
Housing Material	Antimicrobial coating			
IP Rating (water and dust protection)	Damp rated			
Lamp Source	LED			
Beam Angle	-			
Color Temperature	3500K			
CRI	≥90			<b>Other info.</b> <ul style="list-style-type: none"> <li>● Integral driver located within the housing and accessible from below the ceiling</li> <li>● Fixture tested per LM79 standard (with 3500K white source)</li> <li>● Optional 90+ CRI (delivered lumens reduced by 15%)</li> <li>● Suitable for drywall/sheetrock or T-bar grid system</li> <li>● No VOC powder coat paint finish</li> <li>● Optional antimicrobial finishes (no VOC) on all interior and exterior painted surfaces</li> <li>● Dimming control option: DALI (Control via DALI protocol, dimming to minimum 1%), ZB (Wireless control, ZigBee H.A. v1.2 (Osram CLM-DIM) )</li> </ul> <a href="https://www.visalighting.com/products/symmetry/CM1972-W">https://www.visalighting.com/products/symmetry/CM1972-W</a>
Lens Type	White acrylic			
Reflector	N/A			
Power Consumption	29W			
Accessories	N/A			
Cost	-			
Remarks	Flush Mount (2)			

Brand	Progress Lighting	Dimensions Information: 	Fixture Image: 
Model Code	P730005-031-30		
Mounting Type	Flush		
Housing Material	Acrylic		
IP Rating (water and dust protection)	Damp rated		
Lamp Source	Integrated LED		
Beam Angle	-		
Color Temperature	3000K		
CRI	≥90		
Lens Type	White acrylic	Other info. <ul style="list-style-type: none"> <li>• Twist on installation with a single locking thumb screw.</li> <li>• LED flush mount with white acrylic diffuser mounts to baked enamel ceiling pan.</li> <li>• 1680 lumens, 80/lumens per watt.</li> <li>• Dimmable to 10% with many Forward Phase (Triac) or Electronic Low Voltage (ELV) dimmers</li> </ul> <a href="https://www.homedepot.com/p/Progress-Lighting-Drums-and-Clouds-Collection-21-Watt-Black-Integrated-LED-Flush-Mount-P730005-031-30/304197060#product-overview">https://www.homedepot.com/p/Progress-Lighting-Drums-and-Clouds-Collection-21-Watt-Black-Integrated-LED-Flush-Mount-P730005-031-30/304197060#product-overview</a>	
Reflector	N/A		
Power Consumption	21W		
Accessories	N/A		
Cost	-		
Remarks	Flush mount (3)		

Brand	Livex Lighting	<b>Dimensions Information:</b>  <ul style="list-style-type: none"> <li>● Fixture Specification: 16" DIA x 7.5" H</li> <li>● CANOPY: 5.25" DIA x 1" H</li> <li>● GLASS: 7.5" DIA x 4.25" H</li> </ul>	<b>Fixture Image:</b> 
Model Code	40727-81		
Mounting Type	Flush		
Housing Material	Glass		
IP Rating (water and dust protection)	Damp rated		
Lamp Source	Incandescent, LED		
Beam Angle	-		
Color Temperature	4000K	<b>Other info.</b> <ul style="list-style-type: none"> <li>● Equipped with Hand Applied Gray Marble Glass</li> <li>● Requires (3) 60 Watt Medium Base Bulbs</li> <li>● Dimmable</li> <li>● Indoor use</li> <li>● Line Voltage</li> <li>● Compatible bulb type: CFL,Eco-Incandescent,Incandescent,LED</li> <li>● Glass type: stained glass</li> <li>● Light bulb base code: E26</li> <li>● Recommended light bulb shape code: A19</li> </ul> <a href="https://www.homedepot.com/p/Livex-Lighting-Wynnewood-3-Light-Painted-Satin-Nickel-Flush-Mount-40727-81/314154982">https://www.homedepot.com/p/Livex-Lighting-Wynnewood-3-Light-Painted-Satin-Nickel-Flush-Mount-40727-81/314154982</a>	
CRI	≥90		
Lens Type	White acrylic		
Reflector	N/A		
Power Consumption	39W		
Accessories	N/A		
Cost	-		
Remarks	Flush mount (4)		



The ABB i-bus® light sensor LF/U 2.1 is a brightness sensor for closed rooms. The light sensor is mounted in a standard installation box in the ceiling. The cover (white) of the sensor is stuck firmly onto the device. The complete unit is then screwed into a flush-type box.

On the Light Controller LR/S x.16.1 (x = 2 or 4) up to 2 or 4 Light Sensors LF/U 2.1 can be connected. The light sensor measures brightness values in closed rooms. When combined with the detected values, the Light Controller is used for constant light control. It is possible to combine the brightness values from several Light Sensors for the calculation of an individual control circuit.

It is thus possible to achieve control of the lighting in rooms with difficult lighting conditions.

The electrical connection to the Light Sensor on the Light Controller is carried out with a twin core MSR cable (SELV), e.g. KNX bus cable. The total length of this cable may not exceed 100 m.

The Light Sensor is supplied with a Plexiglas rod which snaps into the sensor housing. The detection range can be limited using the Plexiglas rod with the white coating.

The Light Controller and the connect Light Sensor are supplied with power via the KNX and do not require any additional power supply.

Technical data

8

<b>Supply</b>	SELV	via LR/S x.16.1 (x = 2 or 4)
<b>Connections</b>	to LR/S x.16.1 <b>Note:</b> Not suitable for Light Controller LR/S 2.2.1 and Light Controller Module LR/M 1.6.1 Max. cable length per sensor	1 connecting terminal white/yellow (connecting terminals are supplied with the device)  100 m, Ø 0.8 mm, P-YCYM or J-Y(ST)Y cable (SELV), e.g. shielded KNX bus cable
<b>Brightness detection</b>	Lighting control operating range  Optimum installation height	Optimised for 500 Lux. 200...1200 Lux for rooms with average furnishing level (reflection 0.5) max. 860 Lux in a very brightly furnished room (reflection 0.7) max. 3000 Lux in a very darkly furnished room (reflection 0.2) The Lux values are measured values on the work surface (reference surface) <sup>1)</sup> 2-3 m
<b>Enclosure</b>	IP 20	to DIN EN 60 529
<b>Safety class</b>	II	to DIN EN 61 140
<b>Isolation category</b>	Overvoltage category Pollution degree	III to DIN EN 60 664-1 2 to DIN EN 60 664-1
<b>Temperature range</b>	Operation Storage Transport	-5 °C ... +45 °C -25 °C ... +55 °C -25 °C ... +70 °C
<b>Environmental conditions</b>	Humidity	Max. 93 %, moisture condensation should be excluded
<b>Design</b>	Flush mounted device Dimensions	For installation in 60 mm flush mounted box 54 x 20 (Ø x H)
<b>Weight</b>	in kg	0.040
<b>Mounting position</b>	as required	

8

<b>Housing, colour</b>	Plastic housing, grey	
<b>Approvals</b>	KNX to EN 50 090-2-2	Certificate, in conjunction with LR/S x.16.1
<b>CE mark</b>	in accordance with the EMC guideline and low voltage guideline	

<sup>1)</sup> Rooms are lit up differently by the incidental daylight and the artificial lighting of the lamps, and not all surfaces in the rooms (walls, floor, furniture, etc.) reflect the light which falls on them in the same manner. Accordingly, even though there is an exactly calibrated constant lighting control in daily operation, deviations to the set target value may occur. These deviations may be up to +/- 100lx should the current ambient conditions in the room, and accordingly the reflection properties of the surfaces (paper, persons, reorganized or new furniture), differ significantly from the original ambient conditions at the time of calibration. Deviations may also occur if the Light Sensor is influenced by direct or reflected light falling on it which is not influenced or only slightly influenced by the surfaces in the detection range of the Light Sensor.

**Note**

For a detailed description of the application program see “Light controller LR/S x.16.1 and light sensor LF/U 2.1” product manual. It is available free-of-charge at [www.ABB.de/KNX](http://www.ABB.de/KNX).

When positioning the Light Sensor in the room, it is important to ensure that the individual control circuits do not interfere with one another. The Light Sensor should be mounted above the area in which the actual lighting intensity is to be measured.

The luminaries or sunlight may not shine directly into the brightness sensor. Pay attention to unfavourable reflections, for example, from mirrored or glass surfaces.

The white fibre-optic rod can limit the detection range and reduce the lateral lighting sensitivity to external lighting sources.

**Note**

If the Light Sensor is not connected to the Light Controller LR/S, a DC voltage of a few mV can be measured directly with a multi-function measurement device. The measured value is between 0 mV (absolute darkness) and a few 100 mV depending on the brightness. If 0 V is also measured at normal brightness, this is due to an open circuit, short circuit or inverse polarity fault or a defective sensor.



# IS 2360 ECO

EAN 4007841 006556



infrared sensor  
360°



max. 7 m

2000w

max. 2000 W



IP54



2 - 2000 lux



8 sec - 35 min



energy saving



5 JAHRE  
HERSTELLER  
GARANTIE  
ohne gesetzlich vorgeschriebene  
Anforderungen



CE

manufacturer's  
warranty  
steinel-professional.de/garantie

## Funktionsbeschreibung

Formschön. Kompakt. Unauffällig. Präzisions-Infrarot-Aufputzsensord IS 2360 ECO. Ideal für Vordächer oder kleine Innenräume, 360° Erfassungswinkel, 160° Öffnungswinkel und 7 m Reichweite. Inkl. Abdeckkappen zur Anpassung des Erfassungsbereichs. Passiv-Infrarot-Sensor-Technologie. Einfache Installation. Farbausführung: Weiß.

## Technische Daten

Ausführung	Bewegungsmelder	Dämmerungseinstellung	2 – 2000 lx
Abmessungen (Ø x H)	115 x 51 mm	Zeiteinstellung	8 s – 35 Min.
Netzanschluss	230 V / 50 – 60 Hz	Schaltausgang 1, Ohmsch	2000 W
Sensortechnologie	Passiv Infrarot	Schaltausgang 1, Anzahl LED/Leuchtstofflampen	6 stk.
Anwendung, Ort	Außenbereich, Innenbereich	Konstantlichtregelung	Nein
Anwendung, Ort, Raum	Flur / Gang, Umkleide, Funktionsraum / Nebenraum, Teeküche, Treppenhaus, WC / Waschraum, Parkhaus / Tiefgarage, Außenbereich, Lager, Innenbereich	Grundlichtfunktion	Nein
Montageort	Decke	Einstellungen via	Potis
Montageart	Aufputz	Mit Fernbedienung	Nein
Schaltzonen	664 Schaltzonen	Vernetzung	Ja
Elektronische Skalierbarkeit	Nein	Art der Vernetzung	Master/Master
Mechanische Skalierbarkeit	Nein	Schutzart	IP54
Montagehöhe	2,00 – 4,00 m	Werkstoff	Kunststoff
optimale Montagehöhe	2,8 m	Umgebungstemperatur	-20 – 50 °C
Erfassungswinkel	360 °	Farbe	Weiß
Öffnungswinkel	180 °	Farbe, RAL	9010
Unterkriechschutz	Ja	Ausweise, Zertifikate	VDE
Reichweite Radial	Ø 3 m (7 m <sup>2</sup> )	Herstellergarantie	5 Jahre
Reichweite Tangential	Ø 7 m (38 m <sup>2</sup> )	VPE1, EAN	4007841006556
Dämmerungseinstellung Teach	Nein		



## KNX DALI-Gateway Plus

REG plus

Artikelnummer 218000

EAN 4010337011064



---






### Merkmale:

- Das DALI-Gateway Plus bildet die Schnittstelle zwischen einer KNX Installation und einer digitalen DALI-Beleuchtungsanlage.
  - Steuerung von max. 64 DALI-Betriebsgeräten als Einzelsteuerung, Gruppensteuerung in max. 32 Gruppen oder Zentralsteuerung über Broadcasttelegramm (Gruppe 17 - 32 jeweils max. 2 Betriebsgeräte).
  - Handbetätigung der Geräte auch unabhängig vom Bus (auch Baustellenbetrieb mit Broadcast-Steuerung).
  - Energiesparfunktion: Abschaltung der Versorgungsspannung der DALI-Betriebsgeräte im ausgeschalteten Zustand möglich (über zusätzlichen KNX Schaltfaktor).
  - 16 Lichtszenen.
  - Einbeziehung der Gruppen in die Lichtszenen möglich.
  - Effektsteuerung für max. 16 Sequenzen in 1 bis 500 Durchläufen (oder unendlich) konfigurierbar.
  - Rückmeldungen von DALI-Fehlerstatus oder -Kurzschluss und Meldung von Ausfall der Versorgungsspannung.
  - Aktive oder passive (Objekt auslesbar) zyklische Rückmeldefunktion.
  - Sammelrückmeldung aller Schaltzustände möglich.
  - Rückmeldungen lassen sich nach Busspannungswiederkehr verzögern.
- Gruppen- und Gerätefunktionen:
- Schalten und Helligkeitswert: Aktive (bei Änderung oder zyklisch auf den Bus sendend) oder passive (Objekt auslesbar) Rückmeldefunktionen.
  - Einstellung des Helligkeitsbereichs möglich.
  - Lampenschonendes Ein- und Ausschalten.
  - Dimmverhalten parametrierbar.
  - Zeitfunktionen (Ein- bzw. Ausschaltverzögerung, erweiterte Treppenhausfunktion - Vorwarnfunktion gemäß DIN 18015-2 oder reduzierter Dauerbeleuchtung).
  - Sperrfunktion oder alternativ Zwangsstellungsfunktion für jede Gruppe parametrierbar. Bei Sperrfunktion ist das Blinken von Leuchtengruppen möglich.
  - Auslesen des DALI-Teilnehmerzustands über KNX.
  - Betriebsstundenzähler als Vor- und Rückwärtszähler mit Grenzwertauswertung.
  - Online- oder Offline-Projektierung der DALI-Teilnehmer mit ETS-Plug-in.
  - Austausch eines einzelnen defekten DALI-Teilnehmers während des Betriebs ohne ETS möglich.
- Betrieb von Notleuchten:
- Geeignet für den Betrieb in Notbeleuchtungsanlagen.
  - Ansteuerung und Überwachung von einzelbatterie- und zentralversorgten DALI-Notbeleuchtungsanlagen.
  - Unterstützung von DALI-Notlichtkonvertern nach EN 62386-202 (Einzelbatteriebetriebene Notleuchten mit DALI-Schnittstelle): Funktionstest, Dauerbetriebstest, eingeschränkter Dauerbetriebstest, Abfrage des Akkuladestatus.
-

# ABB i-bus® KNX

## Design Ranges – Operations: ABB-tacteo

■ = Function is supported  
 - = Function is not supported

Program		ABB-tacteo®				
						
Square (vert.)	(86 mm x 86 mm)	TB/U1.1.1-CG	TB/U2.4.1-CG	TB/U4.4.1-CG	TB/U6.4.1-CG	TR/U.1.1-CG
Square (horiz.)	(86 mm x 86 mm)					
Vertical	(86 mm x 115 mm)	TB/U1.2.1-CG	TB/U2.7.1-CG	TB/U4.7.1-CG	TB/U6.7.1-CG	TR/U.2.1-CG
Horizontal	(115 mm x 86 mm)	TB/U1.3.1-CG	TB/U2.8.1-CG	TB/U4.8.1-CG	TB/U6.8.1-CG	TR/U.3.1-CG
Premium customization		TB/U1-CG	TB/U2-CG	TB/U4-CG	TB/U6-CG	TR/U-CG
<b>Control element</b>						
Standard function		■	■	■	■	■
Additional function		■	■	■	■	■
<b>Indication</b>						
Display		-	-	-	-	■
Actual temperature display		-	-	-	-	■
Status display via text and/or ICON		-	-	-	-	■
<b>RTC</b>						
Manual operation		-	-	-	-	■
Heating and/or cooling with/without additional stage		-	-	-	-	■
Fan coil		-	-	-	-	■
Master/slave		-	-	-	-	■
Basic load		-	-	-	-	■
Internal and/or external actual temperature sensor		-	-	-	-	■
Internal actual temperature sensor		■	■	■	■	■
<b>Installation</b>						
VDE		■	■	■	■	■
BS		■	■	■	■	■
IT	(only as 115 mm x 86 mm)	■	■	■	■	■
NEMA	(only as 86 mm x 115 mm)	■	■	■	■	■

# ABB i-bus® KNX Line Coupler, MDRC LK/S 4.2, 2CDG 110 171 R0011



2CDC 071 022 S0012

The ABB i-bus® KNX Line Coupler LK/S 4.2 is a modular installation device with a module width of 2 space units. It is used as a line or area coupler or as a repeater. As a line coupler, the LK/S connects a line with a main line, as an area coupler it connects a main line with an area line. It provides electrical isolation in this way.

If required, the LK/S filters telegrams and only routes the telegrams intended for other lines. It is possible to route or block all telegrams for diagnostic purposes.

## Technical data

<b>Supply</b>	Rated voltage	21...31 V DC, via the bus
	Power consumption	Maximum 0.25 W
	Current consumption	Maximum 12 mA
<b>Connections</b>	KNX, subline (2 = Line)	Via left bus connection terminal
	KNX, subline (1 = Main line)	Via right bus connection terminal
<b>Operating and display elements</b>	Button/LED   (red)	For assignment of the physical address
	LED  ON (green)	For indicating operation
	LED  Main Line (yellow)	For indicating telegram traffic on the main line
	LED  Line (yellow)	For indicating telegram traffic on the sub line
<b>Enclosure</b>	IP 20	To EN 60 529
<b>Safety class</b>	III, in the installed state	To EN 61 140
<b>Insulation category</b>	Overtoltage category	III to EN 60 664-1
	Pollution degree	II to EN 60 664-1
<b>KNX safety extra low voltage</b>	SELV 31 V DC	
<b>EMC requirements</b>	Compliant to EN 61000-6-2, EN 61000-6-3 and EN 50090-2-2	
<b>Temperature range</b>	Operation	- 5 °C...+ 45 °C
	Storage	- 25 °C...+ 55 °C
	Transport	- 25 °C...+ 70 °C
<b>Ambient conditions</b>	Maximum air humidity	To EN 50 491 95 %, no condensation allowed
<b>Design</b>	Modular installation device (MDRC)	Modular installation device, Pro M
	Dimensions	90 x 36 x 64.5 mm (H x W x D)
	Mounting width	2 modules at 18 mm
	Mounting depth	64.5 mm
<b>Installation</b>	On 35 mm mounting rail	To EN 60 715
<b>Mounting position</b>	As required	
<b>Weight without packaging</b>	0.075 kg	
<b>Housing/colour</b>	Plastic housing, grey	
<b>Approval</b>	EN 60 669-1, EN 50 428	
<b>KNX certification</b>	EN 50 090-2-2, EN 50 491	
<b>CE mark</b>	In accordance with the EMC guideline and low voltage guideline, RoHS	

# ABB i-bus® KNX DALI Light Controller, 8-fold, MDRC DLR/S 8.16.1M, 2CDG110101R0011



## Product description

The ABB i-bus® KNX DALI Light Controller DLR/S 8.16.1M is a KNX modular installation device (MDRC) in ProM design for installation in the distribution board on a 35 mm mounting rail.

The DALI Light Controller can, in conjunction with the application program *Control Dim Groups 8f DALI/1*, integrate devices with DALI interfaces into a KNX building installation. The connection to the KNX is implemented via a KNX connection terminal on the device shoulder.

The 8 sensor inputs for the Light Sensor LF/U, together with the first 8 lighting groups of the DALI Light Controller, can be used for a constant light control.

Up to 64 DALI devices can be connected to the DALI output. The 64 DALI devices should be assigned to 16 lighting groups with the ETS-independent Software Tool. Control of the 64 DALI devices via KNX is exclusively group-oriented.

The fault status (lamps and ballasts) of every individual DALI device can be sent via a coded communication object on the KNX.

In the DLR/S, a staircase lighting time curve can be set. Constant light control can be combined with a staircase lighting time curve, so that constant light control can be implemented during the staircase lighting time curve.

The 16 lighting groups can be integrated into scenes as required. Using 1 bit or 8 bit KNX scene telegrams, these scenes can then be recalled or stored via the KNX. Furthermore, a *Master/Slave* function with integrated offset is available that can be used to integrate further lighting groups or dimming actuators into the light control.

Using central telegrams, all the DALI devices connected to a DALI output can be commonly controlled via the KNX (broadcast).

The DLR/S is a DALI control device (master) and requires an AC or DC auxiliary power supply. The DALI power source for the 64 DALI devices is integrated into the DALI Light Controller. In order to control the DALI devices manually or via the KNX, the KNX voltage and the auxiliary voltage (light controller operating voltage) must be applied. Should one of these voltage sources be absent, the DALI devices can no longer be controlled. The reaction of the DALI devices on voltage failure can be parameterized.

Individual lighting groups can be switched or dimmed using manual control on the device. Furthermore, the fault for every lighting group is indicated by a yellow LED on the DLR/S.

# ABB i-bus<sup>®</sup> KNX

## DALI Light Controller, 8-fold, MDRC

### DLR/S 8.16.1M, 2CDG110101R0011











#### Technical data

<b>Supply</b>	Light controller supply voltage	100...240 V AC (+10 %/-15 %) 85...265 V AC, 50/60 Hz 110...240 V DC
	Power consumption total via mains	Maximum 3.5 W at 230 V AC and max. load <sup>1)</sup>
	Current consumption total via mains	Maximum 15 mA at 230 V AC and max. load <sup>1)</sup>
	Leakage loss total for device	Maximum 1.6 W at 230 V AC and max. load <sup>1)</sup>
	Current consumption KNX	Maximum 10 mA
	Power consumption via KNX	Maximum 210 mW
<b>DALI output</b>	Number of outputs	1 to EN 60 929 and DIN EN 62 386 The DALI output is a fixed 230 V, i.e. unintentional application of the light controller supply voltage will not cause destruction of the DALI output.
	Number of DALI devices	Maximum 64
	Number of lighting groups	16
	Distance between DLR/S and last DALI device	
	Cable cross-section:	
	0.50 mm <sup>2</sup>	100 m <sup>2)</sup>
	0.75 mm <sup>2</sup>	150 m <sup>2)</sup>
1.00 mm <sup>2</sup>	200 m <sup>2)</sup>	
1.50 mm <sup>2</sup>	300 m <sup>2)</sup>	
<b>Sensor inputs</b>	Light Sensor LF/U 2.1	For detailed information, see Light Sensor LF/U 2.1, page 18
	Number of inputs	8
	Max. cable length per sensor	Per light sensor 100 m, Ø 0.8 mm, P-YCYM or J-Y(ST)Y cable (SELV), e.g. shielded KNX bus cable
<b>Connections</b>	KNX	KNX connection terminal, 0.8 mm Ø, solid
	DALI outputs and mains voltage	Screw terminal: 0.2...2.5 mm <sup>2</sup> fine stranded 0.2...4 mm <sup>2</sup> single core
	Tightening torque	Max. 0.6 Nm
	Light Sensor LF/U:	
	Wire end ferrule without/with plastic sleeve	Without 0.25...2.5 mm <sup>2</sup> / with 0.25...4 mm <sup>2</sup>
	TWIN ferrule	0.5...2.5 mm <sup>2</sup>
	Tightening torque	Max. 0.6 Nm
<b>Brightness detection</b>	Lighting control operating range	Optimized for 500 Lux. 200...1,200 Lux for rooms with average furnishing level, degree of reflection 0.5 Max. 860 Lux in a very brightly furnished room (reflection 0.7) Max. 3,000 Lux in a very darkly furnished room (reflection 0.2) The Lux values are measured values on the work surface (reference surface) <sup>3)</sup>

# ABB i-bus® KNX

## DALI Light Controller, 8-fold, MDRC

### DLR/S 8.16.1M, 2CDG110101R0011

<b>Operating and display elements</b>	Button/LED 	For assignment of the physical address
	Button  /LED 	For switchover between manual operation and KNX operation
	Button 	Switch to next lighting group
	Button 	Switch ON or dim UP
	Button 	Switch OFF or dim DOWN
	Button 	Detect devices
	LED  ON	Display for operation readiness
	LED  DALI	DALI operating voltage display
16 LED 	Lighting group 1...16 display	
<b>Degree of protection</b>	IP 54	Compliant to EN 60 529
<b>Protection class</b>	II	Compliant to EN 61 140
<b>Isolation category</b>	Overvoltage category	III to DIN EN 60 664-1
	Pollution degree	2 to DIN EN 60 664-1
	Atmospheric pressure	Atmosphere up to 2,000 m
<b>KNX safety extra low voltage</b>	SELV 24 VDC	
<b>DALI voltage</b>	Typical 16 V DC (9.5...22.5 V DC)	To DIN EN 60 929 and DIN EN 62 386
	<b>No-load voltage</b>	16 V DC <sup>4)</sup>
	Lowest supply current at 11.5 V	160 mA
	Highest supply current	230 mA
<b>Temperature range</b>	Power	-5 °C...+45 °C
	Storage	-25 °C...+55 °C
	Transport	-25 °C...+70 °C
<b>Environmental conditions</b>	Humidity	Maximum 95 %, no condensation allowed
<b>Design</b>	Modular installation device (MDRC)	Modular installation device, ProM
	Dimensions	90 x 108 x 64.5 mm (H x W x D)
	Mounting width	6 x 18 mm modules
	Mounting depth	68 mm
<b>Mounting</b>	On 35 mm mounting rail	Compliant to EN 60 715
<b>Installation position</b>	Any	
<b>Weight</b>	0.26 kg	
<b>Housing, color</b>	Plastic housing, halogen-free, gray	
<b>Approvals</b>	KNX to EN 50 090-1, -2	Certification
	EN 62 386 (Part 101 and 102)	DALI
<b>CE mark</b>	In accordance with the EMC guideline and low voltage guideline	

<sup>1)</sup> Maximum load corresponds to 64 DALI devices at 2 mA each.

<sup>2)</sup> The length relates to the entire routed DALI control cable.

The maximum values are rounded off and relate to the resistance value. EMC influences are not considered. For this reason, the values should be considered as absolute maximum values.

<sup>3)</sup> Rooms are lit up differently by the incidental daylight and the artificial light of the lamps. Not all the surfaces in the rooms, e.g. walls, floor and furniture, reflect the light which falls on them in the same manner. Accordingly, even though there is an exactly calibrated constant light control in daily operation, deviations to the setpoint value may occur. These deviations may be up to +/- 100 lx, should the current ambient conditions in the room, and accordingly the reflection properties of the surfaces (paper, people, reorganized or new furniture), differ significantly from the original ambient conditions at the time of calibration. Deviations may also occur if the light sensor is influenced by direct or reflected light falling on it, which is not influenced or only slightly influenced by the surfaces in the detection range of the light sensor.

<sup>4)</sup> Cannot be measured directly on the digital multimeter, as there is not a constant DC voltage due to the DALI telegrams. Measure with a CRO for correct results. One exception is the KNX download phase. In this phase, no DALI telegrams are sent, whereby the DALI voltage is constantly present on the DALI output.



## DALI USB

PC interface module for DALI systems

### Product description

- Interface module from USB to a DALI system
- For connecting Tridonic software tools
- Addressing, programming and parametrising DALI installations and Tridonic devices
- Power supply via DALI line and USB interface
- 5-year guarantee



**Wiring diagrams and installation examples**, page 3

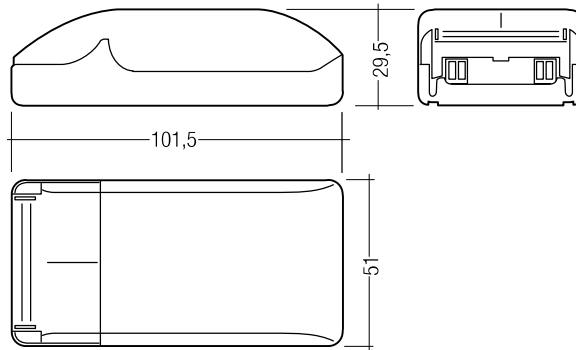


## DALI USB

PC interface module for DALI systems

### Technical data

Supply via	DALI cable and USB interface
Current draw	6 mA from DALI
Input	1 USB (Personal Computer)
Output	DALI
Ambient temperature $t_a$	0 ... +50 °C
Type of protection	IP20



### Ordering data

Type	Article number	Packaging, carton	Weight per pc.
DALI USB	24138923	50 pc(s).	0,155 kg

TECHNICAL DATA

# ABB i-bus® KNX

## DG/S x.64.1.1

### DALI-Gateway Basic



#### Description of product

The KNX ABB i-bus® DALI Gateway Basic DG/S x.64.1.1 is a KNX modular installation device (MDRC) in Pro M design for installation in the distribution board on a 35 mm mounting rail.

It is a DALI Single-Master controller to DALI standard EN 62386 Parts 101ed2 and 103ed1.

It supports type 0 and type 1 DALI operating devices with DALI interfaces to EN 62386 and these can be integrated into a KNX building installation. The gateway connects to the ABB i-bus® via a KNX connection terminal on the device shoulders.

The DALI Gateways differ in the number of DALI outputs. They are equivalent, and each of them has the same technical properties and functions.

Up to 64 DALI devices can be connected to each DALI output. Both „normal“ lamps (DALI type 0) and battery operated emergency lighting (DALI type 1) can be connected to the DALI output in a mixed configuration.

The lamps are variably controlled via KNX per DALI output via

- Broadcast (all lamps jointly)
- 16 lighting groups
- 64 individual lamps
- 16 scenes
- 64 self-contained emergency lights






The fault status (lamps, ballasts or emergency lighting converters) of each DALI device or of the lighting group is sent on the KNX by a variety of KNX group objects.

In addition to the standard functions, e.g. switching, dimming and brightness value setting with the corresponding feedback, the DALI gateway has Staircase lighting, Scene, Slave, Forced operation and Block functions. The lighting groups or individual lamps can be integrated into an energy-efficient building automation system via a KNX presence detector or light controller.

Function, duration and partial duration tests and battery tests for emergency lighting systems with individual batteries to EN 62386-202 can be triggered and stopped via KNX. The results are provided on the KNX.

The DALI gateway has a wide-range power supply input. No separate DALI power supply is required. The DALI power supply for 64 DALI devices per output is integrated into the DALI gateway.

The ABB i-bus® Tool permits commissioning (DALI) and diagnostics without the ETS.

Technical data			
<b>KNX DALI gateway</b>	DALI Single-Master Controller	EN 62386 Parts 101ed2 and 103ed1	
<b>Supply</b>	Gateway supply voltage	100 – 240 V AC	
	Voltage range	85...265 V AC, 50/60 Hz	
		110...240 V DC	
		DG/S 1.64.1.1	DG/S 2.64.1.1
	Power consumption total via mains <sup>1)</sup>	maximum 6 W	maximum 11 W
	Current consumption total via mains <sup>1)</sup>	maximum 25 mA	maximum 48 mA
	Leakage loss total for device <sup>1)</sup>	maximum 2 W	maximum 4 W
	KNX current consumption	maximum 10 mA	
	Power consumption via KNX	maximum 210 mW	
<b>DALI outputs (channels)</b>		DG/S 1.64.1.1	DG/S 2.64.1.1
	Number of outputs	1	2
	Voltage proof, short circuit proof	230 V AC	
	Number of DALI devices	Maximum 64 per output to EN 62386; DALI devices for emergency lighting with individual battery to EN 62386-202 are supported. <sup>1)</sup>	
	Distance between gateway and last DALI device		
	Cable cross-section 0,5 mm <sup>2</sup>	100 m <sup>2)</sup>	
	Cable cross-section 0,75 mm <sup>2</sup>	150 m <sup>2)</sup>	
	Cable cross-section 1,0 mm <sup>2</sup>	200 m <sup>2)</sup>	
	Cable cross-section 1,5 mm <sup>2</sup>	300 m <sup>2)</sup>	
<b>Connections</b>	KNX	KNX connection terminal, 0,8 mm Ø, single core	
	DALI outputs and Mains voltage	Screw terminal, universal head 0.2...4 mm <sup>2</sup> fine stranded 0.2...6 mm <sup>2</sup> single core	
	Tightening torque	Max. 0.6 Nm	
<b>Operating and display elements</b>	Button 	DALI output test	
	Push button/LED   (red)	For allocation of the physical KNX address	
	LED  (green)	Operation readiness indicator	
	LED  (yellow)	Display of DALI fault	
<b>Protection degree</b>	IP 20	To EN 60529	
<b>Protection class</b>	II	To EN 61140	
<b>Isolation category</b>	Overvoltage category	III according to EN 60664-1	
	Pollution degree	2 to EN 60664-1	
<b>KNX safety extra low voltage</b>	SELV 24 V DC		
<b>DALI voltage</b>	Typical 16 V DC (12...20.5 V DC)	To EN 60929 and EN 62386	
	No-load voltage	18 V DC	
	Lowest supply current at 12 V DC	160 mA	
	Highest supply current	250 mA	
<b>Temperature range</b>	Operation	- 5 °C...+45 °C	
	Storage	-25 °C...+55 °C	
	Transport	-25 °C...+70 °C	

<b>Technical data</b>			
<b>Environmental conditions</b>	Humidity	Maximum 93%, moisture condensation should be excluded	
	Atmospheric pressure	Atmosphere up to 2,000 m	
<b>Design</b>	Modular installation device (MDRC)	Modular installation device, Pro M	
	Dimensions	90 x 70 x 63.5 mm (H x W x D)	
	Mounting width	4x 18 mm modules	
	Mounting depth	68 mm	
<b>Installation</b>	On 35 mm mounting rail	To EN 60715	
<b>Mounting position</b>	any		
<b>Weight</b>		DG/S 1.64.1.1	DG/S 2.64.1.1
		0.13 kg	0.15 kg
<b>Housing, color</b>	Plastic housing, gray	Halogen-free	
		Flammability V-0 as per UL94	
<b>Approvals</b>	KNX to EN 50 090-1, -2	Certification	
	EN 50 491-5-2		
<b>CE mark</b>	In accordance with the EMC directive and low voltage directive		

\*) at 230 V AC and max. load

- 1) Both „normal“ lamps and battery operated emergency lighting can be connected in a mixed configuration to the DALI output. However, the maximum number of DALI devices may not exceed 64.
- 2) The length refers to the entire routed DALI control cable. The maximum values are rounded and refer to the resistance value. EMC influences are not taken into account and therefore the values should be considered as absolute maximum values.

Item	Qty	Description of products and services	Price per unit	Amount
------	-----	--------------------------------------	----------------	--------

		<p><b>Radio Time Switch, 8-channel, MDRC</b></p> <p>The Radio Time Switch sends current time and date on the bus. The time can be optionally received via a DCF or GPS antenna. Furthermore the device can be used to easily adjust the time programs.</p> <p>Functions:</p> <ul style="list-style-type: none"> <li>- 800 memory locations</li> <li>- Astronomical function with automatic calculation of sunrise and sunset times</li> <li>- Operation on the device with display backlight</li> <li>- Programming of the time programs on a PC</li> <li>- Transfer of time programs via memory card or via the KNX bus</li> <li>- Automatic summer/winter time changeover</li> <li>- Holiday and random programs</li> <li>- Protection against unauthorised access (PIN)</li> <li>- 8 years power reserve (lithium backup battery)</li> </ul> <p>Number of channels                      8</p> <p>Supply voltage                            110 – 240 V AC, 50/60 Hz</p> <p>Connection                                screw-less terminals</p> <p>Mounting                                    on 35 mm mounting rail, EN 60 715</p> <p>Manufacturer                              ABB STOTZ- KONTAKT</p> <p><b>Type</b>                                        <b>FW/S 8.2.1</b></p> <p>Material: .....                              Labour: .....</p>	Carry:	
--	--	---	--------	--

			Carry:	
--	--	--	--------	--



# IPS/S3.1.1




Products Low Voltage Products and Systems Intelligent Building Systems ABB i-bus KNX System Components and Interfaces

## General Information

<b>Extended Product Type:</b>	IPS/S3.1.1
<b>Product ID:</b>	2CDG110177R0011
<b>EAN:</b>	4016779906517
<b>Catalog Description:</b>	IPS/S3.1.1 IP Schnittstelle
<b>Long Description:</b>	Connects the KNX bus with the Ethernet network. The device uses the KNXnet/IP protocol for communication (Tunneling). KNX devices can be programmed via the LAN using ETS. For this and further clients 5 Tunneling Server are available. The IP address can be

## Additional Information

<b>Color:</b>	Grey
<b>Communication Interface:</b>	Ethernet
<b>Communication Speed:</b>	1000000
<b>Compatible Bus Systems:</b>	KNX
<b>Country of Origin:</b>	Germany (DE)
<b>Customs Tariff Number:</b>	85176200
<b>Data Sheet, Technical Information:</b>	<a href="http://www.abb.com/knx">www.abb.com/knx</a>
<b>Declaration of Conformity - CE:</b>	<a href="http://www.abb.com/knx">www.abb.com/knx</a>
<b>Degree of Protection:</b>	IP20
<b>EAN:</b>	4016779906517
<b>ETIM 5:</b>	EC000674 - Interface for bus system
<b>ETIM 6:</b>	EC000674 - Interface for bus system
<b>Environmental Information:</b>	<a href="http://www.abb.com/knx">www.abb.com/knx</a>
<b>Housing Material:</b>	Plastic
<b>Instructions and Manuals:</b>	<a href="http://www.abb.com/knx">www.abb.com/knx</a>
<b>Invoice Description:</b>	IPS/S3.1.1 IP Schnittstelle
<b>Minimum Order Quantity:</b>	1 piece
<b>Mounting Type:</b>	DIN-rail adapter
<b>Number of LEDs:</b>	3
<b>Object Classification Code:</b>	A
<b>Package Level 1 Gross Weight:</b>	0.12 kg
<b>Package Level 1 Height:</b>	65 mm
<b>Package Level 1 Length:</b>	41 mm
<b>Package Level 1 Units:</b>	1 piece
<b>Package Level 1 Width:</b>	92 mm
<b>Power Loss:</b>	1.5 W
<b>Product Main Type:</b>	IPS/S
<b>Product Name:</b>	System Components and Interfaces
<b>Product Net Depth:</b>	64,5 mm
<b>Product Net Height:</b>	90 mm
<b>Product Net Weight:</b>	0.1 kg
<b>Product Net Width:</b>	36 mm
<b>Selling Unit of Measure:</b>	piece
<b>Surface Finishing (</b>	Matt
	
<b>)</b>	
<b>Width in Number of Modular Spacings:</b>	2
<b>eClass:</b>	7.0 27143102
<b>RAL Number:</b>	RAL 7035 - Light Grey

# Square D loadcentres offer exclusive features with a long standing reputation for quality and reliability

## Key Features

- ✓ **Single teardrop positioning hole**  
Enables single-person installation. The loadcentre can be hung in position and is easily secured with the embossed mounting holes.



- ✓ **Bolt on main breaker** - all 100A and 200A panels have bolt on main breakers for solid connection. Straight-in wiring for main breaker connection saves wire and time - minimize service cable bends. New feature: Main breaker K.O. are now factory removed to save install time.



- ✓ **Plated copper bus** — one-piece copper bus provides exceptional conductivity and is plated to ensure superior performance and durability



- ✓ **Shield copper bus** — an industry first, reduces the chance of accidental contact with the bus



- ✓ **180° rotation** - for top, bottom or side feed — improves application flexibility



- ✓ **Backed out neutral screws** - save labor and installation time.



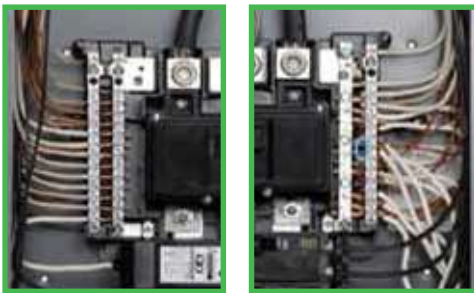
# Square D Plug-on Neutral Loadcentres

The Square D plug-on neutral loadcentres are designed to accept the plug-on (pigtail less) combination arc fault circuit breakers. The plug-on combination arc fault circuit breakers connect directly to the neutral bar of the loadcentre, eliminating the need to attached a separate neutral wire to the neutral bar. The Square D loadcentres features a fully distributed neutral bar that is versatile enough to accept either pigtail or pigtail less arc fault breaker or ground fault breaker.

- Distributed Neutral Bar**  
 Plug-on Neutral Square D service entrance loadcentres are engineered to accept the pigtail less arc fault circuit breaker.



## Compare the difference



Plug-on Neutral Connections


Pigtail Neutral Connections

- Faster Installation / Frees Gutter Space**  
 With the elimination of the pigtail wires in the panel the contractor has fewer connections which saves time and frees gutter space for a cleaner look.
- Easier Troubleshooting**  
 With a much cleaner look, tracing the destination of wires is easier and inspection of panels easier.
- TIME SAVER Diagnostics**  
 Simple 5 seconds test to assist in identifying the type of fault in a circuit.

Main Amp Rating	Number of QO Circuits		Catalogue Number	Main Wire Size AWG/kcmil AL/Cu	Product Dimensions					
	Standard	Tandem			Height		Width		Depth	
					Inches	mm	Inches	mm	Inches	mm
Main Lugs Loadcentre										
N/A	24	47	<b>CQO124L125GCPON</b>	#4-2/0	21.00	533	14.25	362	3.75	95
Main Breaker Loadcentre										
100 A	24	47	<b>CQO124M125C100PON</b>	#4-2/0	21.00	533	14.25	362	3.75	95
100 A	30	60	<b>CQO130M225C100PON</b>	#4-2/0	26.25	667	14.25	362	3.75	95
100 A	42	80	<b>CQO142M225C100PON</b>	#4-2/0	34.00	864	14.25	362	3.75	95
200 A	42	80	<b>CQO142M200CPON</b>	#4-250	34.00	864	14.25	362	3.75	95
200 A	60	80	<b>CQO160M200CPON</b>	#4-250	41.25	1048	14.25	362	3.75	95
100 A	24	47	<b>CQO124M125RB100PON</b> ①	#4-2/0	22.06	560	14.75	375	4.12	105

① OUTDOOR rated

## Gateways, interface converters KNX/BACnet

Specifications								
Type	Description							
	<b>IP Gateway KNX/BACnet N 143</b>			<ul style="list-style-type: none"> <li>■ With BACnet Application Specific Controller (B-ASC) as gateway between KNX TP and BACnet/IP</li> <li>■ With up to 250 BACnet objects</li> <li>■ With up to 455 BACnet COV subscriptions</li> <li>■ With automatic translation of KNX communication objects into BACnet objects according to the configuration with ETS</li> <li>■ For communication between KNX/EIB devices and PCs or other devices with Ethernet (100BaseT) interface, as well as in conjunction with a LAN modem or DSL router for remote access to a KNX/EIB installation</li> <li>■ For use as an interface, e.g. for ETS3 or for visualization software</li> <li>■ Uses the KNXnet/IP protocol</li> <li>■ With one KNXnet/IP Tunneling connection for parallel bus access by ETS and further PC software</li> </ul>				
	<ul style="list-style-type: none"> <li>■ With ObjectServer connection for visualization via network connections with long signal transmission duration</li> <li>■ With assignment of the network parameters by the installer using ETS, or automatically by a DHCP server in the network</li> <li>■ With 2 LEDs for display of operational availability and IP communication</li> <li>■ With additional power supply by an external safety extra low voltage power supply for DC 24 V</li> <li>■ With pluggable terminal block for connection of external power supply unit (not included)</li> <li>■ With integrated bus coupling unit with bus connection via bus terminal</li> <li>■ Ethernet connection via RJ45 socket</li> <li>■ For mounting on DIN rail EN 60715-TH35-7.5</li> </ul>							
Selection and ordering data								
Type	Version	DT	Order no.	Price in € per PU	PU (ST, SZ, M)	PS/ P. unit	PG	Weight per PU (kg)
N 143	IP Gateway KNX/BACnet N 143	A	5WG1 143-1AB01		1	1		0.120



## **Appendix K** Building Energy Management Product Datasheets

(next page)





# REZIRACK 2.0

Residential Roof Mounting System

LOW COST - LEAK PROOF - QUICK INSTALL

**REZIRACK 2.0** is KB Racking's upgraded residential shingle roof solar mounting solution, designed for use with both fully-railed and shared-rail mounting configurations. The system uses industry-leading flashing products, promoting rapid installation while forming a rigid solar mounting platform.

**REZIRACK 2.0**'s adaptable design is complimented by its simple installation and feature-rich mounting rails. The KB10 rails offer integrated wire management, side mounting and common fasteners for a clean and fast installation.

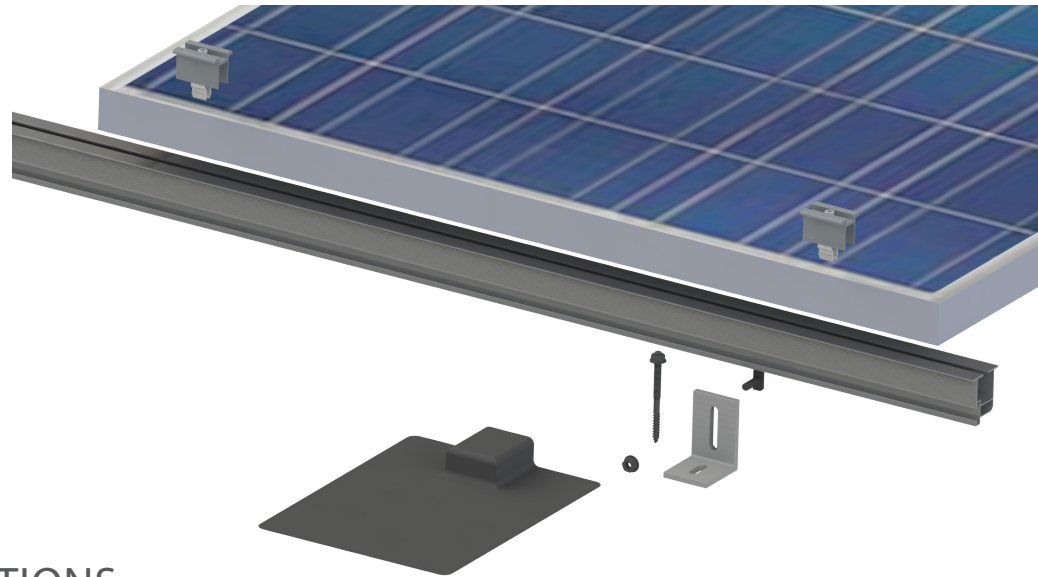


## FEATURES

- Rapid installation using industry-leading flashing products
- Integrated wire management
- Configured for fully-railed and shared-rail systems
- Side-mounted with T-bolts
- Low overall system weight
- 25-year standard product warranty, extended warranty available

# REZI RACK 2.0

Residential Roof Mounting System



## TECHNICAL

## SPECIFICATIONS

Distribution Load	1.5 - 3 lbs/ft <sup>2</sup>
Inclinations	Flush
Wind Speed	Up to 190mph
Material	6000 series aluminum
Module Type	All standard size framed PV modules
Wire Management	Built into KB10 Rail
Orientation	Landscape, Portrait
Rail Length	10', 20'
Configurations	Shared-Rail, Fully-Railed
Roof Pitch	0° - 45°
Roof Type	All asphalt shingle roofs
Grounding Method	ETL certified KB Konnect clamps
Module Spacing	Customizable based on project requirements
Roof Clearance	Up to 8" (Bottom of module to roof)
Span Lengths	Dependent on project location, 3' - 8'



Fully-Railed  
*Two Rails per row of modules*



Shared-Rail  
*Rails shared between modules*

MADE IN AMERICA



MADE IN CANADA

# Enphase IQ 7, IQ 7+, and IQ 7X Microinverters

with EN4 bulkhead

The high-powered smart grid-ready **Enphase IQ 7 Series Microinverters™** with Enphase EN4 bulkhead dramatically simplify the installation process while achieving the highest system efficiency.

Part of the Enphase IQ System, the IQ 7, IQ 7+, and IQ 7X Microinverters integrate with the Enphase IQ Envoy™, Enphase IQ Battery™, and the Enphase Enlighten™ monitoring and analysis software.

IQ Series Microinverters extend the reliability standards set forth by previous generations and undergo over a million hours of power-on testing, enabling Enphase to provide an industry-leading warranty of up to 25 years.



## Easy to Install

- Lightweight and simple
- Faster installation with improved, lighter two-wire cabling
- Built-in rapid shutdown compliant (NEC 2014, 2017, & 2020)
- Integrated Enphase EN4 bulkhead allows for direct connection to PV modules with TE PV4S SOLARLOK connectors or other intermatable connectors<sup>1</sup>

## Productive and Reliable

- Optimized for high-powered 60-cell, 72-cell<sup>2</sup>, and 96-cell<sup>3</sup> modules
- More than a million hours of testing
- Class II double-insulated enclosure
- UL listed

## Smart Grid Ready

- Complies with advanced grid support, voltage and frequency ride-through requirements
- Remotely updates to respond to changing grid requirements
- Configurable for varying grid profiles
- Meets CA Rule 21 (UL 1741-SA)

1. Enphase adapters are available for use with other connectors. Consult Enphase for more information..
2. The IQ 7+ Microinverter is required to support 72-cell modules.
3. The IQ 7X Microinverter is required to support 96-cell modules.



To learn more about Enphase offerings, visit [enphase.com](https://enphase.com)



## Enphase IQ 7 and IQ 7+ Microinverters with EN4 bulkhead

INPUT DATA (DC)	IQ7-60-E-US		IQ7PLUS-72-E-US		IQ7X-96-E-US	
Commonly used module pairings <sup>4</sup>	235 W - 350 W +		235 W - 440 W +		320 W - 460 W +	
Module compatibility	60-cell PV modules only		60-cell and 72-cell PV modules		96-cell PV modules	
Maximum input DC voltage	48 V		60 V		79.5 V	
Peak power tracking voltage	27 V - 37 V		27 V - 45 V		53 V - 64 V	
Operating range	16 V - 48 V		16 V - 60 V		25 V - 79.5 V	
Min/Max start voltage	22 V / 48 V		22 V / 60 V		33 V / 79.5 V	
Max DC short circuit current (module I <sub>sc</sub> )	15 A		15 A		10 A	
Overvoltage class DC port	II		II		II	
DC port backfeed current	0 A		0 A		0 A	
PV array configuration	1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit					
OUTPUT DATA (AC)	IQ 7 Microinverter		IQ 7+ Microinverter		IQ 7X Microinverter	
Peak output power	250 VA		295 VA		320 VA	
Maximum continuous output power	240 VA		290 VA		315 VA	
Nominal (L-L) voltage/range <sup>5</sup>	240 V / 211-264 V	208 V / 183-229 V	240 V / 211-264 V	208 V / 183-229 V	240 V / 211-264 V	208 V / 183-229 V
Maximum continuous output current	1.0 A (240 V)	1.15 A (208 V)	1.21 A (240 V)	1.39 A (208 V)	1.31 A (240 V)	1.51 A (208 V)
Nominal frequency	60 Hz		60 Hz		60 HZ	
Extended frequency range	47 - 68 Hz		47 - 68 Hz		47-68 Hz	
AC short circuit fault current over 3 cycles	5.8 Arms		5.8 Arms		5.8 Arms	
Maximum units per 20 A (L-L) branch circuit <sup>6</sup>	16 (240 VAC)	13 (208 VAC)	13 (240 VAC)	11 (208 VAC)	12 (240 VAC)	10 (208 VAC)
Overvoltage class AC port	III		III		III	
AC port backfeed current	18mA		18mA		18 mA	
Power factor setting	1.0		1.0		1.0	
Power factor (adjustable)	0.85 leading ... 0.85 lagging		0.85 leading ... 0.85 lagging		0.85 leading ... 0.85 lagging	
EFFICIENCY	@240 V	@208 V	@240 V	@208 V	@240 V	@208 V
Peak efficiency	97.6 %	97.6 %	97.5 %	97.3 %	97.5 %	97.3 %
CEC weighted efficiency	97.0 %	97.0 %	97.0 %	97.0 %	97.5 %	97.0 %
MECHANICAL DATA						
Ambient temperature range	-40°C to +65°C (-40°F to +149°F)		-40°C to +65°C (-40°F to +149°F)		-40°C to +60°C (-40°F to +140°F)	
Relative humidity range	4% to 100% (condensing)					
Connector type	Enphase EN4 bulkhead					
Adapters <sup>7</sup> (optional)	1. ECA-EN4-S22: DC adapter, EN4 to Multi-Contact MC4 type, 150 mm (5.9in) 2. ECA-EN4-S22-L: DC adapter, EN4 to Multi-Contact MC4 type, 600 mm (23.6in) 3. ECA-EN4-FW: DC adapter, EN4 to unterminated cable, 150 mm (5.9in), for wiring of any DC connector type.					
Dimensions (HxWxD)	212 mm x 175 mm x 30.2 mm (without bracket)					
Weight	1.08 kg (2.38 lbs)					
Cooling	Natural convection - No fans					
Approved for wet locations	Yes					
Pollution degree	PD3					
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure					
Environmental category / UV exposure rating	NEMA Type 6 / outdoor					
FEATURES						
Communication	Power Line Communication (PLC)					
Monitoring	Enlighten Manager and MyEnlighten monitoring options. Both options require installation of an Enphase IQ Envoy.					
Disconnecting means	The AC and DC connectors have been evaluated and approved by UL for use as the load-break disconnect means required by NEC 690 and C22.1-2018 Rule 64-220.					
Compliance	CA Rule 21 (UL 1741-SA) UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2018 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions.					

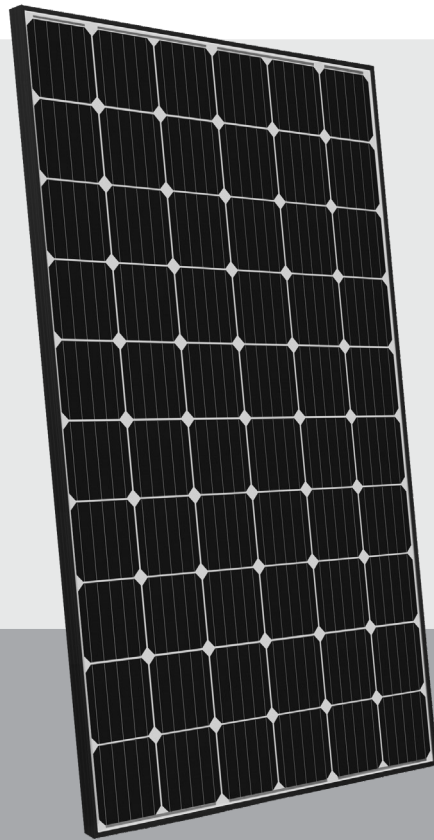
4. No enforced DC/AC ratio. See the compatibility calculator at <https://enphase.com/en-us/support/module-compatibility>.

5. Nominal voltage range can be extended beyond nominal if required by the utility.

6. Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

7. Adapters 1 and 2 are qualified per UL subject 9703. Adapter 3 requires installers to field install their choice of connector.

To learn more about Enphase offerings, visit [enphase.com](https://enphase.com)



**ASSURED ENERGY**  
Product Liability Insurance QBE



**PERC TECHNOLOGY\***  
Passivated Emitter and Rear Cell



**30** YEAR LINEAR POWER WARRANTY  
ANNI GARANZIA LINEARE PRODUZIONE  
**20** YEAR PRODUCT WARRANTY  
ANNI GARANZIA PRODOTTO

## HIGH EFFICIENCY LINE

**SG315M (BF)**

 "MADE IN ITALY" MODULE

PEIMAR monocrystalline solar panels, produced using a combination of innovative production processes and advanced engineering techniques, provide customers with maximum output and super high performance (over 20% efficiency). This allows fewer panels to be used to generate more energy, ideal if space is restricted or environmental conditions are challenging. Modern design, using matching black cells and frames and a very long lifespan ensure this monocrystalline are a great option.

\*Thanks to the use of **PERC** cells, PEIMAR modules are able to reach even higher efficiencies, as they facilitate the light imprisonment in close proximity to the rear surface and optimise the electron capture.



**POSITIVE POWER OUTPUT TOLERANCE**



MODULE FIRE PERFORMANCE: **CLASS I**



**ANTI-REFLECTIVE GLASS**



**HAILSTORM RESISTANCE**

### CELLS

**60**  
MONO



QTY:  
60 CELLS  
TYPE:  
MONO 5BB  
**PERC TECHNOLOGY** ⚡  
DIMENSION:  
156x156 mm / 6x6"

### FRAME



### BACKSHEET



### JUNCTION BOX



## ELECTRICAL CHARACTERISTICS (STC)\*

Nominal Output (Pmax)	
Flash Test Power Tolerance	
Voltage at Pmax (Vmp)	
Current at Pmax (Imp)	
Open Circuit Voltage (Voc)	
Short Circuit Current (Isc)	
Maximum System Voltage	
Maximum Series Fuse Rating	
Module Efficiency	

## SG315M (BF)

Nominal Output (Pmax)	315 W
Flash Test Power Tolerance	0/+5 W
Voltage at Pmax (Vmp)	33 V
Current at Pmax (Imp)	9.57 A
Open Circuit Voltage (Voc)	40.93 V
Short Circuit Current (Isc)	9.82 A
Maximum System Voltage	1500 V
Maximum Series Fuse Rating	15 A
Module Efficiency	19.36%

## MECHANICAL CHARACTERISTICS

Solar Cells	60 (6x10) monocrystalline <b>PERC</b>
Solar Cells Size	156x156 mm / 6x6"
Front Cover	3.2 mm / 0.12" thick, low iron tempered glass
Back Cover	TPT (Tedlar-PET-Tedlar)
Encapsulant	EVA (Ethylene vinyl acetate)
Frame	Anodized aluminium alloy, double wall
Frame finishing	Black
Backsheet finishing	White
Diodes	3 Bypass diodes serviceable
Junction Box	IP67 rated
Connector	MC4 or compatible connector
Cables Length	900 mm / 35.4"
Cables Section	4.0 mm <sup>2</sup> / 0.006 in <sup>2</sup>
Dimensions	1640x992x40 mm / 64.5x39x1.57"
Weight	18 Kg / 39.7 lbs
Max. Load	Certified to 5400 Pa

## TEMPERATURE CHARACTERISTICS

NOCT**	45±2 °C
Temperature Coefficient of Pmax	-0.40 %/°C
Temperature Coefficient of Voc	-0.32 %/°C
Temperature Coefficient of Isc	0.047 %/°C
Operating Temperature	-40 °C ~ +85°C

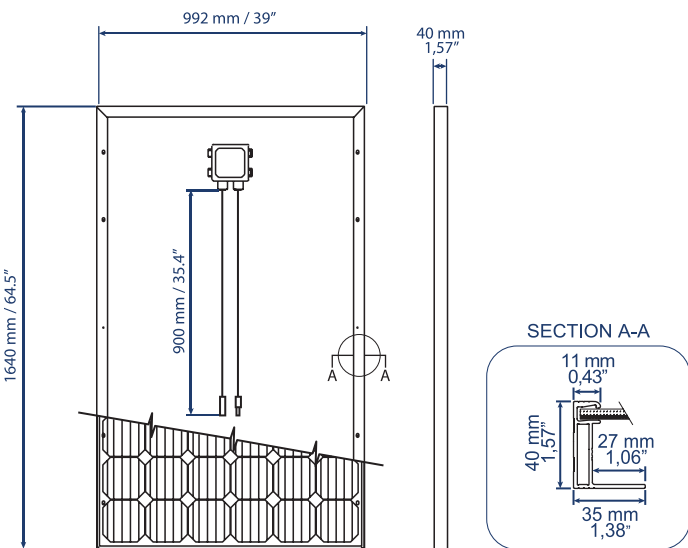
## PACKAGING\*\*\*

Pallet dimensions	1700x1200x1200 mm / 67x47x47"
Pieces per pallet	27
Weight	516 Kg / 1138 lbs

## CERTIFICATIONS

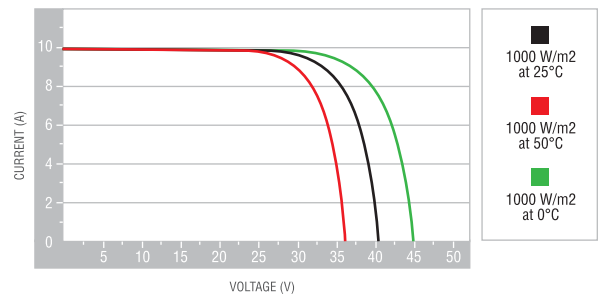
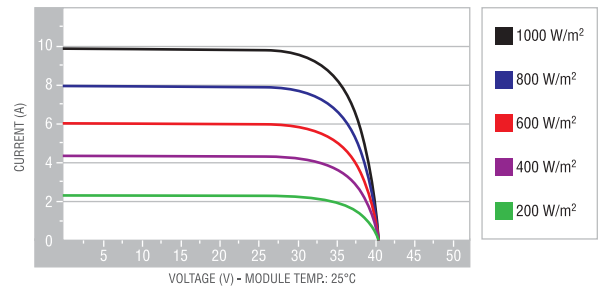
Fire Resistance Rating	Class C (for ULC/ORD-C1703-01)
Module fire performance	Type 1 (for UL 1703)

## DIMENSIONS



## CURRENT/VOLTAGE CHARACTERISTICS

Values apply to modules: SG315M (BF)



\*STC: (Standard Test Condition) Irradiance 1000W/m<sup>2</sup>; Module Temperature 25°C; Air Mass 1.5

\*\*NOCT: (Nominal Operation Cell Temperature) Sun 800W/m<sup>2</sup>; Air 20°C; Wind speed 1/m/s

\*\*\*Pallets can be stacked up to two

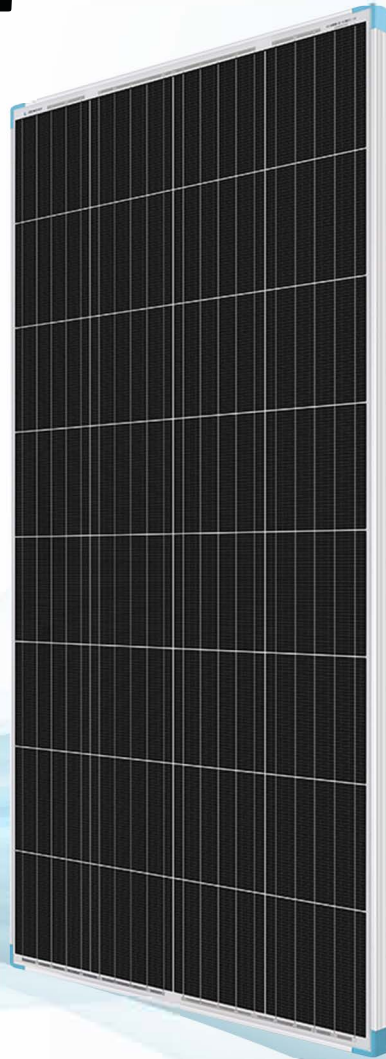
It is important to point out, that all technical specifications, information and figures contained in this datasheet are estimated values. Peimar reserves the right to change the technical specifications, information and figures contained in this document at any time without notice.

US\_VERS 1\_05/2019

**PEIMAR**  
ITALIAN PHOTOVOLTAIC MODULES

Via Creta 72, 25124 Brescia, ITALY • www.peimar.com • info@peimar.com





# RNG-175D

## 175W Monocrystalline Solar Panel

### Key Features

Sleek design and a durable frame, the Renogy 175 Watt 12 Volt Monocrystalline Panel provides you with the highest efficiency per area and is the perfect item for off-grid applications.

- High module conversion efficiency
- Top ranked PTC rating
- Quick and inexpensive mounting
- 100% EL testing on all Renogy modules
- No hot spots guaranteed

### Potential Uses

The Renogy 175 Watt Monocrystalline Panel can be used in various off-grid applications that include 12 and 24 volts arrays, water pumping systems, signaling systems and other off-grid applications.



Power Output Warranty



Material and Workmanship Warranty

# RNG-175D

## 175W Monocrystalline Solar Panel

### Electrical Data

Maximum Power at STC*	175 W
Optimum Operating Voltage ( $V_{mp}$ )	17.95 V
Optimum Operating Current ( $I_{mp}$ )	9.75 A
Open Circuit Voltage ( $V_{oc}$ )	21.6 V
Short Circuit Current ( $I_{sc}$ )	10.35 A
Module Efficiency	19.8%
Maximum System Voltage	600 VDC UL
Maximum Series Fuse Rating	15 A

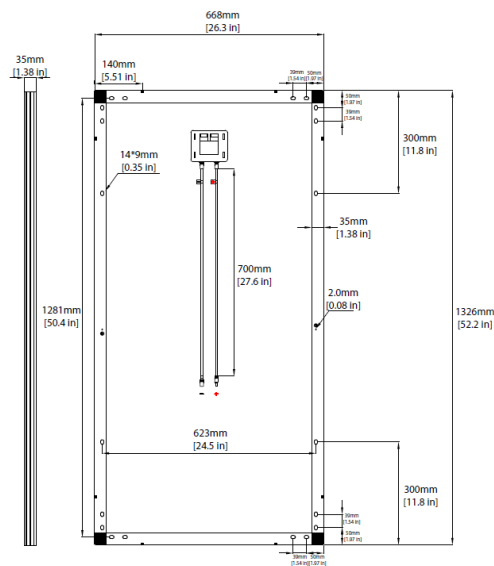
### Thermal Characteristics

Operating Module Temperature	-40°C to +80°C
Nominal Operating Cell Temperature (NOCT)	47±2°C
Temperature Coefficient of Pmax	-0.42%/°C
Temperature Coefficient of Voc	-0.31%/°C
Temperature Coefficient of Isc	0.05%/°C

### Junction Box

IP Rating	IP 65
Diode Type	15SQ045
Number of Diodes	2 Diode(s)
Output Cables	12 AWG (2.30 ft long)

### Module Diagram



### Mechanical Data

Solar Cell Type	Monocrystalline (6.25 x 6.25in)
Number of Cells	32 (4 x 8)
Dimensions	52.2 x 26.3 x 1.38 in (1326 x 668 x 35 mm)
Weight	19.8 lbs (9 kg)
Front Glass	Tempered Glass 0.13 in (3.2 mm)
Frame	Anodized Aluminum Alloy
Connectors	Solar Connectors
Fire Rating	Class A

### Solar Connectors

Rated Current	30A
Maximum Voltage	1000VDC
Maximum AWG Size Range	10 AWG
Temperature Range	-40°F to 194°F
IP Rating	IP 67

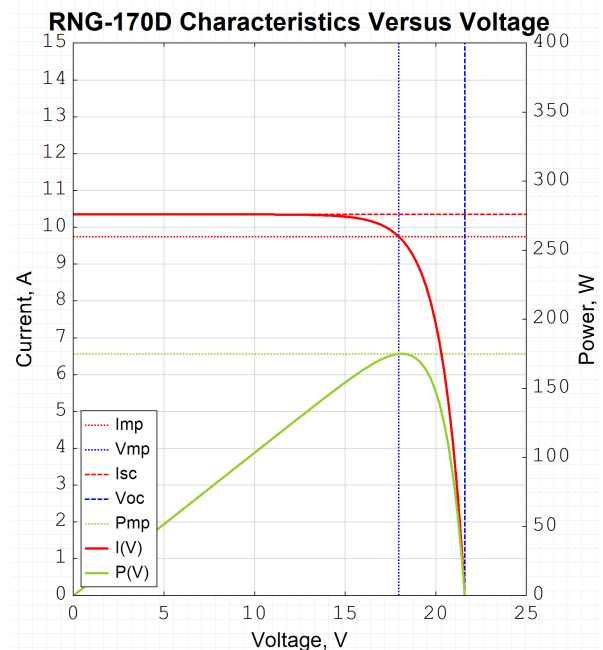
### Certifications



Module Application: Class A



### IV Curve



\*All specifications and data described in this data sheet are tested under Standard Test Conditions (STC - Irradiance: 1000W/m<sup>2</sup>, Temperature: 25°C, Air Mass: 1.5) and may deviate marginally from actual values. Renogy and any of its affiliates has reserved the right to make any modifications to the information on this data sheet without notice. It is our goal to supply our customers with the most recent information regarding our products. These data sheets can be found in the downloads section of our website, [www.renogy.com](http://www.renogy.com)



[Power Supplies](#)   [Transformers](#)   [Isolation Transformers](#)

[Single Phase Isolation Transformers](#)   **15 kVA Isolation Transformer, single phase, 208V to 110V**



## 15 kVA Isolation Transformer, single phase, 208V to 110V

5 out of 5 based on [1 reviews](#) | [Write a review](#)

**\$2,386.44**

## 15 kVA Isolation Transformer Features

- 15 kva capacity, available in the circuit of AC 50Hz/60Hz.
- To step down/up the single phase voltage 208V to 110V ( Various voltages of primary and secondary are available here for your selection).
- High efficiency and low temperature rise.
- IP 20 protection grade of enclosure for indoor or outdoor use, rated for hazardous locations as well as harsh industrial environments.

## 15 kVA Isolation Transformer Specifications

Model	ATO-DG15kVA
Phase	Single phase
Capacity	15kVA
Primary Voltage	208V AC (optional: 110V/ 120V/ 220V/ 230V/ 240V/ 380V/ 400V/ 415V/ 480V)
Secondary Voltage	110V AC (optional: 24V/ 36V/ 48V/ 120V/ 208V/ 220V/ 230V/ 240V/ 380V/ 400V/ 415V/ 480V)
Frequency	50Hz / 60Hz
Winding Material	Aluminum/Copper wire (Optional)
Work Efficiency	≥95%
Insulation Resistance	≥50 MΩ
Electrical Strength	2000V AC/1 min
Noise	≤35dB (1 meter)
Insulation Grade	Grade B (130°C), Grade F (155°C), Grade H (180°C)
Cooling Method	Natural or air cooling
Overload Capacity	Allow more than 1.2 times rated load to work for up to 1 hour
Induced Overvoltage Withstand Test	125Hz/800V/min
Transformation Ratio	<3%
Air Carrying Current	<6%
Impedance Voltage	about 6%

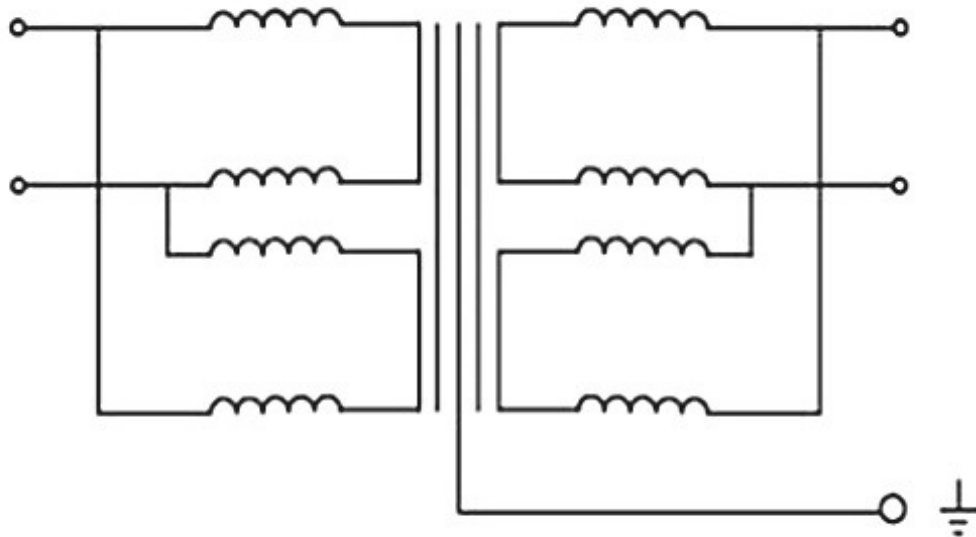
Temperature	-15°C~+45°C
Humidity	≤90%RH, without condensation
Altitude	<2000m, non corrosive gas and conductive dust
Enclosure Protection Grade	IP20
Warranty	12 months
Weight of Aluminium Wire Transformer	Open type: 80kg Protected type: 102kg
Weight of Copper Wire Transformer	Open type: 90kg Protected type: 124kg

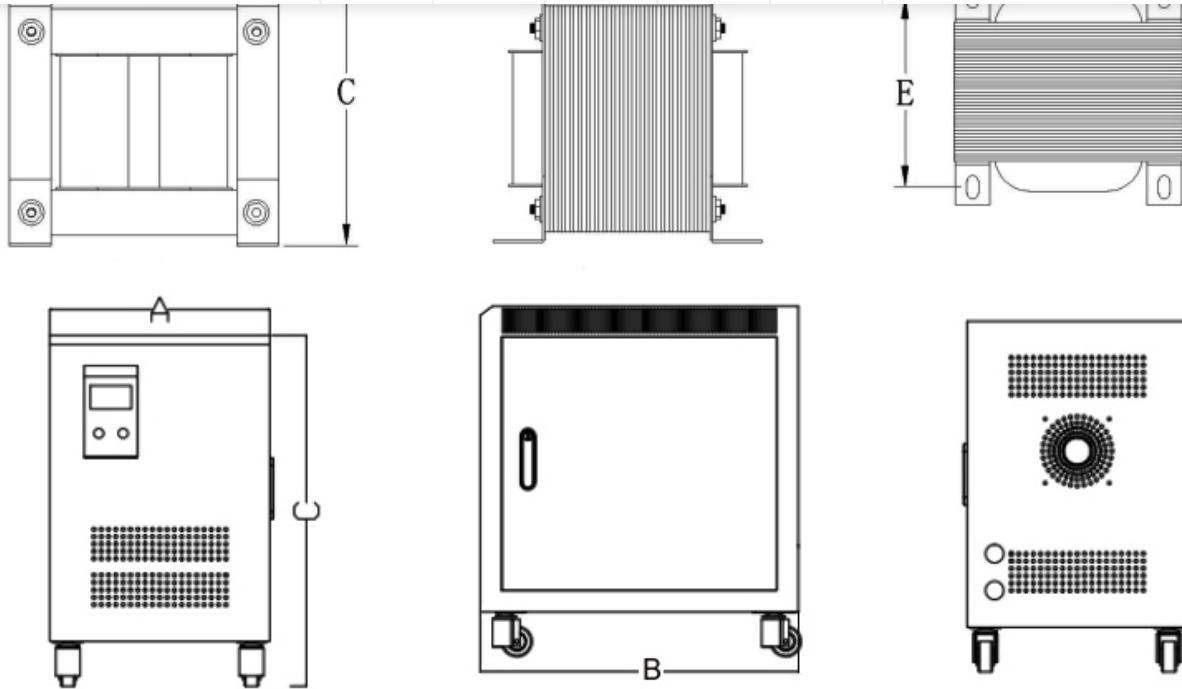
**Note:**

*Transformer can only convert voltage and CANNOT convert frequency.*

*Transformer CANNOT convert single phase voltage to 3 phase voltage.*

*Support voltage customization, various specifications customization.*

**Single Phase Isolation Transformer Schematic Diagram****15 kVA Isolation Transformer Dimension**



Aluminium Wire Transformer Size	Copper Wire Transformer Size
Open type: a*b*c=290*300*420mm	Open type: a*b*c=300*330*345mm
Mouting size: D*E=150*180mm (aperture: 20*10mm)	Mouting size: D*E=190*200mm (aperture: 20*10mm)
Protected type: A*B*C=380*530*560mm	Protected type: A*B*C=380*530*560mm

### Tips: Other functions of the isolation transformer

An isolation transformer is added for personal safety when using some electrical appliances. For example, when repairing a color TV set, the maintenance personnel may suffer from an electric shock if he contacts this circuit accidentally because the power supply unit of the color TV set is connected with the electric supply, thus endangering his personal safety. When repairing some household appliances, the isolation transformer should also be connected. The connection method is: Connect one connector of the isolation transformer to the socket and the other connector to another socket firstly, then connect the repairing household appliance to the socket where the isolation transformer is connected.



# C7189U Remote Indoor Sensor

## INSTALLATION INSTRUCTIONS

### APPLICATION

This indoor sensor is designed to sense temperature at a remote location and send this information to the VisionPRO Thermostat. This sensor can be used as a stand alone sensor or as part of an averaging network. Once a remote indoor temperature sensor is connected to the thermostat, the thermostat's sensor is no longer used. The thermostat's installer setup should be modified to tell the thermostat that remote indoor temperature sensor(s) have been used. The Inside temperature reading on the thermostat's display will be the remote sensor(s) temperature location(s).

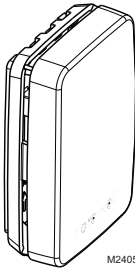


Fig. 1. C7189U Remote Indoor Sensor



### CAUTION

**Electrical Interference (Noise) Hazard.**  
**Can cause erratic system operation.**

Keep wiring at least one foot away from large inductive loads such as motors, line starters, lighting ballasts and large power distribution panels.

Use shielded cable to reduce interference when rerouting is not possible.

### SPECIFICATIONS

**Operating Ambient Temperature Range:**

45 to 88°F (7.2 to 32°C).

**Display Range:**

0 to 99°F (-18 to 37°C).

**Sensor Accuracy:**

+/-1.5°F at 70°F (+/- .84 at 21°C)

**Operating Relative Humidity:**

5% to 95% non-condensing.

**Finish:**

White.

**Resistance Characteristics:**

Negative temperature coefficient (NTC). Resistance decreases as the temperature increases.

**Dimensions in inches (mm):**

1 1/2 (38) wide x 2 1/4 (57) high x 3/4 (19) deep.

**Distance:**

Maximum distance between thermostat and sensor is 200 feet.

### Must be installed by a trained, experienced technician

- Read these instructions carefully. Failure to follow these instructions can damage the product or cause a hazardous condition.
- Check the specification in this booklet to verify that this product is suitable for the application.
- Always test for proper operation after installation



# INSTALLATION

## Installation Tips

Install the sensor about 5 feet (1.5m) above the floor in an area with good air circulation at average temperature. Maximum distance between remote sensor and the thermostat is 200 feet. See Fig. 2.

### CAUTION Electrical Hazard

Can cause electrical shock or equipment damage. Disconnect power before beginning installation.

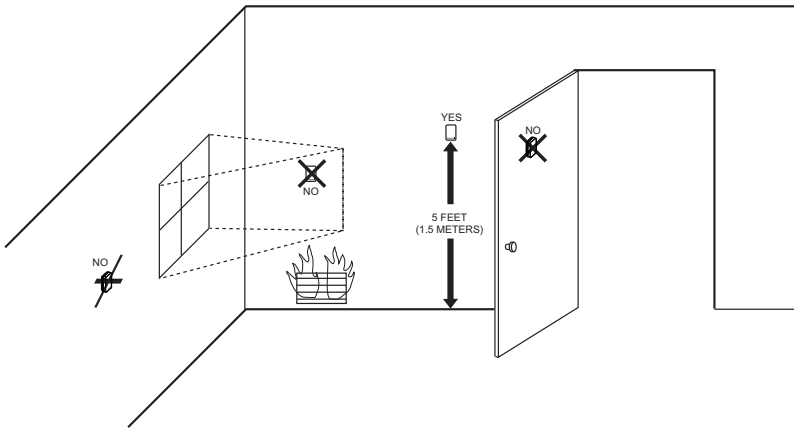


Fig. 2. Typical location for C7189U Sensor.

M24115

## Remote Sensor Wallplate Installation

Remove the cover from the remote sensor as shown in Fig. 3.

1. Pull wires through wire hole.
2. Position wallplate on wall, level and mark screw hole positions with pencil.
3. Drill holes at marked positions, then tap in supplied wall anchors.
4. Place wallplate over anchors, insert and tighten mounting screws. See Fig. 4.

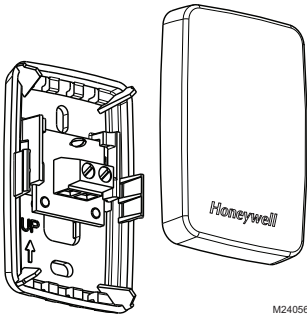


Fig. 3. Remove the cover.

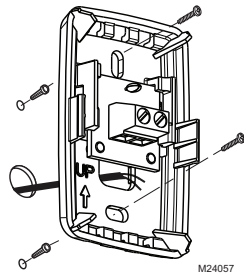


Fig. 4. Mount wallplate to wall.

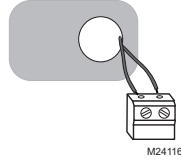
## WIRING

The sensor can be used to provide one remote sensor (see Fig. 6) or as a temperature averaging network with multiple sensors connected (see Fig. 7). The thermostat is not part of the average network.

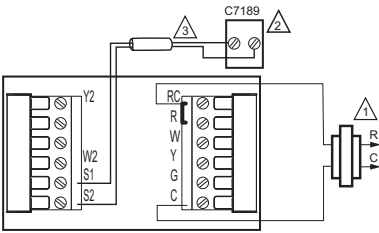
**CAUTION**  
**ELECTRICAL HAZARD.**

Can cause electrical shock or equipment damage. Disconnect power before wiring.

1. Run the wire cable from the thermostat to the remote sensor location.
2. Loosen screw terminals, insert wires into terminal block (polarity does not matter), then retighten screws.
3. Push excess wire back into the wall opening.
4. Plug the wall opening with non-flammable insulation to prevent drafts from affecting the sensor operation and replace the cover on the remote sensor.
5. Connect the two wires to the thermostat's remote sensor terminals (polarity does not matter) and replace the thermostat back onto the wallplate. See Fig. 6.



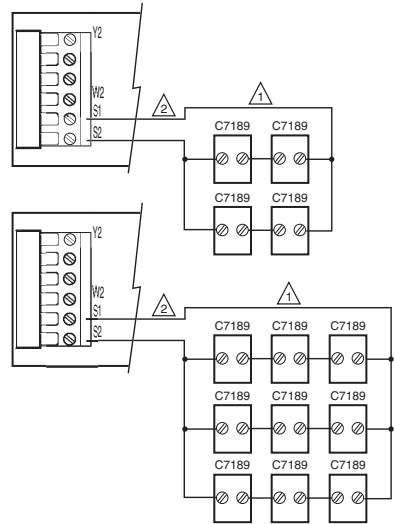
**Fig. 5. Terminal block wiring.**



- ⚠️ 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- ⚠️ 2 IF MORE THAN ONE C7189U REMOTE SENSOR IS REQUIRED, REFER TO FIGURE 7.
- ⚠️ 3 WIRES MUST HAVE A CABLE SEPARATE FROM THE THERMOSTAT CABLE.

M19972A

**Fig. 6. Wiring a single C7189U Sensor.**



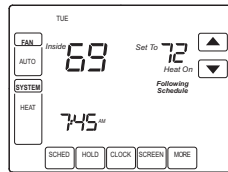
- ⚠️ 1 SENSORS MUST BE ARRANGED IN THIS CONFIGURATION TO OPERATE CORRECTLY.
- ⚠️ 2 WIRES MUST HAVE A CABLE SEPARATE FROM THE THERMOSTAT CABLE.

M19973

**Fig. 7. Wiring Multiple C7189U Sensors.**

**OPERATION**

Once a remote indoor temperature sensor is connected to the thermostat, the thermostat's sensor is no longer used. The thermostat's installer setup should be modified to tell the thermostat that remote indoor temperature sensor(s) have been used. The Inside temperature reading on the thermostat's display will be the remote sensor(s) temperature location(s). See Fig. 8.



M19974

**Fig. 8. Inside Temperature Reading on TH8000 Series Thermostat.**

## CHECKOUT

For best results, allow the sensor to absorb the air moving through the room for a minimum of twenty minutes before taking a resistance measurement.

1. Use an accurate thermometer (+/- 1°F[0.5°C]) measure the temperature at the sensor location.
2. Remove one wire from one of the sensor's wiring terminals. Use an ohmmeter to measure the resistance across the sensor. Verify the sensor accuracy with the temperature/resistance in Table 1.

## CALIBRATION

The sensor is calibrated at the factory and cannot be recalibrated in the field.

**Table 1. Sensor Resistance at Room Temperature.**

Room Temperature		Ohms of Resistance
°F	°C	
40	4.4	22537
42	5.6	21516
44	6.7	20546
46	7.8	19626
48	8.9	18754
50	10.0	17926
52	11.1	17136
54	12.2	16387
56	13.3	15675
58	14.4	14999
60	15.6	14356
62	16.7	13743
64	17.8	13161
66	18.9	12607
68	20.0	12081
70	21.1	11578
72	22.2	11100
74	23.3	10644
76	24.4	10210
78	25.6	9795
80	26.7	9398
82	27.8	9020
84	28.9	8659
86	30.0	8315
88	31.1	7986
90	32.2	7672
92	33.3	7372
94	34.4	7086
96	35.6	6813
98	36.7	6551
100	37.8	6301

### Home and Building Technologies

In the U.S.:

Honeywell

715 Peachtree Street NE

Atlanta, GA 30308

customer.honeywell.com

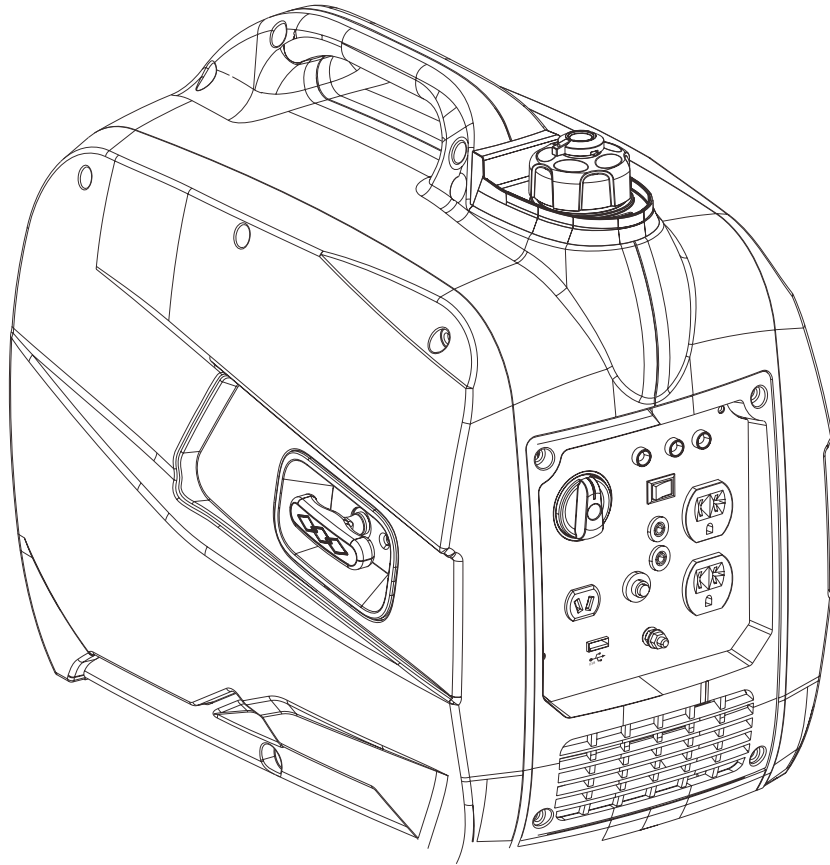
# Honeywell



**MODEL 56200i**

# **2000W INVERTER GENERATOR**

**Instruction Manual**



## **NEED HELP? CONTACT US!**

Have product questions? Need technical support? Please feel free to contact us:



**1-800-232-1195 (M-F 8AM-5PM CST)**



**TECHSUPPORT@WENPRODUCTS.COM**

**IMPORTANT:** Your new tool has been engineered and manufactured to WEN's highest standards for dependability, ease of operation, and operator safety. When properly cared for, this product will supply you years of rugged, trouble-free performance. Pay close attention to the rules for safe operation, warnings, and cautions. If you use your tool properly and for its intended purpose, you will enjoy years of safe, reliable service.

For replacement parts and the most up-to-date instruction manuals, visit **WENPRODUCTS.COM**

# CONTENTS

<b>WELCOME</b>	<b>3</b>
Specifications.....	3
Introduction .....	4
<b>SAFETY</b>	<b>5</b>
Safety Information .....	5
Generator Safety Warnings .....	6
<b>BEFORE OPERATING</b>	<b>9</b>
Know Your Inverter Generator.....	9
Generator Preparation.....	10
<b>OPERATION &amp; MAINTENANCE</b>	<b>14</b>
Starting Your Generator .....	14
Stopping Your Generator .....	16
Subsequent Starting of the Generator .....	16
Using Your Generator.....	18
Maintenance.....	21
Transportation & Storage.....	28
Troubleshooting Guide.....	29
Wire Diagram.....	30
Exploded View & Parts List.....	38
Warranty Statement .....	39

To purchase accessories for your tool, visit **WENPRODUCTS.COM**

**Parallel Connection Kit**  
**Magnetic Oil Dipstick (Model Number 55201)**



# SPECIFICATIONS

## DC OUTPUT

Rated Voltage	12V DC
Rated Amperage	8.3A
Rated Wattage	100W
USB Charger	5V, 1A

## AC OUTPUT

Rated Wattage	1600W
Surge Wattage	2000W
Rated Voltage	120V
Rated Amperage	13.3A
Frequency	60 Hz
Phase	Single

## ENGINE

Engine Type	4 stroke, OHV, single cylinder with forced air cooling system
Spark Plug Type	NGK CR5HS/Torch A5RTC
Spark Plug Gap	0.6 - 0.8 mm (0.024 - 0.031 in)
Spark Plug Torque	1/2 - 3/4 turn after gasket contacts base or 15 ft-lbs
Displacement	79.7 cc
Fuel Tank Capacity	1.19 US gallon 87 octane minimum
Oil Capacity	12.7 fl. oz. (0.38 L)
Lubrication System	Splash Lubrication
Half-Load Run Time	6 Hours
Noise Rating: (Tested from 22 ft away with an ambient dB rating of 44 dB)	50 dB at no load 51 dB at 1/4 load 52 dB at 1/2 load 55 dB at 3/4 load

## Single Phase Isolation Transformer

ATO single phase isolation transformer use of advanced manufacturing techniques and rigorous design and advanced optimization methods terminals, with excellent performance, reliable, low power consumption, small size, wiring security, wide range of features, is an ideal transformer power supply. It is suitable for circuit of 50-60Hz, voltage up to 500V, usually applied as power supply for machine tool electrical appliances, local lighting and indicator lamps.

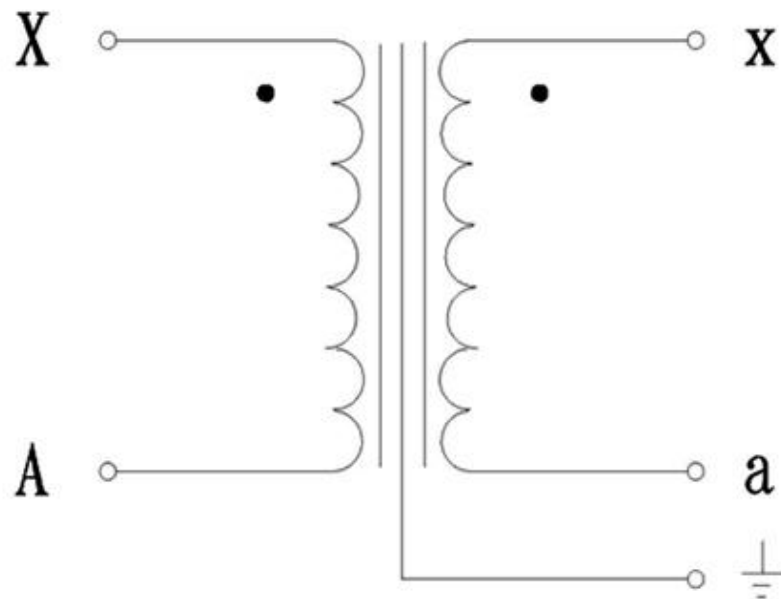
### 1. Specification

Model	ATODG - □ □ kVA
Phase	Single phase
Capacity	0.3~60kVA (Can be Customized)
Primary Voltage	110V/ 120V/ 208V/ 220V/ 230V/ 240V (Can be Customized)
Secondary Voltage	110V/ 120V/ 208V/ 220V/ 230V/ 240V (Can be Customized)
Frequency	50Hz / 60Hz
Winding Material	Aluminum / Copper wire (Optional)
Work Efficiency	≥95%
Insulation Resistance	≥50 MΩ
Electrical Strength	2000V AC/1 min
Noise	≤35dB (1 meter)
Insulation Grade	Grade B (130°C), Grade F (155°C), Grade H (180°C)
Cooling Method	Natural or air cooling
Overload Capacity	Allow more than 1.2 times rated load to work for up to 1 hour
Induced Overvoltage Withstand Test	125Hz/800V/min
Transformation Ratio	<3%
Air Carrying Current	<6%
Impedance Voltage	about 6%
Total Losses	0.1
Certification	CE, ISO
Temperature	-15°C~+45°C
Humidity	≤90%RH, without condensation
Altitude	<2000m, non corrosive gas and conductive dust
Enclosure Protection Grade	IP 20
Warranty	12 months

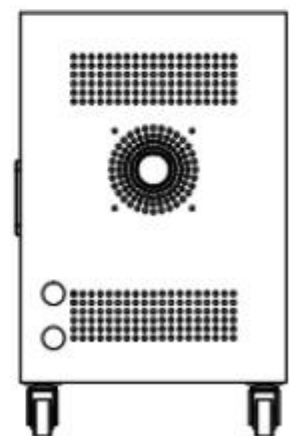
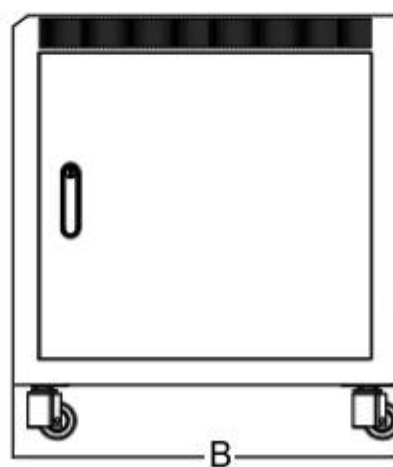
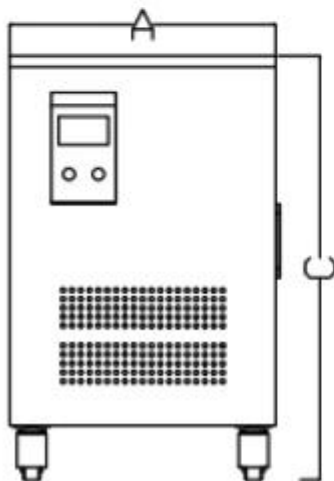
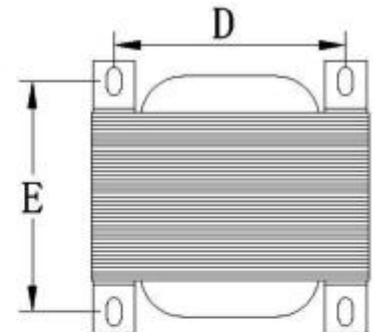
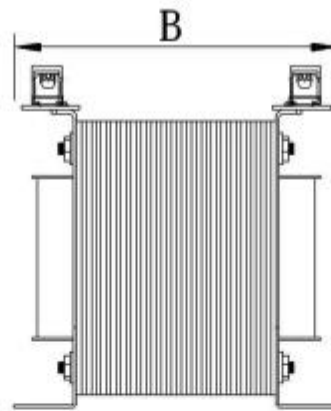
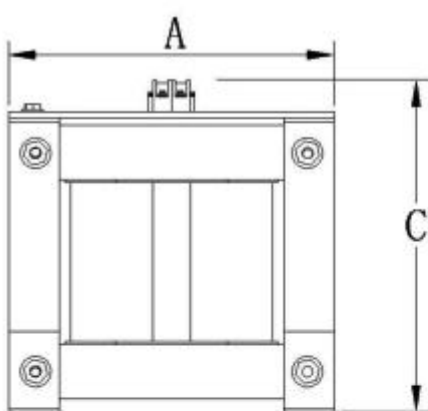
### 2. Normal Working Environment

- Transformer can work under the follow environment: Altitude should be lower than 2500m.
- Temperature of ambient medium: Minimum temperature should be higher than -15°C. Maximum temperature should be lower than +45°C.
- Relative air humidity: The maximum humidity month the should more than 95% average humidity, and the average lowest temperature should be +25°C.
- Current voltage wave similar to sine wave.
- Fixing in a place where no snow and rain.
- Fixing in place where no shake, no roughing up and no vibration place.
- No explosion medium in or beside, no metal corrosion medium and no insulation damage air and conductive dust.

### 3. Schematic Diagram



### 4. Dimension




[Toggle Navigation](#) X

[Français](#)
[Why Choose Us](#) | [Digital Catalogue](#) | [Find A Branch](#) | [Resources](#) | [Services](#)
[Product Categories All Products](#) ▾

[Product Categories All Products](#) ▾


[Quick Order Pad](#) ▾

Cart (0)

**KEEP YOUR TEAM SAFE: PANDEMIC INVENTORY CLEARANCE**
[Shop Now >>](#)
[Electrical](#) | [Distribution](#) | [Molded Case Circuit Breakers](#) | **CIRCUIT BREAKER,1POLE,20A,TEY,277V,**
[Email](#)
[Print](#)


## CIRCUIT BREAKER,1POLE,20A,TEY,277V,

**GE**
**Web Price** ⓘ:  
**\$174.63 / EACH**


 [Compare](#)
**Availability**
 Pick Up  Shipping

**To view Availability for another location, please enter postal code below** ⓘ

 New Postal Code 



360°

 Item # **WWG3HXC1** Mfr. Model # **3HXC1** UNSPSC # **39121601**

 CATALOGUE PAGE # **89** Shipping Weight **0.75 lbs**

### Technical Specs

Item	<b>Circuit Breaker</b>
AC Voltage Rating	<b>277 VAC</b>
For Use With	<b>GE AE Lighting Panels</b>
High Amp Trip Setting	<b>575</b>
Number of Poles	<b>1</b>
Terminal Connection	<b>Screw Clamp</b>
Phase	<b>1</b>
Phase Connection	<b>N'importe quelle</b>
Circuit Breaker Mounting Style	<b>Bolt On Panelboard</b>
Width	<b>1.00"</b>
Min. Wire Size	<b>14 AWG</b>
Circuit Breaker Actuator	<b>Toggle</b>

Amps	<b>20</b>
Max. AIR Rating	<b>14 kA</b>
Series	<b>TEY</b>
Circuit Breaker Type	<b>Standard</b>
DC Voltage Rating	<b>125 VDC</b>
Trip Type	<b>Thermal Magnetic</b>
Instantaneous Trip	<b>Fixed</b>
Frame Size	<b>TEY</b>
Height	<b>5.25"</b>
Depth	<b>3.06"</b>
Max. Wire Size	<b>10 AWG</b>
Standards	<b>UL, CSA</b>

800-321-8998

CAD >



Search



Circuit Breakers ▾

Fuses

Enclosures for Circuit Breakers ▾

Power Supply

Tools

Accessories ▾

Motor Control ▾

Breaker Panels

Load Centers

Panel Boards ▲

1200 Amp

225 Amp

400 Amp

Meter Mains

Weather

Proof

Enclosures

400 Amp SIEMENS Par  
120/240 Volt Main Lu  
(Main Breaker Option  
distribution accepts Plug-in

# P2C42MLO400ABS, 400 MLO P2 Panel board by SIEMENS

Siemens

Can\$494.04

SKU: P2\_MLO

Shipping: Calculated at Checkout



Call For Current  
Availability 800-  
321-8998



## OVERVIEW

### PRODUCT DESCRIPTION

P2MLO

0.0 ★★★★★  
No rating available

Busway Plugs

Fusible Switches

Safety Switches

Mounting Hardware Kits

Buttons and Switches

Fittings

Pullout Fusible Disconnects

Transformers

Shop by Brand

Square D by Schneider Electric

Eaton | Cutler-Hammer

GE Industrial

Siemens

Westinghouse

Federal Pacific | Federal Pioneer

I-T-E

Cooper Crouse-Hinds

Allen-Bradley

P2C42MLO400ABS, 400 Amp MLO. Indoor 120/240 3 Phase 4 Wire. Uses type QP breaker in branch section. Comes complete with Interior, Dead front and box. This panel is ideal for use in office buildings, shops, schools and light industry. Designed for economy. Convertible to main breaker at an additional cost of \$800.00.

YOU MAY ALSO LIKE

RECOMMENDED

400 Amp SIEMENS Panelboard 120/240 Volt Main Lugs Only (Main Breaker Optional) distribution accepts Plug-in type breakers.



P2C42JX400ABS, 400 Amp Main Breaker P2 Panel board by SIEMENS

Can\$1,543.88

CALL FOR CURRENT AVAILABILITY 800-321-8998

NQ442L4C Complete Load ce 400A MLO, 42 Circuits by Squ

Can\$616.31

CALL FOR CURRENT AVAILABILITY 800-8998

0.0 ★★★★★ No rating available

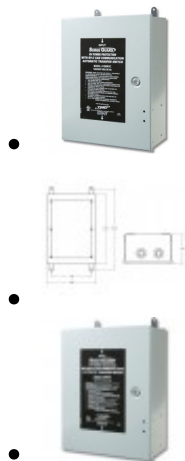


[Home](#) » [90A Hardwire Automatic Transfer Switch](#)

# 90A Hardwire Automatic Transfer Switch



**WARNING:** Cancer and  
Reproductive Harm  
[www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov)



\$893.20

Availability:

1

Product Code:

SOUTHWIRE-41390

Brand:

[Southwire](#)

Tweet

Like 0

Qty:  Add to Cart[Add to Wish List](#) [Add to Compare](#)

## Description

- Surge Guard Model 41390-RVC provides premium protection for your motorhome and enhanced features over other transfer switches on the market
- Total electrical protection for your RV
- Protects your RV bumper to bumper from faulty park power
- *Optional* easy to read LCD display constantly monitors and displays the condition of power being supplied to your RV
- RVC communication allows instant display of voltage, current and fault conditions on an RVC compatible device
- Automatic Transfer Switch Features
- Transfers to generator power automatically when energized after 30 second delay
- When both shore power and generator power are available, generator dominates after a 30 second delay
- Once the generator is shut down, shore power activates after a 3-4 second delay
- 90A full rated contactor mounted on vibration isolators to ensure quiet operation
- Over/under voltage protection
- Contactor opens outside of (<95V and >132V) range after 9-second delay
- Instantaneous trip at voltages above 140V and below 70V
- Over/under frequency protection
- Contactor opens outside of (54-70Hz) range after 30-second delay
- Source power connection integrity
- Contactor will not close or will open in the event of an open source conductor or miswire. L1, L2, Neutral and Ground
- Brown/blackout protection 2 min 15 second delay is initiated after removal of power to ensure AC compressor head bleed off, feature can be disabled on remote. (optional)
- Measures and displays both L1 & L2 load current independently
- Surge Guard Features
- 4-mode protection, 3,350 Joules
- Energy capacity - 130,000 Amps peak
- Fuse protected L1/L2 surge suppressers
- Plain text display (Replace Surge) of open fuses indicating a failed MOV or open surge connection
- Remote Panel Indicator (Optional) 40272
- Continuous visual indication of source voltage (L1, L2) load current or diagnostics
- Plain English display of faults. No cryptic error codes
- LCD technology with automatic light sensitive back lighting for easy reading in any ambient light condition
- 3rd Party Display Systems
- RS232 proprietary output data stream for communication with external equipment

## Related Products



## **Appendix L** Smart Building Design Product Datasheets

(next page)

# 25x Zoom IR WDR PTZ IP Cameras

HDZP252DI

Honeywell's latest HDZ PTZ is part of the growing line of IP-based products. The high definition, True Day/Night WDR PTZ cameras provide extremely crisp video with up to 2 million effective pixels and 25x optical zoom for continuous surveillance in many security applications.

## Superior Image Quality

- Full HD 1080p resolution, 50/60 fps image with a 1/2.8" 2 megapixel sensor
- True WDR 120 dB ensures glare-free images
- True Day/Night provides vivid color images by day and clear black-and-white images at night with ICR (Infrared Cut Filter Removal)
- Excellent low-light performance with 3D noise reduction, saving storage and bandwidth together with H.265 codec

## Flexible Surveillance Solution

- 4.8–120 mm, F1.6–F4.4, 25x optical zoom lens with 360° continuous rotation for the flexibility to clearly view the target area with desired width and depth
- H.265, H.264 and MJPEG codec, triple stream support
- Six IR LEDs provide up to 328 ft. (100 m) of illumination in dimly lit or nighttime scenes (depending on scene reflectance)
- Water resistant (IP66) camera housing
- -40°F to 158°F (-40°C to 70°C) working temperature
- Built-in Analytics in the camera, such as face detection
- Security features include individual signed certificates and data encryption

## Onboard Video Storage

- Supports up to 128 GB microSDHC card for local video storage on events, continuous, or schedule, or with network interruption. Card not included



## Easy to Install and Use

- Built-in High PoE (Power over Ethernet) eliminates separate power supply and associated wiring; 12 VDC input where PoE power is unavailable
- ONVIF Profile S and G compliant
- Remote configuration, motorized pan, tilt and zoom adjustments and auto focus through web client

## Market Opportunities

The combination of the latest digital technology and advanced video processing makes HDZ ideally suited for large-scale surveillance in cities, roadways, airports, government facilities, schools and campuses, industrial environments and anywhere detailed surveillance is essential.

## FEATURES AND BENEFITS

- |   |   |  |   |  |
|---|---|--|---|--|
| <ul style="list-style-type: none"> <li>• 4.8–120 mm, F1.6–F4.4, 25x optical zoom lens</li> <li>• 1/2.8" progressive scan image sensor</li> <li>• Up to 50/60 fps primary stream. Up to 25/30 fps secondary streams</li> </ul> | <ul style="list-style-type: none"> <li>• Up to triple stream support</li> <li>• Ultra-low light performance</li> <li>• 328 ft. (100 m) IR distance, depending on scene reflectance</li> <li>• True WDR: 120 dB</li> </ul> | <ul style="list-style-type: none"> <li>• Excellent low light performance with down to 0 lux BW (with IRs on)</li> <li>• Multiple, selectable compression formats (H.265/H.264/MJPEG)</li> <li>• Wall mount accessory included</li> </ul> | <ul style="list-style-type: none"> <li>• Built-in Analytics, including Face detection</li> <li>• Automatically restores to previous PTZ and lens position after power failure</li> <li>• Choice of 12 VDC or PoE+ power inputs</li> </ul> | <ul style="list-style-type: none"> <li>• On board camera storage: up to 128 GB microSD card (not included)</li> <li>• ONVIF profile S and G compliant</li> <li>• Water resistant IP66 ingress protection rating</li> </ul> |
|---|---|--|---|--|

# HDZ Series – 25x Zoom IR WDR IP PTZ Cameras Technical Specifications

CAMERA	
IMAGE SENSOR	1/2.8" Exmor CMOS
OPTICAL ZOOM	25x
DIGITAL ZOOM	16x
NUMBER OF PIXELS (H × V)	1920 × 1080 (1080p)
WDR	120 dB
S/N RATIO	> 50 dB (AGC off)
MINIMUM ILLUMINATION	0.005 lux (color)/0 lux (B/W) @ F1.6 (with IR LEDs on)
FOCAL LENGTH	4.8 mm – 120 mm
MAX APERTURE	F1.6 – F4.4
FOCUS MODE	Manual/Auto
IR DISTANCE	Up to 328 ft. (100 m), depending on scene reflectance
ANGLE OF VIEW	H: 59.2° – 2.4°
WHITE BALANCE	Auto/Indoor/Outdoor/ATW/Manual
EXPOSURE MODE	Iris Priority/Shutter Priority/Gain Priority/Manual
ELECTRONIC SHUTTER	1/1 to 1/30,000 sec
BACKLIGHT COMPENSATION	BLC/HLC/WDR (120 dB)
DEFOG	On/Off
NOISE REDUCTION	2D/3D
DAY/NIGHT	Auto (ICR)/Color/BW
OPERATION	
PAN TRAVEL	360° endless
TILT TRAVEL	-15° to 90°, auto flip 180°
MANUAL PAN SPEED	Up to 200°/s
MANUAL TILT SPEED	Up to 120°/s
PRESETS	300
PRESET SPEED	Pan: Up to 240°/s; Tilt: Up to 200°/s
TOURS	8
AUTO PAN/SCAN	1 / 1
PATTERN	5
PRIVACY MASKS	24
MOTION DETECTION	On/Off
IMAGE ROTATION	Flip
AUDIO IN/OUT	1 / 1
ALARM INPUT/OUTPUT	2 / 1
VIDEO ANALYTICS	Face detection
EVENT	Motion Detect; Audio Detect; SD card capacity warning
EVENT NOTIFICATION	Record (SD card and FTP), Relay output, Email, Preset, Tour, Pattern, Snapshot
LANGUAGES SUPPORTED	English, Japanese
ELECTRICAL	
POWER SOURCE	12 VDC ± 25%, 3A PoE+ (802.3at) class 4
POWER CONSUMPTION	13 W; 20 W max (IR LEDs on)

MECHANICAL	
DIMENSIONS	Ø160.0 mm × 295.0 mm Ø6.3" × 11.6"
PRODUCT WEIGHT	8.8 lb. (4.0 kg)
CONNECTORS	Power input: Bare wire with connectors Network: RJ45 connector Alarm I/O: Twisted wire (2 in/1 out) Audio I/O: Twisted wire (1 in/1 out)
CONSTRUCTION MATERIAL	Aluminum
CONSTRUCTION COLOR	White (RAL CODE 9003)
ENVIRONMENTAL	
OPERATING TEMPERATURE	-40°C to 70°C (-40°F to 158°F)
RELATIVE HUMIDITY	Less than 90%, non-condensing
WATERPROOF STANDARD	IP66
IP SPECIFICATIONS	
VIDEO COMPRESSION	H.265 / H.264 / MJPEG
VIDEO STREAMING	<b>Primary Stream:</b> 1080p/720p @ 60/50 fps <b>2nd Stream:</b> D1/CIF @ 30/25 fps <b>3rd Stream:</b> 720p/D1/CIF @ 30/25 fps
VIDEO RESOLUTION	1080p (1920×1080p) / 720p (1280×720) / D1 (704×576/704×480) / CIF (352×288/352×240)
AUDIO COMPRESSION	G.711a/G.711Mu/AAC/G.726
AUDIO STREAM	Full-duplex, Simplex
INTERFACE	RJ-45, 10/100 Mbps Ethernet
SUPPORTED PROTOCOLS*	IPv4/v6, TCP/IP, UDP, RTP, RTSP, HTTP, HTTPS, SSL, FTP, SMTP, DHCP, PPPoE, UPnP, SNMP, Bonjour, DDNS, IEEE 802.1x, QoS, NTP, IP Filter, ONVIF
SECURITY	User account and password protection, HTTPS, IP Filter, IEEE 802.1x, Digest authentication, User access log, Hardware security chipset protection
MAXIMUM USERS ACCESS	20 users
MICRO SD	Support for microSD up to 128 GB (card not included)
MICRO SD FUNCTION	Event trigger recording Continuous and scheduled recording Automatic recording when network fails
SUPPORTED WEB BROWSERS	Internet Explorer® (11.0+)
SUPPORTED OS	Windows® 7 32-bit/64-bit
COMMUNICATION	ONVIF Profile S and G
REGULATORY	
EMISSIONS	FCC Part 15B, EN55032
IMMUNITY	EN55024, EN50130-4
SAFETY	EU: EN60950-1 North America UL listed to UL/CSA 60950-1
ROHS	EN50581: 2012

\* Some development may be required in specific user cases to support some of these protocols in the field as they mature over time.

# HDZ Series – 25x Zoom IR WDR IP PTZ Cameras

## RECOMMENDED ACCESSORIES

ONVIF support and open API software integration. Refer to [www.onvif.org](http://www.onvif.org) for the ONVIF specification and the Honeywell Open Technology Alliance website (<http://www.security.honeywell.com/hota/>) to learn more about our open and integrated solutions.



### RECOMMENDED MOUNTS

HDZPMA	Pole mount adapter for wall mount
HDZCMA	Corner mount adapter for wall mount
HDZJB	Junction box
HDZNPTA	1.5" NPT adapter
HDZWM2	Wall mount with access hole
HDZGM	Wall mount gooseneck bracket
HDZCM1	Ceiling mount
HDZCM2	Ceiling mount extension pole for HDZCM1, 220 mm
HDZCM3	Ceiling mount extension pole for HDZCM1, 420 mm

HEN081*4	8ch, 2 HDD, 8 PoE, 4K, H.265
HEN161*4	16ch, 2 HDD, 16 PoE, 4K, H.265
HEN321*4	32ch, 2 HDD, 16 PoE, 4K, H.265
HEN162*4	16ch, 4 HDD, 16 PoE, 4K, H.265
HEN322*4	32ch, 4 HDD, 16 PoE, 4K, H.265
HEN642*4	64ch, 4 HDD, 16 PoE, 4K, H.265
HEN163*4	16ch, 8 HDD, 16 PoE, 4K, H.265, RAID 5&6
HEN323*4	32ch, 8 HDD, 16 PoE, 4K, H.265, RAID 5&6
HEN643*4	64ch, 8 HDD, 16 PoE, 4K, H.265, RAID 5&6

\* The \* = hard drive capacity in TB.

## ORDERING

HDZP252DI

Network TDN PTZ Dome, 1080p Resolution, 25x Zoom, WDR, H.265/H.264, NTSC/PAL, 6 IR LEDs, IP66, PoE+, micro SD Card Compatible (Supports up to 128 GB cards, card not included)

### For more information

[www.honeywell.com/security/uk](http://www.honeywell.com/security/uk)

### Honeywell Security and Fire

Aston Fields Road  
Whitehouse Industrial Estate  
Runcorn  
Cheshire WA7 3DL  
Tel: 08448 000 235  
[www.honeywell.com](http://www.honeywell.com)

ONVIF and the ONVIF logo are trademarks of ONVIF Inc. Honeywell reserves the right, without notification, to make changes in product design or specifications.

HSFV-HDZP252DI-01-UK(0617)DS-R  
© 2017 Honeywell International Inc.

**Honeywell**



# 5853

## WIRELESS GLASSBREAK DETECTOR



Honeywell's 5853 Wireless Glassbreak Detector offers uncompromised performance and unmatched false alarm immunity. The FlexCore™ signal processor utilizes an Application Specific Integrated Circuit (ASIC)—processing sound data in parallel rather than sequentially. This permits sound frequency, duration and amplitude to be analyzed 50% faster to minimize false alarms while maintaining the highest possible level of detection.

The 5853 can be mounted on any wall or ceiling within a 25' range, with no minimum range limitation. The LEDs indicate test mode, alarms and trouble conditions. It is compatible with all 5800 Series wireless devices.

### FEATURES

- Test mode can be activated remotely with FG-701 Tester
- Four selectable sensitivity settings (Max, Medium, Low and Lowest)
- FlexCore signal processor
- Senses the sound of a variety of glass (tempered, wired, laminate, ordinary plate, etc.)
- Sleek design with front and back case tamper
- Ten year battery life with easily replaceable batteries
- Transmits supervisory, low battery and tamper messages to control panel

### SPECIFICATIONS

#### Dimensions:

- 4.95" H x 3.09" W x 1.1" D

#### Range:

- 25' (7.6 meters) maximum from farthest protected glass
- No minimum range

#### Power:

- Two 3V Batteries (included)
  - Replace only with ADEMCO # 466, Panasonic® CR123A, Sanyo® CR123A, Duracell® DL123A, or Varta CR123A (Lithium Manganese Dioxide)

#### Operating Temperature:

- 14° F – 122° F  
( -10° C to 50° C)

### ORDERING

5853

Wireless Glassbreak Dectector

#### Honeywell Security & Custom Electronics

Honeywell International Inc.  
PO Box 9035  
Syosset, NY 11791  
www.honeywell.com

RE06045  
L/5853/D  
August 2006  
© 2006 Honeywell International Inc.

# Honeywell

# NFS2-640(E)

## Intelligent Addressable Fire Alarm System



Intelligent Fire Alarm Control Panels

### General

The NFS2-640 intelligent Fire Alarm Control Panel is part of the ONYX® Series of Fire Alarm Controls from NOTIFIER.

In stand-alone or network configurations, ONYX Series products meet virtually every application requirement.

The NFS2-640's modular design makes system planning easier. The panel can be configured with just a few devices for small building applications, or networked with many devices to protect a large campus or a high-rise office block. Simply add additional peripheral equipment to suit the application.

A host of other options are available, including single- or multi-channel voice; firefighter's telephone; LED, LCD, or PC-based graphic annunciators; networking; advanced detection products for challenging environments; wireless fire protection; and many additional options.

**NOTE:** Unless called out with a version-specific "E" at the end of the part number, "NFS2-640" refers to models NFS2-640 and NFS2-640E; similarly, "CPU2-640" refers to models CPU2-640 and CPU2-640E.

### Features

- Certified for seismic applications when used with the appropriate seismic mounting kit.
- Approved for Marine applications when used with listed compatible equipment. See DN-60688.
- One, expandable to two, isolated intelligent Signaling Line Circuit (SLC) Style 4, 6 or 7.
- Wireless fire protection using SWIFT Smart Wireless Integrated Fire Technology. See DN-60820.
- Up to 159 detectors and 159 modules per SLC; 318 devices per loop/636 per FACP or network node.
  - Detectors can be any mix of ion, photo, thermal, or multi-sensor; wireless detectors are available for use with the FWSG.
  - Modules include addressable pull stations, normally open contact devices, two-wire smoke detectors, notification, or relay; wireless modules are available for use with the FWSG.
- Standard 80-character display, 640-character large display (NCA-2), or display-less (a node on a network).
- Network options:
  - High-speed network for up to 200 nodes (NFS2-3030, NFS2-640, NFS-320(C), NFS-320SYS, NCA-2, DVC-EM, ONYXWorks, NFS-3030, NFS-640, and NCA).
  - Standard network for up to 103 nodes (NFS2-3030, NFS2-640, NFS-320(C), NFS-320SYS, NCA-2, DVC-EM, ONYXWorks, NCS, NFS-3030, NFS-640, NCA, AFP-200, AFP-300/400, AFP-1010, and AM2020). Up to 54 nodes when DVC-EM is used in network paging.
- 6.0 A switch mode power supply with four Class A/B built-in Notification Appliance Circuits (NAC). Selectable System Sensor, Wheelock, or Gentex strobe synchronization.
- Built-in Alarm, Trouble, Security, and Supervisory relays.
- VeriFire® Tools online or offline programming utility. Upload/Download, save, store, check, compare, and simulate panel databases. Upgrade panel firmware.
- Autoprogramming and Walk Test reports.
- Multiple central station communication options:
  - Standard UDACT
  - Internet
  - Internet/GSM
- 80-character remote annunciators (up to 32).
- EIA-485 annunciators, including custom graphics.
- Printer interface (80-column and 40-column printers).
- History file with 800-event capacity in nonvolatile memory, plus separate 200-event alarm-only file.
- Alarm Verification selection per point, with automatic counter.
- Presignal/Positive Alarm Sequence (PAS).
- Silence inhibit and Auto Silence timer options.
- March time/temporal/California two-stage coding/strobe synchronization.
- Field-programmable on panel or on PC, with VeriFire Tools program check, compare, simulate.
- Full QWERTY keypad.
- Battery charger supports 18 – 200 AH batteries.
- Non-alarm points for lower priority functions.
- Remote ACK/Signal Silence/System Reset/Drill via monitor modules.
- Automatic time control functions, with holiday exceptions.
- Surface Mount Technology (SMT) electronics.
- Extensive, built-in transient protection.
- Powerful Boolean logic equations.
- Support for SCS Series smoke control system in HVAC mode.



NFS2-640

NFS2-640-DVC\_right.jpg

# ISO-X(A)

## Fault Isolator Module



Intelligent/Addressable Devices

### General

The Notifier ISO-X(A) Fault Isolator Module is used with Notifier Onyx and CLIP series Fire Alarm Control Panels (FACPs) to protect the system against wire-to-wire short circuits on the SLC loops.

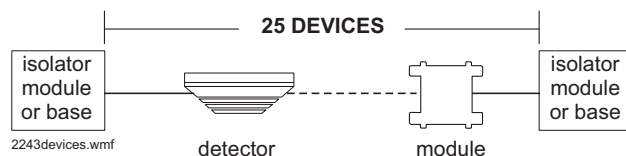
### Features

- Powered by SLC loop directly, no external power required.
- Base mounts on standard junction boxes (4.0"/10.16 cm square by 2.125"/5.398 cm deep).
- Integral LED blinks to indicate normal condition. Illuminates steady when short circuit condition is detected.
- High noise (EMF/RFI) immunity.
- Wide viewing angle of LED.
- SEMS screws with clamping plates for ease of wiring.
- Opens SLC loop automatically on detection of short, preventing the short from causing failure of the entire loop.
- Automatically resets on correction of short.
- Supports Style 4, 6, or 7 wiring.

### Applications

The Fault Isolator Modules should be spaced between groups of sensors in a loop to protect the rest of the loop. Use to isolate short circuit problems within a section of a loop so that other sections can continue to operate normally. The ISO-X(A) supports a maximum of 25 devices in-between isolators, except when using relay bases or legacy IPX multisensors.

**NOTE: ON LOADS PER RELAY BASE AND LEGACY MULTI-SENSOR DETECTORS/ISOLATORS/ISOLATOR BASES:** the maximum number of addressable devices between isolators (or B224BI isolator bases) is 25 devices.



B224RB relay bases and legacy IPX-751 multisensor detectors draw more current than all other intelligent devices. When calculating the 25-device maximum: B224RB.

- B224RB represents 2.5 devices.
- IPX-751 in a standard base represents 12 devices.
- IPX-751 in a relay base represents 14.5 devices.
- All other addressable devices represent 1 device.

See examples on page 2.

**NOTE: ON MAXIMUM NUMBER OF DEVICES:** See the SLC Manual (PN 51253) for information on loss of addresses due to current limitations. Each module or base added reduces the capacity of address positions in an SLC. All SLC field devices must have been purchased after February 1995 to meet the aforementioned requirements. If the SLC field devices were purchased prior to February 1995, each ISO-X(A) used reduces the capacity of an SLC by two address positions. Requirements differ as applied to relay bases (see note above).



ISO-X(A)

### Construction

The face plate is made of off-white plastic. Includes yellow LED indicator that pulses when normal and illuminates steady when a short is detected.

### Operation

Automatically opens circuit when the line voltage drops below four volts. Fault Isolator Modules should be spaced between groups of addressable devices (maximum 25, see notes on page 1) in a loop to protect the rest of the loop. If a short occurs between any two isolators, then both isolators immediately switch to an open circuit state and isolate the groups of sensors between them. The remaining units on the loop continue to fully operate.

In Style 4 loops, the ISO-X(A) is generally used at each T-tap branch, to limit the effect of short circuits on a branch to the devices on that branch. The LED indicator is on continuously during a short circuit condition.

The ISO-X(A) Fault Isolator Module automatically restores the shorted portion of the communications loop to normal condition when the short circuit condition is removed.

### Installation

- Mount on a standard junction box (4.0"/10.16 cm square) which is at least 2.125"/5.398 cm deep.
- Terminal screws are provided for "in and out" wiring.
- Installation instructions are provided with each module.
- Surface-mount box is available as an option.

## Specifications

**Normal operating voltage:** 15 – 32 VDC (peak).

**Standby current:** 450 µA (not isolating) .

**Maximum current draw:** 17 mA (device in isolation, LED latched in alarm).

**Temperature range:** 32°F to 120°F (0°C to 49°C).

**Relative humidity:** 10% to 93% (non-condensing).

**Weight:** 5 oz. (150 grams).

**Dimensions:** 4.5"H x 4.5"W x 0.25" D (11.43 cm H x 11.43 cm W x 0.635 cm D).

## Agency Listings and Approvals

In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL:** S635 (UOXX); BP6480 (AMCX, APOU).
- **ULC:** S635 (OUOXXC, ISO-XA).
- **FM Approved.**
- **CSFM:** 7165-0028:0214; 7165-0028:0224; 7165-0028:0243.
- **MEA:** 17-96-E; 104-93-E Vol. VI; 290-91-E Vol. V; 317-01-E; 447-99-E.
- **U.S. Coast Guard:** 161.002/42/1 (NFS-640); 161.002/50/0 (NFS2-640/NFS-320/NFS-320C, excluding B210LP(A)).
- **Lloyd's Register:** 11/600013 (NFS2-640/NFS-320/NFS-320C, excluding B210LP(A)).
- **BSA:** 578-81-SA.

## Architectural/Engineering Specifications

Fault Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Fault Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop. If a wire-to-wire short occurs, the Fault Isolator Module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Fault Isolator Module shall automatically reconnect the isolated section of the SLC loop. The Fault Isolator Module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Fault Isolator Module after its normal operation. The Fault Isolator Module shall mount in a standard 4.0" (10.16 cm) deep electrical box, in a surface-mounted backbox, or in the Fire Alarm Control Panel. It shall provide a single LED which shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

## Product Line Information

**NOTE:** "A" suffix indicates ULC Listed model.

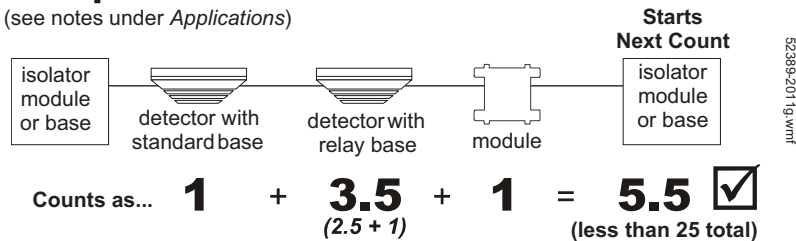
**ISO-X:** Isolator Module.

**ISO-XA:** Isolator Module. Canadian (ULC) version.

**SMB500:** Surface Mount Backbox

## Examples of Device Counts

(see notes under *Applications*)



Notifier® is a registered trademark of Honeywell International Inc.  
©2012 by Honeywell International Inc. All rights reserved. Unauthorized use of this document is strictly prohibited.



This document is not intended to be used for installation purposes.  
We try to keep our product information up-to-date and accurate.  
We cannot cover all specific applications or anticipate all requirements.  
All specifications are subject to change without notice.



Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.  
www.notifier.com



## Selectable-Output Horns, Strobes, and Horn Strobes

*SpectrAlert® Advance selectable-output horns, strobes, and horn strobes are rich with features guaranteed to cut installation times and maximize profits.*



**SPECTRAlert**  
**ADVANCE**  
from System Sensor

### Features

- Plug-in design with minimal intrusion into the back box
- Tamper-resistant construction
- Automatic selection of 12- or 24-volt operation at 15 and 15/75 candela
- Field-selectable candela settings on wall and ceiling units: 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, and 185
- Horn rated at 88+ dBA at 16 volts
- Rotary switch for horn tone and three volume selections
- Universal mounting plate for wall and ceiling units
- Mounting plate shorting spring checks wiring continuity before device installation
- Electrically compatible with existing SpectrAlert products
- Compatible with MDL sync module

**The SpectrAlert Advance series** offers the most versatile and easy-to-use line of horns, strobes, and horn strobes in the industry. With white and red plastic housings, wall and ceiling mounting options, and plain and FIRE-printed devices, SpectrAlert Advance can meet virtually any application requirement.

Like the entire SpectrAlert Advance product line, horns, strobes, and horn strobes include a variety of features that increase their application versatility while simplifying installation. All devices feature plug-in designs with minimal intrusion into the back box, which make installations fast and foolproof while virtually eliminating costly and time-consuming ground faults. Furthermore, a universal mounting plate with an onboard shorting spring tests wiring continuity before the device is installed, protecting devices from damage.

In addition, field-selectable candela settings, automatic selection of 12- or 24-volt operation, and a rotary switch for horn tones with three volume selections enables installers to easily adapt devices to suit a wide range of application requirements.

### Agency Listings



S4011 (chimes, horn strobes, horns)  
S5512 (strobes)



3023572



MEA452-05-E



7125-1653:186 (indoor strobes)  
7125-1653:188 (horn strobes,  
chime strobes)  
7135-1653:189 (horns, chimes)



# SpectrAlert Advance Specifications

## Architect/Engineer Specifications

### General

SpectrAlert Advance horns, strobes, and horn strobes shall mount to a standard 4 × 4 × 1½-inch back box, 4-inch octagon back box, or double-gang back box. Two-wire products shall also mount to a single-gang 2 × 4 × 17⁄8-inch back box. A universal mounting plate shall be used for mounting ceiling and wall products. The notification appliance circuit wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance products, when used with the Sync-Circuit™ Module accessory, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts. When used with the Sync-Circuit Module, 12-volt-rated notification appliance circuit outputs shall operate between 9 and 17.5 volts; 24-volt-rated notification appliance circuit outputs shall operate between 17 and 33 volts. Indoor SpectrAlert Advance products shall operate between 32 and 120 degrees Fahrenheit from a regulated DC or full-wave rectified unfiltered power supply. Strobes and horn strobes shall have field-selectable candela settings including 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, and 185.

### Strobe

The strobe shall be a System Sensor SpectrAlert Advance Model \_\_\_\_\_ listed to UL 1971 and shall be approved for fire protective service. The strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

### Horn Strobe Combination

The horn strobe shall be a System Sensor SpectrAlert Advance Model \_\_\_\_\_ listed to UL 1971 and UL 464 and shall be approved for fire protective service. The horn strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have three audibility options and an option to switch between a temporal three-pattern and a non-temporal (continuous) pattern. These options are set by a multiple position switch. On four-wire products, the strobe shall be powered independently of the sounder. The horn on horn strobe models shall operate on a coded or non-coded power supply.

### Synchronization Module

The module shall be a System Sensor Sync-Circuit model MDL listed to UL 464 and shall be approved for fire protective service. The module shall synchronize SpectrAlert strobes at 1 Hz and horns at temporal three. Also, while operating the strobes, the module shall silence the horns on horn strobe models over a single pair of wires. The module shall mount to a 4<sup>11</sup>/<sub>16</sub> × 4<sup>11</sup>/<sub>16</sub> × 2<sup>1</sup>/<sub>8</sub>-inch back box. The module shall also control two Style Y (class B) circuits or one Style Z (class A) circuit. The module shall synchronize multiple zones. Daisy chaining two or more synchronization modules together will synchronize all the zones they control. The module shall not operate on a coded power supply.

## Physical/Electrical Specifications

<b>Standard Operating Temperature</b>	32°F to 120°F (0°C to 49°C)
<b>Humidity Range</b>	10 to 93% non-condensing
<b>Strobe Flash Rate</b>	1 flash per second
<b>Nominal Voltage</b>	Regulated 12 DC/FWR or regulated 24 DC/FWR <sup>1</sup>
<b>Operating Voltage Range<sup>2</sup></b>	8 to 17.5 V (12 V nominal) or 16 to 33 V (24 V nominal)
<b>Input Terminal Wire Gauge</b>	12 to 18 AWG
<b>Ceiling-Mount Dimensions (including lens)</b>	6.8" diameter × 2.5" high (173 mm diameter × 64 mm high)
<b>Wall-Mount Dimensions (including lens)</b>	5.6" L × 4.7" W × 2.5" D (142 mm L × 119 mm W × 64 mm D)
<b>Horn Dimensions</b>	5.6" L × 4.7" W × 1.3" D (142 mm L × 119 mm W × 33 mm D)
<b>Wall-Mount Back Box Skirt Dimensions (BBS-2, BBSW-2)</b>	5.9" L × 5.0" W × 2.2" D (151 mm L × 128 mm W × 56 mm D)
<b>Ceiling-Mount Back Box Skirt Dimensions (BBSC-2, BBSCW-2)</b>	7.1" diameter × 2.2" high (180 mm diameter × 57 mm high)
<b>Wall-Mount Trim Ring Dimensions (sold as a 5 pack) (TR-HS, TRW-HS)</b>	5.7" L × 4.8" W × 0.35" D (145 mm L × 122 mm W × 9 mm D)
<b>Ceiling-Mount Trim Ring Dimensions (sold as a 5 pack) (TRC-HS, TRCW-HS)</b>	6.9" diameter × 0.35" high (175 mm diameter × 9 mm high)

### Notes:

1. Full Wave Rectified (FWR) voltage is a non-regulated, time-varying power source that is used on some power supply and panel outputs.
2. P, S, PC, and SC products will operate at 12 V nominal only for 15 and 15/75 cd.

# NBG-12LX

## Addressable Manual Pull Station



Intelligent/Addressable Devices

### General

The Notifier NBG-12LX is a state-of-the-art, dual-action (i.e., requires two motions to activate the station) pull station that includes an addressable interface for any Notifier intelligent control panel except FireWarden series panels, and the NSP-25 panel. Because the NBG-12LX is addressable, the control panel can display the exact location of the activated manual station. This leads fire personnel quickly to the location of the alarm.

### Features

- Maintenance personnel can open station for inspection and address setting without causing an alarm condition.
- Built-in bicolor LED, which is visible through the handle of the station, flashes in normal operation and latches steady red when in alarm.
- Handle latches in down position and the word “ACTIVATED” appears to clearly indicate the station has been operated.
- Captive screw terminals wire-ready for easy connection to SLC loop (accepts up to 12 AWG/3.25 mm<sup>2</sup> wire).
- Can be surface mounted (with SB-10 or SB-I/O) or semi-flush mounted. Semi-flush mount to a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box.
- Smooth dual-action design.
- Meets ADAAG controls and operating mechanisms guidelines (Section 4.1.3[13]); meets ADA requirement for 5 lb. maximum activation force.
- Highly visible.
- Attractive shape and textured finish.
- Key reset.
- Includes Braille text on station handle.
- Optional trim ring (BG12TR).
- Meets UL 38, Standard for Manually Actuated Signaling Boxes.
- Up to 99 NBG-12LX stations per loop on CLIP protocol loops.
- Up to 159 NBG-12LX stations per loop on FlashScan® protocol loops.
- Dual-color LED blinks green to indicate normal on FlashScan® systems.

### Construction

Shell, door, and handle are molded of durable polycarbonate material with a textured finish.

### Specifications

- **Shipping Weight:** 9.6 oz. (272.15 g)
- **Normal operating voltage:** 24 VDC.
- **Maximum SLC loop voltage:** 28.0 VDC.
- **Maximum SLC standby current:** 375 µA.
- **Maximum SLC alarm current:** 5 mA.
- **Temperature Range:** 32°F to 120°F (0°C to 49°C)
- **Relative Humidity:** 10% to 93% (noncondensing)
- **For use indoors in a dry location**



The NBG-12LX  
Addressable Manual Pull Station

### Installation

The NBG-12LX will mount semi-flush into a single-gang, double-gang, or standard 4" (10.16 cm) square electrical outlet box, or will surface mount to the model SB-10 or SB-I/O surface backbox. If the NBG-12LX is being semi-flush mounted, then the optional trim ring (BG12TR) may be used. The BG12TR is usually needed for semi-flush mounting with 4" (10.16 cm) or double-gang boxes (not with single-gang boxes).

### Operation

Pushing in, then pulling down on the handle causes it to latch in the down/activated position. Once latched, the word “ACTIVATED” (in bright yellow) appears at the top of the handle, while a portion of the handle protrudes from the bottom of the station. To reset the station, simply unlock the station with the key and pull the door open. This action resets the handle; closing the door automatically resets the switch.

Each manual station, on command from the control panel, sends data to the panel representing the state of the manual switch. Two rotary decimal switches allow address settings (1 – 159 on FlashScan® systems, 1 – 99 on CLIP systems).

### Architectural/Engineering Specifications

Manual Fire Alarm Stations shall be non-coded, with a key-operated reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key. An operated station shall automatically condition itself so as to be visually detected as activated. Manual stations shall be constructed of red-colored polycarbonate material with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in white letters, 1.00 inches (2.54 cm) or larger. Stations shall be suitable for surface mounting on matching backbox SB-10 or SB-I/O; or semi-flush mounting on a standard single-gang, double-gang, or



4" (10.16 cm) square electrical box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) or per national/local requirements. Manual Stations shall be Underwriters Laboratories listed.

Manual stations shall connect with two wires to one of the control panel SLC loops. The manual station shall, on command from the control panel, send data to the panel representing the state of the manual switch. Manual stations shall provide address setting by use of rotary decimal switches.

The loop poll LED shall be clearly visible through the front of the station. The LED shall flash while in the normal condition, and stay steadily illuminated when in alarm.

## Product Line Information

**NBG-12LX:** Dual-action addressable pull station. Includes key locking feature. (Listed for Canadian and non-Canadian applications.)

**NBG-12LXSP:** Spanish/English labelled version.

**NBG-12LXP:** Portuguese labelled version.

**SB-10:** Surface backbox; metal.

**SB-I/O:** Surface backbox; plastic.

**BG12TR:** Optional trim ring.

**17021:** Keys, set of two.

**NY-Plate:** New York City trim plate.

## Agency Listings and Approvals

In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL/ULC Listed:** S692 (listed for Canadian and non-Canadian applications).
- **MEA:** 67-02-E.
- **CSFM:** 7150-0028:0199.
- **FDNY:** COA #6085 (NFS2-640), COA #6098 (NFS2-3030).
- **BSMI:** CI313066760047.
- **U.S. Coast Guard.**
- **Lloyd's Register.**
- **FM Approved.**

**Patented:** U.S. Patent No. D428,351; 6,380,846; 6,314,772; 6,632,108.

NOTIFIER® and FlashScan® are registered trademarks of Honeywell International Inc.

©2012 by Honeywell International Inc. All rights reserved. Unauthorized use of this document is strictly prohibited.



This document is not intended to be used for installation purposes.  
We try to keep our product information up-to-date and accurate.  
We cannot cover all specific applications or anticipate all requirements.  
All specifications are subject to change without notice.



Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.  
[www.notifier.com](http://www.notifier.com)

# FSP-851(A) Series

## Intelligent Plug-In Photoelectric Smoke Detectors with FlashScan®



Intelligent/Addressable Devices

### General

Notifier FSP-851(A) Series intelligent plug-in smoke detectors with integral communication provide features that surpass conventional detectors. Detector sensitivity can be programmed in the control panel software. Sensitivity is continuously monitored and reported to the panel. Point ID capability allows each detector's address to be set with rotary, decimal address switches, providing exact detector location for selective maintenance when chamber contamination reaches an unacceptable level. The FSP-851(A) photoelectric detector's unique optical sensing chamber is engineered to sense smoke produced by a wide range of combustion sources. Dual electronic thermistors add 135°F (57°C) fixed-temperature thermal sensing on the FSP-851T(A). The FSP-851R(A) is a remote test capable detector for use with DNR(A)/DNRW duct detector housings. FSP-851(A) series detectors are compatible with Notifier Onyx and CLIP series Fire Alarm Control Panels (FACPs).

**FlashScan®** (U.S. Patent 5,539,389) is a communication protocol developed by Notifier that greatly increases the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices in the group has new information, the panel's CPU stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of earlier designs.

### Features

- Sleek, low-profile design.
- Addressable-analog communication.
- Stable communication technique with noise immunity.
- Low standby current.
- Two-wire SLC connection.
- Compatible with FlashScan® and CLIP protocol systems.
- Rotary, decimal addressing (1-99 on CLIP systems, 1-159 on FlashScan systems).
- Optional remote, single-gang LED accessory.
- Dual LED design provides 360° viewing angle.
- Visible bi-color LEDs blink green every time the detector is addressed, and illuminate steady red on alarm (*FlashScan systems only*).
- Remote test feature from the panel.
- Walk test with address display (an address on 121 will blink the detector LED: 12-[pause]-1 (*FlashScan systems only*)).
- Built-in functional test switch activated by external magnet.
- Built-in tamper-resistant feature.
- Sealed against back pressure.
- Constructed of off-white fire-resistant plastic, designed to commercial standards, and offers an attractive appearance.
- 94-5V plastic flammability rating.
- SEMS screws for wiring of the separate base.
- Optional relay, isolator, and sounder bases.



FSP-851(A) in B210LP(A) Base

B210-2951.jpg

### Specifications

**Sensitivity:** 0.5% to 2.35% per foot obscuration

**Size:** 2.1" (5.3 cm) high; base determines diameter.

- **B210LP(A):** 6.1" (15.5 cm) diameter.
- **B501(A):** 4.1" (10.4 cm) diameter.
- **B200S(A):** 6.875" (17.46 cm) diameter.
- **B200SR(A):** 6.875" (17.46 cm) diameter.
- **B224RB(A):** 6.2" (15.748 cm) diameter.
- **B224BI(A):** 6.2" (15.748 cm) diameter.

**Shipping Weight:** 5.2oz. (147g).

**Operating Temperature range:** FSP-851(A), 0°C to 49°C (32°F to 120°F). FSP-851T(A), 0°C to 38°C (32°F to 100°F). Low temperature signal for FSP-851T(A) at 45°F +/- 10°F (7.22°C +/- 5.54°C). FSP-851R(A) installed in a DNR(A)/DNRW, -20°C to 70°C (-4°F to 158°F).

**UL/ULC Listed Velocity Range:** 0-4000 ft/min. (1219.2 m/min.), suitable for installation in ducts.

**Relative Humidity:** 10%-93% noncondensing.

**Thermal Ratings:** Fixed-temperature setpoint 135°F (57°C).

### DETECTOR SPACING AND APPLICATIONS

Notifier recommends spacing detectors in compliance with NFPA 72. In low airflow applications with smooth ceiling, space detectors 30 feet (9.144m) for ceiling heights 10 feet (3.148m) and higher. For specific information regarding detector spacing, placement, and special applications refer to NFPA 72. *System Smoke Detector Application Guide*, document A05-1003, is available at [systemsensor.com](http://systemsensor.com)

### ELECTRICAL SPECIFICATIONS

**Voltage Range:** 15-32 volts DC peak.

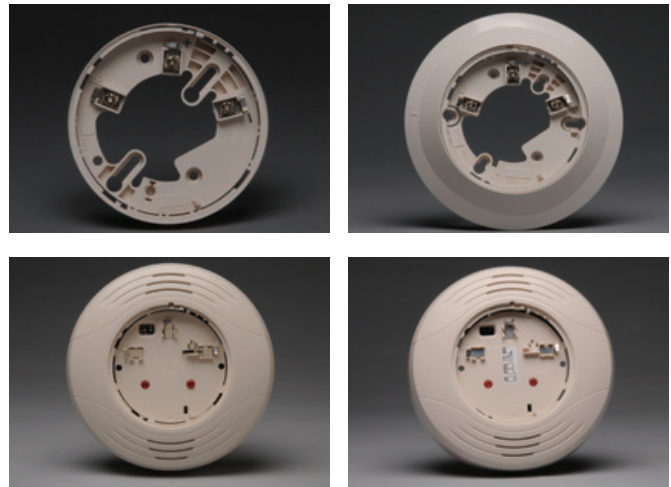
**Standby Current (max. avg.):** 300µA @ 24VDC (one communication every five seconds with LED enabled).

**LED Current (max.):** 6.5mA @ 24 VDC ("ON").



# 200 Series Mounting Base Options

*System Sensor mounting bases and kits provide a variety of installation options for detectors in any application.*



## Features

- Bases enable quick and secure detector plug-in
- SEMS screws provide easy wiring connection
- Support for 12-24 AWG provides installation flexibility
- Multiple accessory options provide mounting flexibility
- Sounder bases are compliant with UL 464 and UL 268

## To meet local code and application requirements,

System Sensor offers relay, isolator, and sounder base options for 200 Series detectors. Relay bases provide one form C contact relay for control of auxiliary functions, such as door closure and elevator recall. Isolator bases allow loops to continue to operate under fault conditions and automatically restore when the fault is removed. Sounder bases are available in a combination temporal 3 and continuous tone model (B200SR) or an addressable model (B200S) that can be activated by the fire alarm control panel based on the event.†

200 Series Bases provide a variety of mounting options to meet your installation challenges. Bases come in flanged or flangless versions for mounting to a variety of junction boxes. See the 200 Series Junction Box Selection Guide on the next page for junction box options. Surface mounting boxes are also available.

## Agency Listings

Model	Listings
B501	UL, ULC,* FM, CSFM
B210LP	UL, ULC, FM, CSFM
B200S	UL, ULC, FM, CSFM
B200SR	UL, ULC, FM, CSFM
B224RB	UL, ULC, FM, CSFM
B224BI	UL, ULC, FM, CSFM

\* For ULC-listed products, add "A" to the model number (e.g., B501A).

† Consult your fire alarm control panel manufacturer for compatibility with the addressable model of the sounder base.

## Specifications – 200 Series Bases

Physical Specifications			
<b>Diameter</b>	B501: 4.1" (104 mm); B210LP: 6.1" (155 mm); B224BI, B224RB, B200SR, B200S: 6.875" (175 mm)		
<b>Wire Gauge</b>	B224BI, B224RB, B200SR, B200S, B210LP, B501: 24 to 12 AWG		
<b>Temperature Range</b>	Refer to applicable sensor Operating Temperature Range using the Base/Sensor Cross Reference Chart at <a href="http://systemsensor.com">systemsensor.com</a>		
<b>Humidity Range</b>	10% to 93% RH non-condensing		
B224RB/B224BI Electrical Ratings		B200SR/B200S Electrical Ratings	
<b>Operating Voltage</b>	15 to 32 VDC (powered by SLC)	<b>External Supply Voltage</b>	16 to 33 VDC (VFWR)
<b>Standby Current</b>	170/450 $\mu$ A max.	<b>Standby Current</b>	500 $\mu$ A max.
<b>Set Time (B224RB only)</b>	Short Delay: 60 to 100 msec Long Delay: 6 to 10 sec		
<b>Reset Time (B224RB only)</b>	20 msec max.		
<b>Relay Characteristics (B224RB only)</b>	2 coil latching relay 1 Form C contact UL/ULC Rating: 0.5 A @ 125 VAC 0.9 A @ 125 VDC 3 A @ 30 VDC	<b>Sound Output</b>	Greater than 90 dBA measured in anechoic room at 10 feet, 24 volts. 85 dBA minimum in UL reverberant room
		<b>Alarm Current</b>	35 mA max.

## 200 Series Junction Box Selection Guide

Model	Single Gang	3.5" Octagonal	4" Octagonal	4" Square	4" Square*	50 mm	60 mm	70 mm	75 mm
B501	No	Yes	No	No	Yes	Yes	Yes	Yes	No
B210LP	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
B224RB	Yes	No	Yes	Yes	Yes	No	No	Yes	No
B224BI	Yes	No	No	Yes	Yes	No	No	Yes	No
B200SR/B200S	Yes	Yes†	Yes	Yes	Yes†	No	No	Yes	No

\* with 3.0" mud ring

† B200SA is not compatible with this junction box

Note: Box depth contingent on base and wire size. Refer to National Electric Code or applicable local codes for appropriate recommendations.

## Ordering Information, 200 Series Bases

Model	Description
B501*	4" Flangeless Mounting Base
B501BP*	4" Flangeless Mounting Base Bulk Pack
B210LP*	6" Flanged Mounting Base
B210LPBP*	6" Flanged Mounting Base Bulk Pack
B200SR*	Standard Sounder Base (Compatible with B501BH Series)
B200S*	Intelligent Addressable Sounder Base
B224RB*	Relay Base
B224BI*	Isolator Base

## 200 Series Accessories

SMB600	Surface Mounting Kit (flanged)
F110	Accessory Flange Ring for 6" Base
F110BP	Accessory Flange Ring for 6" Base Bulk Pack
F210	Accessory New Smaller Flange Ring for 6" Base
RA100Z*	Remote LED Annunciator
M02-04-00	Detector Test Magnet
M02-09-00	Test Magnet with Telescoping Handle
XR2B	Detector Removal Tool (T55-127-000 included)
XP-4	Extension Pole for XR2B (5 to 15 ft.)
T55-127-000	Detector Removal Head
BCK-200B	Black Detector Kit
WCK-200B	White Detector Kit

\* Add "A" to model number for ULC-listed product (e.g., B501A)

## B200S Addressable Sounder Base Product Overview

When used with compatible fire alarm control panels, the B200S sounder base provides unmatched flexibility to configure the output to various events. When combined with System Sensor SpectrAlert® Advance notification appliances, the B200S can serve as a UL464 compliant component of the general evacuation signaling, improving aesthetics and reducing system costs.

### Features\*:

- Simple addressing scheme - base adopts the same address as attached sensor
- Synchronizable with SpectrAlert Advance notification appliances
- Four standard tone patterns at two selectable volumes
- Custom tone capability
- Support for Temporal-4 CO annunciation

\* Note: Some features are dependent on Fire Alarm Panel programming. Consult your Fire Alarm Panel manual for more information on the capabilities of your system.



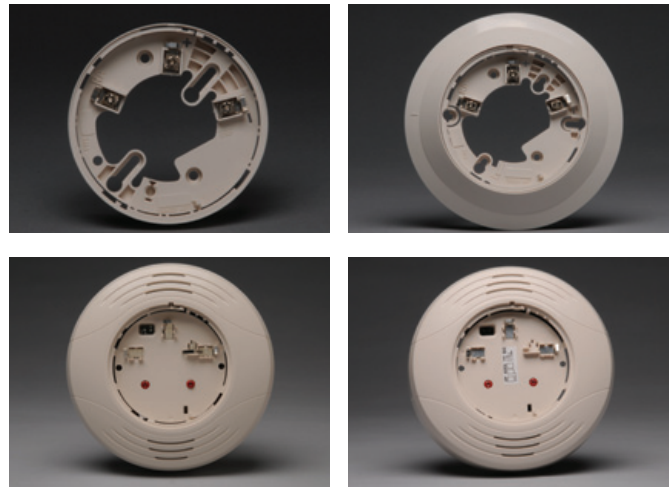
3825 Ohio Avenue • St. Charles, IL 60174  
Phone: 800-SENSOR2 • Fax: 630-377-6495  
[www.systemsensor.com](http://www.systemsensor.com)

©2012 System Sensor.  
Product specifications subject to change without notice. Visit [systemsensor.com](http://systemsensor.com) for current product information, including the latest version of this data sheet.  
SPDS13801 • 09/12



# 200 Series Mounting Base Options

*System Sensor mounting bases and kits provide a variety of installation options for detectors in any application.*



## Features

- Bases enable quick and secure detector plug-in
- SEMS screws provide easy wiring connection
- Support for 12-24 AWG provides installation flexibility
- Multiple accessory options provide mounting flexibility
- Sounder bases are compliant with UL 464 and UL 268

## To meet local code and application requirements,

System Sensor offers relay, isolator, and sounder base options for 200 Series detectors. Relay bases provide one form C contact relay for control of auxiliary functions, such as door closure and elevator recall. Isolator bases allow loops to continue to operate under fault conditions and automatically restore when the fault is removed. Sounder bases are available in a combination temporal 3 and continuous tone model (B200SR) or an addressable model (B200S) that can be activated by the fire alarm control panel based on the event.†

200 Series Bases provide a variety of mounting options to meet your installation challenges. Bases come in flanged or flangless versions for mounting to a variety of junction boxes. See the 200 Series Junction Box Selection Guide on the next page for junction box options. Surface mounting boxes are also available.

## Agency Listings

Model	Listings
B501	UL, ULC,* FM, CSFM
B210LP	UL, ULC, FM, CSFM
B200S	UL, ULC, FM, CSFM
B200SR	UL, ULC, FM, CSFM
B224RB	UL, ULC, FM, CSFM
B224BI	UL, ULC, FM, CSFM

\* For ULC-listed products, add "A" to the model number (e.g., B501A).

† Consult your fire alarm control panel manufacturer for compatibility with the addressable model of the sounder base.



## Specifications – 200 Series Bases

Physical Specifications			
<b>Diameter</b>	B501: 4.1" (104 mm); B210LP: 6.1" (155 mm); B224BI, B224RB, B200SR, B200S: 6.875" (175 mm)		
<b>Wire Gauge</b>	B224BI, B224RB, B200SR, B200S, B210LP, B501: 24 to 12 AWG		
<b>Temperature Range</b>	Refer to applicable sensor Operating Temperature Range using the Base/Sensor Cross Reference Chart at <a href="http://systemsensor.com">systemsensor.com</a>		
<b>Humidity Range</b>	10% to 93% RH non-condensing		
B224RB/B224BI Electrical Ratings		B200SR/B200S Electrical Ratings	
<b>Operating Voltage</b>	15 to 32 VDC (powered by SLC)	<b>External Supply Voltage</b>	16 to 33 VDC (VFWR)
<b>Standby Current</b>	170/450 $\mu$ A max.	<b>Standby Current</b>	500 $\mu$ A max.
<b>Set Time (B224RB only)</b>	Short Delay: 60 to 100 msec Long Delay: 6 to 10 sec		
<b>Reset Time (B224RB only)</b>	20 msec max.		
<b>Relay Characteristics (B224RB only)</b>	2 coil latching relay 1 Form C contact UL/ULC Rating: 0.5 A @ 125 VAC 0.9 A @ 125 VDC 3 A @ 30 VDC	<b>Sound Output</b>	Greater than 90 dBA measured in anechoic room at 10 feet, 24 volts. 85 dBA minimum in UL reverberant room
		<b>Alarm Current</b>	35 mA max.

## 200 Series Junction Box Selection Guide

Model	Single Gang	3.5" Octagonal	4" Octagonal	4" Square	4" Square*	50 mm	60 mm	70 mm	75 mm
B501	No	Yes	No	No	Yes	Yes	Yes	Yes	No
B210LP	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
B224RB	Yes	No	Yes	Yes	Yes	No	No	Yes	No
B224BI	Yes	No	No	Yes	Yes	No	No	Yes	No
B200SR/B200S	Yes	Yes†	Yes	Yes	Yes†	No	No	Yes	No

\* with 3.0" mud ring

† B200SA is not compatible with this junction box

Note: Box depth contingent on base and wire size. Refer to National Electric Code or applicable local codes for appropriate recommendations.

## Ordering Information, 200 Series Bases

Model	Description
B501*	4" Flangeless Mounting Base
B501BP*	4" Flangeless Mounting Base Bulk Pack
B210LP*	6" Flanged Mounting Base
B210LPBP*	6" Flanged Mounting Base Bulk Pack
B200SR*	Standard Sounder Base (Compatible with B501BH Series)
B200S*	Intelligent Addressable Sounder Base
B224RB*	Relay Base
B224BI*	Isolator Base

## 200 Series Accessories

SMB600	Surface Mounting Kit (flanged)
F110	Accessory Flange Ring for 6" Base
F110BP	Accessory Flange Ring for 6" Base Bulk Pack
F210	Accessory New Smaller Flange Ring for 6" Base
RA100Z*	Remote LED Annunciator
M02-04-00	Detector Test Magnet
M02-09-00	Test Magnet with Telescoping Handle
XR2B	Detector Removal Tool (T55-127-000 included)
XP-4	Extension Pole for XR2B (5 to 15 ft.)
T55-127-000	Detector Removal Head
BCK-200B	Black Detector Kit
WCK-200B	White Detector Kit

\* Add "A" to model number for ULC-listed product (e.g., B501A)

## B200S Addressable Sounder Base Product Overview

When used with compatible fire alarm control panels, the B200S sounder base provides unmatched flexibility to configure the output to various events. When combined with System Sensor SpectrAlert® Advance notification appliances, the B200S can serve as a UL464 compliant component of the general evacuation signaling, improving aesthetics and reducing system costs.

### Features\*:

- Simple addressing scheme - base adopts the same address as attached sensor
- Synchronizable with SpectrAlert Advance notification appliances
- Four standard tone patterns at two selectable volumes
- Custom tone capability
- Support for Temporal-4 CO annunciation

\* Note: Some features are dependent on Fire Alarm Panel programming. Consult your Fire Alarm Panel manual for more information on the capabilities of your system.



3825 Ohio Avenue • St. Charles, IL 60174  
Phone: 800-SENSOR2 • Fax: 630-377-6495  
[www.systemsensor.com](http://www.systemsensor.com)

©2012 System Sensor.  
Product specifications subject to change without notice. Visit [systemsensor.com](http://systemsensor.com) for current product information, including the latest version of this data sheet.  
SPDS13801 • 09/12





# B200S/B200S-LF Intelligent Sounder Bases

*System Sensor B200S series sounder bases set a new standard for performance, installation ease, and aesthetics.*

## B200S Series Features

- Addressability for maximum configuration flexibility
- Two volume levels (75 or 85 dBA)
- Multiple event-driven tone outputs
- Supports Continuous, ANSI Temporal 3, ANSI Temporal 4, and March Time tones
- Custom tone capability with some FACP models
- Ability to synchronize with other System Sensor notification devices
- UL 268 and UL 464 compliant
- Pre-wire mounting plate fits various junction box sizes
- Mechanical locking feature prevents removal of attached sensor head
- Additional terminal connections on Canadian model (B200SA) enable silence feature
- 520 Hz +/- 10% square wave tone (B200S-LF)



B200S-LF

B200S

**The B200S** sounder base series is designed for new and existing dwelling unit applications. It offers maximum flexibility in installation, configuration, and operation to meet or exceed UL 268 and UL 464 requirements.

The sounder base “listens in” to the communication between the attached sensor head and the fire alarm control panel (FACP) to adopt the same address as the detector, but as a unique device type on the loop. The FACP can then use that address to command an individual sounder — or a group of sounders — to activate. The command set from the panel can be tailored to the specific event, allowing selection of volume, tone, and group. In addition, some FACPs will enable custom tone patterns.<sup>†</sup>

The B200S series sounder bases recognize the System Sensor synchronization protocol. This enables it to be used as a component of the general evacuation signal — along with other System Sensor horns, horn strobes, and chimes — when connected to a power supply or FACP output capable of generating the System Sensor synchronization pulses.

The B200S series offers several key advantages. The sounder base employs a separate mounting plate that installs on various junction box sizes to eliminate unsightly surface-mount boxes. The mounting plate enables pre-wiring of all connections to speed and simplify installation. The housing also locks with the mounting plate using two retaining screws, for added tamper resistance.

**The B200S-LF** low frequency sounder base is designed to meet the NFPA 72 sleeping space requirement to produce a fundamental frequency of 520 Hz +/- 10% with a square wave or its equivalent. Studies show that a lower frequency, centered around 520 Hz, is the most ideal to awaken sleeping occupants, even those with mild to severe hearing loss.

## Agency Listings



S911



3035027



B200S: 7135-1653:0213  
B200S-LF: 7300-1653:0238

<sup>†</sup>Refer to the appropriate FACP manual for more information.

Physical Specifications	
Base Diameter	6.875" (17.46 cm)
Base Height	2.0" (5.08 cm) less sensor
Shipping Weight	<b>B200S:</b> 0.50 lb. (227 gm); <b>B200S-LF:</b> 0.60 lb. (272 gm)
Operating Temperature Range	Refer to applicable sensor Operating Temperature Range using the Base/Sensor Cross Reference Chart at <a href="http://systemsensor.com">systemsensor.com</a>
Operating Humidity Range	10% to 93% relative humidity (non-condensing)
Electrical Specifications: B200S	
External Supply Voltage	16 to 33 VDC (VFWR)
External Supply Standby Current	500 $\mu$ A maximum
Alarm Current	35 mA maximum at high-volume setting; 15 mA maximum at low-volume setting
SLC Operating Voltage	15 to 32 VDC
SLC Standby Current	300 $\mu$ A maximum (base only, refer to applicable sensor specification)
Electrical Specifications: B200S-LF	
External Supply Voltage	16 to 33 VDC (VFWR)
External Supply Standby Current	550 $\mu$ A maximum
Alarm Current	High volume setting: 70 mA maximum @ 33.0 VDC 90 mA maximum @ 24.0 VDC 140 mA maximum @ 16.0 VDC Low volume setting: 15 mA maximum @ 33.0 VDC 20 mA maximum @ 24.0 VDC 25 mA maximum @ 16.0 VDC
SLC Operating Voltage	15 to 32 VDC
SLC Standby Current	300 $\mu$ A maximum (base only, refer to applicable sensor specification)
Sound Output	
High Volume	Greater than 85 dBA minimum – measured in a UL reverberant room at 10 ft. 24 Volts (in continuous tone)
Low Volume	Greater than 75 dBA minimum – measured in a UL reverberant room at 10 ft. 24 Volts (in continuous tone)



# B224RB Plug-in Relay Detector Base

3825 Ohio Avenue, St. Charles, Illinois 60174  
 1-800-SENSOR2, FAX: 630-377-6495  
 www.systemsensor.com

**SPECIFICATIONS**

Base Diameter: 6.85 in (17.4 cm)  
 Base Height (less sensor): 1.61 in (4.1 cm)  
 Operating Temperature Range: Refer to applicable sensor Operating Temperature Range using the Base/Sensor Cross Reference Chart at systemsensor.com  
 Operating Humidity Range: 10% to 93% Relative Humidity (Non-condensing)

**Electrical Ratings**

Operating Voltage: 15 to 32 VDC  
 Standby Current: 170 µA

**Relay Characteristics**

Coil: 2 coil latching  
 Contact Type: Form C  
 Contact Relay Ratings

CURRENT RATING	MAXIMUM VOLTAGE	LOAD DESCRIPTION	APPLICATION
2 A	25 VAC	General purpose (PF = 0.35)	Non-coded
3 A	30 VDC	General purpose	Non-coded
2 A	30 VDC	General purpose	Coded
0.46 A	30 VDC	(L/R = 20ms)	Non-coded
0.7 A	70.7 VAC	General purpose (PF = 0.35)	Non-coded
0.3 A	110 VDC	General purpose	Non-coded
0.9 A	125 VDC	General purpose	Non-coded
0.5 A	125 VAC	General purpose	Non-coded
0.3 A	125 VAC	General purpose (PF = 0.35)	Non-coded
0.24 A	220 VDC	General purpose	Non-coded
0.25 A	250 VAC	Resistive load	Non-coded

Set Time (Position 1): 60 msec minimum, 100 msec maximum  
 Set Time (Position 2): 6 seconds minimum, 10 seconds maximum  
 Reset Time: 20 msec

**BEFORE INSTALLING**

Please read the System Smoke Detector Applications Guide, which provides detailed information on detector spacing, placement, zoning, wiring, and special applications. Copies of this application guide are available from System Sensor. NFPA 72 guidelines should be observed.

NOTICE: This manual should be left with the owner/user of this equipment. IMPORTANT: The detector used with these bases must be tested and maintained regularly following NFPA 72 requirements. The detectors should be cleaned at least once a year.

**GENERAL INFORMATION**

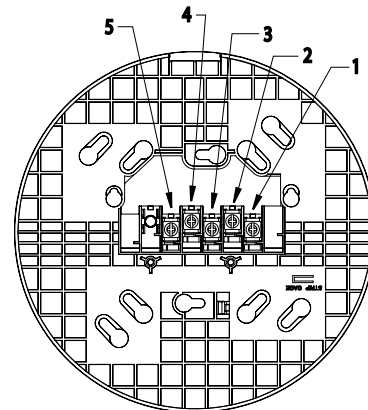
The relay base is intended for use in an intelligent system. Form C latching relay contacts are included for the control of an auxiliary function. The relay can operate in two different modes (short and long delay). The activation time when the short delay is used is 60 msec to 100 msec, while the activation time for the long delay is 6 sec to 10 sec. A shunt with pin headers, located on the base PC board, can be used to choose your desired delay. B224RB is set at the short delay when manufactured. If you wish to use the long delay, please move the shunt to the adjacent pair of pin headers. See Figures 2 and 6.

**B224RB TERMINALS**

**NO. FUNCTION**

1. Normal Close
2. Common
3. Normal Open
4. Comm. Line In (-) and Out (-)
5. Comm. Line In (+) and Out (+)

**FIGURE 1. TERMINAL DESIGNATION:**



C0471-06

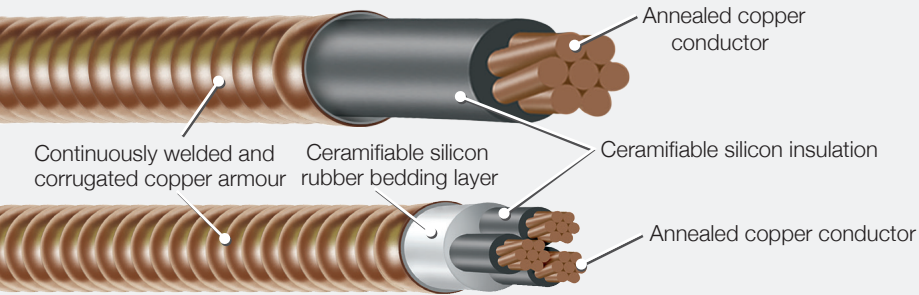
**MOUNTING**

Mount the mounting plate directly to an electrical box. The plate will mount directly to 4-inch square (with and without plaster ring), 4-inch octagon, 3 1/2-inch octagon, single gang and double gang junction boxes.

1. Connect field wiring to terminals, as shown in Figure 4.
2. Attach the mounting plate to the junction box as shown in Figure 2.
3. To mount the base, hook the tab on the base to the groove on the mounting plate.
4. Then, swing the base into position to engage the pins on the product with the terminals on the mounting plate.
5. Secure the base by tightening the mounting screws.
6. Install a compatible smoke detector as described in the installation manual for the detector.

# VITALink® Power Cable

## 2-Hour Fire Rated



ULC S139 with hose stream  
90°C, 600 Volt CEC Type RC90  
CSA Listed  
UL/ULC Electrical Circuit  
Integrity System (FHIT7 120)

VITALink® is a self-contained 2-hour fire rated cable system CSA Listed as Type RC90 and Certified to ULC S139 “Tests for Fire Resistant Cables”. Installed per the Canadian Electrical Code, RSCC manufacturer’s instructions and the qualification criteria of ULC Electrical Circuit Integrity System FHIT7 120, VITALink® meets the code requirements for 2 hour Fire Rated Circuits, Electrical Circuit Protective Systems, Survivability or Circuit Integrity as applicable. We equally have Canadian approval for the FHIT7 120A and FHIT7 60.

VITALink® cables offer cost, reliability and ease of installation advantages over other methods of providing Fire Rated Circuits.

The equipment grounding copper sheath is terminated with a readily available brass connector (multiple sources) and the cable connections are made without the need for splicing or special tools. When compared to Mineral Insulated (MI) cable, VITALink® is not exposed to costly field expenses in preparing cable ends, special panel penetrations, additional flexible terminations and the splicing of shorter lengths in longer runs. VITALink® is not susceptible to voltage failures caused by moisture ingress through leaky seals or faulty storage.

Alternate methods such as encasement in 2 inches of concrete or enclosure within 2-hour fire-resistant building construction may be advantages in some applications but expensive or useless in others. It must be remembered that alternate methods do not test the electrical capability of the circuit during or after a fire but only the structural ability to prevent fire spread.

### Features

- 2-Hour Fire Rating per ULC S139 with hose stream, Horizontal & Vertical applications
- Simple termination, standard tools widely available brass connectors
- Available in long lengths
- Welded copper sheath suitable for equipment bonding per CEC rules 10-618 and 10-804
- Welded copper sheath forms impervious armor
- Suitable for wet locations

### Performance Standards

- CSA Listed type RC90 per CSA 22.2 No. 123
- 2 Hour Fire Rating per ULC S139
- Electrical Circuit Integrity System #120 (FHIT7) – ULC Canada
- Wet location rating 90°C
- Meets NFPA 130 for Transit and NFPA 502 for Tunnel applications
- Single conductor ampacity when installed per CEC Table 1

### Applications

- Fire Pumps
- Emergency Systems
- Exhaust & Pressurization fans
- Fireman’s Elevators
- Fire Alarm
- Egress elevators
- Emergency Device activation
- Lighting & Signage

# WIN-PAK® 4.8

## INTEGRATED SECURITY SOLUTION

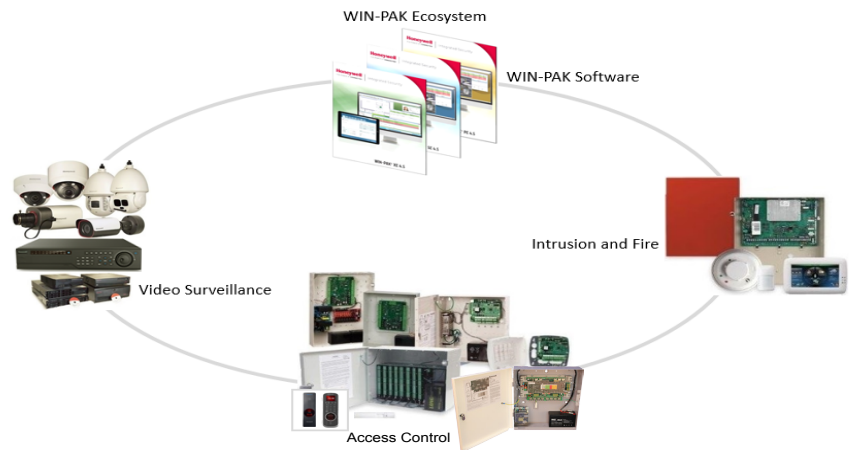
Honeywell's WIN-PAK 4.8 software solution provides a cost-effective way to integrate and manage access control, video surveillance, and intrusion detection through a single interface.



WIN-PAK 4.8 provides an intuitive browser-based interface allowing users to perform common access control actions from virtually anywhere.

WIN-PAK 4.8 can be easily scaled from a single site up to a multi-region, enterprise-level solution with multiple Accounts and Subaccounts, all without placing restrictions on the number of users or sites being managed.

WIN-PAK 4.8 supports third party integrations such as HID's Mobile Access®, BioConnect® Suprema® and Morpho biometrics, point-of-sale systems, visitor management, and HR applications. Using the included WIN-PAK API, your software developers can create custom integrations to meet your integration needs.



### FEATURES & BENEFITS

#### Eliminates disparate systems and interfaces

- Integrated access, video, intrusion, and fire\* systems through one interface
- Direct management of biometrics using HON-FIN4000 controller/reader
- Provision OmniAssure Touch and HID mobile credentials through WIN-PAK

#### Increases situational awareness, eliminates costly false alarms

- Disarm intrusion system through any valid card swipe at an access control reader
- Arm intrusion system through a valid triple-swipe at an access control reader

- Coordinate intrusion, access, or fire\* events with video actions to maximize awareness

#### Scales as your business grows

- Unrestricted number of cardholders and system users
- Unrestricted number of sites and access points
- Accommodates up to 40 recorders and 2,560 cameras.

#### Minimizes onboarding and training costs

- Intuitive web interface for access management, with embedded Help tool

#### Minimizes server deployment costs

- Supports VMWare 6.5 to help leverage existing IT infrastructure and server assets

#### Minimizes maintenance and system supervisory costs

- Customizable and automated system reporting functions with email delivery
- Perform common daily access control tasks from anywhere through the web interface
- Included API for custom integrations to third-party systems

**Honeywell**

# WIN-PAK® 4.8 TECHNICAL SPECIFICATIONS

	WPX48	WPS48	WPP48
WEB BROWSER	Included-Access Only		
SYSTEM WORKSTATION/USERS	1	5	Unrestricted
INTRUSION INTEGRATION	NA	VISTA-128/250 FBPT and BPT	
INTEGRATED VIDEO	NA	40 NVRs x 64 Cameras - 2,560 Cameras	
ACCOUNTS/SUBACCOUNTS	1/1	1/1	5 /Unrestricted
HON-FIN4000 SUPPORT	NA	32	600
TIME AND ATTENDANCE REPORTS WEB MODULE	NA	NA	Included
NOTIFICATIONS AND REPORTING	Email, SMS		
INTERACTIVE FLOOR PLANS	Included		
ELEVATOR CONTROL	Included		
PHOTO ID PRODUCTION	Included		
LOCKDOWN	Included		
CUSTOM CARDHOLDER FIELD TEMPLATES	Included		
TRACKING AND MUSTER REPORTS	Included		
GUARD TOUR REPORTS	Included		

## ORDERING

WIN-PAK 4.8	
WPX48	WIN-PAK XE 4.8
WPS48	WIN-PAK SE 4.8
WPP48	WIN-PAK PE 4.8
WIN-PAK XE 4.8 UPGRADES	
UX48S48	Upgrade from WPX48 to WPS48
UX48P48	Upgrade from WPX48 to WPP48
WIN-PAK SE 4.8 UPGRADES	
US48P48	Upgrade from WPS48 to WPP48

SOFTWARE SUPPORT*	
SMUWPXE	SMU - WIN-PAK XE
SMUWPS	SMU - WIN-PAK SE
SMUWPP	SMU - WIN-PAK PE
EXPANDED SUPPORT OPTIONS**	
SRVWPPAPI	WIN-PAK API Developer Support
SMU24WPXE	24/7 Emergency Support - WIN-PAK XE
SMU24WPS	24/7 Emergency Support - WIN-PAK SE
SMU24WPP	24/7 Emergency Support - WIN-PAK PE
SSAEUWPXE	Software Support Agreement - WIN-PAK XE
SSAEUWPS	Software Support Agreement - WIN-PAK SE
SSAEUWPP	Software Support Agreement - WIN-PAK PE
SSAEU24WPXE	Software Support Agreement with 24/7 Emergency Support - WIN-PAK XE
SSAEU24WPS	Software Support Agreement with 24/7 Emergency Support - WIN-PAK SE
SSAEU24WPP	Software Support Agreement with 24/7 Emergency Support - WIN-PAK PE

\* SMU = Software Maintenance Upgrade program provides latest releases per 1-year increments

\*\* WIN-PAK training is a prerequisite for all SSAEU

### For more information

[www.honeywellaccess.com/](http://www.honeywellaccess.com/)

### Honeywell Commercial Security

715 Peachtree Street NE  
Atlanta, GA 30308  
1.800.323.4576  
[www.honeywell.com](http://www.honeywell.com)

L/WNPK48D/D | 12/19  
© 2019 Honeywell International Inc.

## SUPPORTED ACCESS

MPA2, NETAXS®-123, PRO3200, NETAXS®-4, PW6000 (panel to approved installers - WPP48 only), HON-FIN4000 (not supported by XE)

## SUPPORTED VIDEO (NOT SUPPORTED BY XE)

ADPRO®, MAXPRO® NVR, MAXPRO® HYBRID, Performance Series (ENVR-includes 4K)

## SUPPORTED INTRUSION (NOT SUPPORTED BY XE)

VISTA-128BPT, VISTA-250BPT, VISTA-128FBPT, VISTA-250FBPT

WIN-PAK 4.8 supports the following 64-bit OS:  
Windows Server 2016,  
Windows Server 2012 R2,  
Windows 10 Professional.

SQL supported:  
SQL 2016 Standard, Express.

Browsers supported:  
Edge™, Chrome™, Safari®,  
FireFox®.

VMWare Supported:  
ESXi 6.5.

Language Supported:  
Arabic, Chinese, Czech, Dutch,  
English, French, Italian, Polish,  
Portuguese, Russian and  
Spanish.

WIN-PAK® is a registered trademark of Honeywell International Inc.

Microsoft®, Windows® Server 2016, Windows® Server 2012, Windows 10, Edge and SQL Server are registered trademarks of Microsoft Corporation. Chrome and Android are trademarks of Google Inc. iOS, iPad® and iPhone® are registered trademarks of Apple Inc. All other trademarks are property of their respective owners.

**Honeywell**



# MPA2 ACCESS CONTROL PANEL

SPECIFICATIONS		
	SPECIFICATIONS	MPA1002E(U)MPS
LEDs	Status LEDs	12 LEDs total (13,8V Power, PoE, Battery Ready, Over Current, Ethernet, RS-485, Reader(s), Door State, Run, Relay Status, Wiegand Comm. OSPD Comm)
Host	Software Compatibility <sup>(1)</sup>	MAXPRO® Cloud, WIN-PAK® XE/SE/PE/CS, Web Services
	MPA2 as Primary Panel	Supported Downstream Panels include MPA2 and NetAXS123 <sup>(2,3)</sup>
	NetAXS123 as Primary Panel	Supported Downstream Panels include MPA2 and NetAXS123 only <sup>(2,3)</sup>
Door Control	Door Control Modes	Card only; Card and PIN; Card or PIN; PIN only; Lockdown; Disabled; Supervisor; Escort; Limited use card; Expire on date; First Card Rule; Snow Day Rule; Time Zone Toggle; Anti-Passback; Duress <sup>(4)</sup>
	Interlocks For Customer Actions	Yes
	Anti-Passback Capability	Local and Global Capability; Hard and Soft Implementation
Cards and Database	Card and Event Buffer Capacity	Panel = 100,000 / Solution = Host dependant
	Firmware Revision	On-board Flash Memory for Field Firmware Revision Updates and Feature Expansion
	Offline Database Backup Available	Card and Configuration Databases
	Export Capabilities	Card Database; Alarms and Events (CSV format) <sup>(4)</sup>
	Number of Card Formats	128 unique card formats can be supported <sup>(4)</sup>
	Site Codes	8
	Maximum Card Format Size	75-bit (maximum card # = 64-bits) <sup>(4,5)</sup>
	Time Zones	127 <sup>(4)</sup>
	Access Levels	Panel = 65535 / Solution = Host dependant
	Holidays	255 <sup>(4)</sup>
Reporting and Analysis	Integrated Basic Reports	Yes
	Import/Export of Card Database	Yes
	Alarm/Event Export	Yes
Web	Supported Browsers	Google Chrome (preferred)

(1) Software compatibility for MPA2: All MPA2 versions programmed as NetAXS123; WIN-PAK® SE; WIN-PAK® PE; WIN-PAK® PRO CS; WIN-PAK® CS 4.80 or greater.

(2) RS-485 panel loop: A total of 9 (8+1) MPA2 (version 1.0.3.37 or higher) and NetAXS123 (version 3.04.15 or higher) panels may be combined in a controller loop. NetAXS-4 panels cannot be used with an EVL.

(3) When mixing MPA2 and NetAXS123 controllers, MPA2 must be the Primary panel and the panel loop must be RS-485.

(4) When using WIN-PAK® software, this feature may have limitations.

(5) Suitable for handling the 75-bit transparent card format of PIV, TWIC, and FRAC cards.

# OmniClass™ 2.0



## Contactless Smart Card Readers

OmniClass™ from Honeywell is a range of 13.56 MHz contactless secure smart card readers that offers superb reliability, consistent read range and ease of installation. They are available in several sizes and each OmniClass reader incorporates smart card technology allowing the user to support biometric profiles and multiple applications on each card simultaneously.

OmniClass can retro-fit any Wiegand output reader, including standard HID® or Honeywell proximity readers.

Smart card technology is ideally suited for access control, logical (PC) access, storage of biometric templates, parking, secure ID's with embedded tamper-proof digital photos, ePurse and many other applications requiring secure and reliable read/write cards.

### Multi Technology Functionality

To make it easier for customers to transition to a smart card system from a 125 kHz prox card system, the range includes options that can support HID Prox, EM4102 and AWID proximity technologies. These multi-technology readers work with all technologies simultaneously and will allow the user to transition to smart cards over time while incorporating the use of multiple card technologies within a single building or across multiple facilities.

In addition, the OmniClass reader range provides enhanced security through mutual authentication and data encryption when using the smart card credential based on the encrypted contactless communication. Whether reading proximity, OmniClass or multi-technology cards, identical user identification data formats are sent to the panel, keeping the data on the card transparent to the user.

### The OmniClass reader range benefits include:

**Suitable for integrated access control systems:** A fast response time between two consecutive card reads makes it suitable for integrated access control and intrusion systems where a triple swipe action at the reader is needed to arm the system.

**More Open:** OmniClass 2.0 readers support global 13.56 MHz smart card technology standards including OmniClass, OmniClass 2.0, iCLASS®, iCLASS SR™/SE®, iCLASS® Seos™ as well as MIFARE Classic\* and MIFARE DESFire EV1\*. Optionally 125 kHz Prox technology is supported including HID® Prox, EM4102 and AWID

**More Secure:** Card numbers for OmniClass/iClass credentials are safely stored and transmitted using 64-bit authentication keys encryption, which is suitable for most access control applications. A higher level of security can be achieved using the AES encrypted iClass SE/ iCLASS Seos and MIFARE DESFire EV1 credentials. Additional keypad versions are available for dual authentication.

**Convenience:** Card numbers are printed on the OmniClass cards/credentials. MIFARE Card Serial Numbers (CSN) also supported. Interoperability between vendors & applications is possible via the smart card's accessible memory.

**Easy to install:** Two piece installation, only mounting plate and reader. Wiegand output for new and retrofit installations, indoor and outdoor.

**Simple transition from 125 kHz PROX to OmniClass smart cards:** Multi technology OmniClass readers make it easy for a HID Prox, EM4102 or AWID card based technology system to transition to an OmniClass smart card based solution.

## FEATURES

- Supports multiple ISO standards: Allows OmniClass 2.0 to read most ISO standard smart card.
- Custom MIFARE Classic and MIFARE DESFire EV1 optionally available
- High-Security: Encrypted data exchange available between card and reader and between reader and host reduces the risk of compromised data and duplicated cards.
- Available in mullion, switch plate and wall-mount sizes
- ADA compliant built-in audible beeper
- Host LED control (programmable)
- Control cards (optional) can be used to manage security keys and change the operating characteristics of the reader
- Hidden mounting screws deter vandalism
- Potted for superior weather resistance
- Wiegand output
- Reads HID Prox, EM4102 and AWID and OmniClass credentials (Multi technology models only)
- Ideal solution for card technology transition (Multi technology models only)

\* Note about MIFARE Classic and MIFARE DESFire EV1 technologies.

The OmniClass 2.0 reader range is by default compatible with HID® SE for MIFARE and HID SE for DESFire EV1 credentials.

Optionally it is possible to configure the OmniClass 2.0 readers with custom user defined keys MIFARE Classic and MIFARE DESFire EV1.

# OmniClass™ 2.0

## Contactless Smart Card Readers

### SPECIFICATIONS

#### SMART CARD READERS



Part Number	OM15BHOND OM15BHONDT	OM30BHOND OM30BHONDT	OM40BHOND OM40BHONDT	OM45BHOND OM45BHONDT	OM55BHOND OM55BHONDT
Mounting	Large Mullion Size suited for mullion-mounted door installations or any flat surface	Mullion Size suited for mullion-mounted door installations or any flat surface	Wall Switch Size designed to mount and cover single US gang switch boxes primarily used in the Americas and includes a slotted mounting plate for European and Asian back box spacing	EU / APAC Square Size 83.8 mm (3.3") square reader is designed to mount to and cover standard European and Asian back boxes	Wall Switch Size designed to mount and cover single gang switch boxes primarily used in the Americas and includes a slotted mounting plate for European and Asian back box spacing
Keypad	No				Yes
Housing Colour	Black				
Dimensions (W x H x D)	4.8 x 15.3 x 2.3 cm 1.9" x 6.0" x 0.9"	4.8 x 10.3 x 2.3 cm 1.9" x 4.1" x 0.9"	8.4 x 12.2 x 2.4 cm 3.3" x 4.8" x 1.0"	8.4 x 8.4 x 2.3 cm 3.3" x 3.3" x 0.9"	8.5 x 12.2 x 2.8 cm 3.3" x 4.8" x 1.1"
Typical Read Ranges *					
OmniClass/iCLASS credential	7.6 cm / 3.0"	7.6 cm / 3.0"	11.4 cm / 4.5"	8.9 cm / 3.5"	12.7 cm / 5.0"
2k/16k Smart (OKP0.../ OKP2...)	7.6 cm / 3.0"	7.6 cm / 3.0"	11.4 cm / 4.5"	8.9 cm / 3.5"	12.7 cm / 5.0"
iClass SE credential	3.2 cm / 1.25"	3.2 cm / 1.25"	4.4 cm / 1.75"	5.1 cm / 2.0"	4.4 cm / 1.75"
Key/tag Smart(PXKEYH.../OKS...)					
<b>MIFARE / DESFire credential</b>					
SE for MIFARE Classic ISO card	5.7 cm / 2.25"	5.7 cm / 2.25"	8.9 cm / 3.5"	7.6 cm / 3.0"	11.4 cm / 4.5"
SE for MIFARE Classic Key/tag	1.3 cm / 0.5"	1.3 cm / 0.5"	3.8 cm / 1.5"	3.8 cm / 1.5"	3.8 cm / 1.5"
SE for DESFire EV1 ISO card	5.1 cm / 2.0"	5.1 cm / 2.0"	8.3 cm / 3.25"	5.1 cm / 2.0"	5.7 cm / 2.25"
Smart Card Compatibility	15693: Reads iClass/OmniClass credentials, card serial number 14443B: Reads iClass/OmniClass credentials (secure)				
Additional ISO support	14443A 1-3: Reads NXP MIFARE Classic credentials, Sector 14443A 1-4: Reads NXP MIFARE DESFire EV1 credentials, AES Encrypted files 14443A: Reads NXP MIFARE Classic, DESFire EV1 credentials, Card Serial Number (CSN or UID)				
Key Length	iClass/OmniClass 64 bit encryption iClass SE / iCLASS Seos 128 bit AES Encryption SE for MIFARE Classic / SE for DESFire EV1 128 bit AES Encryption				
Data Encryption	Available between card and reader (OmniClass and iClass) Additionally on credential (SE for MIFARE Classic and MIFARE DESFire EV1)				
Crypto Processor Hardware Common Criteria Rating	EAL5+				
Regulatory Approvals	UL294/cUL (US), FCC Certification (US), IC (Canada), CE (EU), C-tick (Australia, New Zealand), SRRR (China), KC (Korea), NCC (Taiwan), iDA (Singapore)				
Operating Temperature	-31° to 150° F (-35° to 65° C)				
Operating Humidity	5 to 95% relative humidity (non-condensing)				
Operating Voltage Range	5 - 16 VDC				
Current	60mA	60mA	65mA	65mA	85mA
Normal standby current	90mA	90mA	90mA	90mA	100mA
Maximum average current					
Termination	9 wire 45 cm Pigtail (D- version) or 9 wire terminal block (DT-version)				
Tamper Output	Available (Optical sensor)				
Hold Wire input	Yes				
Panel Interfaces	(all built-in) Wiegand				
IP Rating	IP55				
Warranty**	Limited Lifetime				

\* Typical read range achieved in air. Different types of metal will cause some degradation.

\*\*See Honeywell Security Group's Sales Policy for complete details.

## OmniClass™ 2.0

Contactless Smart Card Readers

### SPECIFICATIONS

#### SMART CARD AND 125 kHz PROX MULTI TECHNOLOGY READERS



Part Number	OM16BHOND OM16BHOND T	OM31BHOND OM31BHOND T	OM41BHOND OM41BHOND T	OM46BHOND OM46BHOND T	OM56BHOND OM56BHOND T
Mounting	Large Mullion Size suited for mullion-mounted door installations or any flat surface	Mullion Size suited for mullion-mounted door installations or any flat surface	Wall Switch Size designed to mount and cover single US gang switch boxes primarily used in the Americas and includes a slotted mounting plate for European and Asian back box spacing	EU / APAC Square Size 83.8 mm (3.3") square reader is designed to mount to and cover standard European and Asian back boxes	Wall Switch Size designed to mount and cover single gang switch boxes primarily used in the Americas and includes a slotted mounting plate for European and Asian back box spacing
Keypad	No				Yes
Housing Colour	Black				
Dimensions (W x H x D)	4.8 x 15.3 x 2.3 cm 1.9" x 6.0" x 0.9"	4.8 x 10.3 x 2.3 cm 1.9" x 4.1" x 0.9"	8.4 x 12.2 x 2.4 cm 3.3" x 4.8" x 1.0"	8.4 x 8.4 x 2.3 cm 3.3" x 3.3" x 0.9"	8.5 x 12.2 x 2.8 cm 3.3" x 4.8" x 1.1"
Typical Read Ranges * OmniClass/iCLASS credential 2k/16k Smart (OKP0.../ OKP2...) iClass SE credential Key/tag Smart(PXKEYH.../OKS...)	6.4 cm / 2.5" 6.4 cm / 2.5" 2.5 cm / 1.0"	6.4 cm / 2.5" 6.4 cm / 2.5" 2.5 cm / 1.0"	11.4 cm / 4.5" 11.4 cm / 4.5" 5.7 cm / 2.25"	8.3 cm / 3.25" 8.3 cm / 3.25" 3.8 cm / 1.5"	11.4 cm / 4.5" 11.4 cm / 4.5" 5.7 cm / 2.25"
MIFARE / DESFire credential SE for MIFARE Classic ISO card SE for MIFARE Classic Key/tag SE for DESFire EV1 ISO card	5.7 cm / 2.25" 1.3 cm / 0.5" 2.5 cm / 1.0"	5.7 cm / 2.25" 1.3 cm / 0.5" 2.5 cm / 1.0"	10.2 cm / 4.0" 3.8 cm / 1.5" 5.1 cm / 2.0"	5.7 cm / 2.25" 2.5 cm / 1.0" 5.1 cm / 2.0"	10.2 cm / 4.0" 3.8 cm / 1.5" 5.1 cm / 2.0"
Proximity credential (125kHz) HID Prox / AWID ISO Card HID Prox / AWID Key/tag EM4102 ISO Card	5.1 cm / 2.0" 2.5 cm / 1.0" 8.9 cm / 3.5"	5.1 cm / 2.0" 2.5 cm / 1.0" 8.9 cm / 3.5"	6.4 cm / 2.5" 3.8 cm / 1.5" 10.2 cm / 4.0"	5.7 cm / 2.25" 3.2 cm / 1.25" 5.1 cm / 2.0"	6.4 cm / 2.5" 3.8 cm / 1.5" 7.6 cm / 3.0"
Smart Card Compatibility	15693: Reads iClass/OmniClass credentials, card serial number 14443B: Reads iClass/OmniClass credentials (secure)				
Additional ISO support	14443A 1-3: Reads NXP MIFARE Classic credentials, Sector 14443A 1-4: Reads NXP MIFARE DESFire EV1 credentials, AES Encrypted files 14443A: Reads NXP MIFARE Classic, DESFire EV1 credentials, Card Serial Number (CSN or UID)				
125kHz proximity compatibility	HID Prox, AWID and EM4102				
Key Length	iClass/OmniClass 64 bit encryption iClass SE / iCLASS Seos 128 bit AES Encryption SE for MIFARE Classic / SE for DESFire EV1 128 bit AES Encryption				
Data Encryption	Available between card and reader (OmniClass and iClass) Additionally on credential (SE for MIFARE Classic and MIFARE DESFire EV1)				
Crypto Processor Hardware Common Criteria Rating	EAL5+				
Regulatory Approvals	UL294/cUL (US), FCC Certification (US), IC (Canada), CE (EU), C-tick (Australia, New Zealand), SRRC (China), KC (Korea), NCC (Taiwan), iDA (Singapore)				
Operating Temperature	-31° to 150° F (-35° to 65° C)				
Operating Humidity	5 to 95% relative humidity (non-condensing)				
Operating Voltage Range	5 - 16 VDC				
Current					
Normal standby current	75mA	75mA	85mA	85mA	95mA
Maximum average current	100mA	100mA	100mA	100mA	105mA
Termination	9 wire 45 cm Pigtail (D- version) or 9 wire terminal block (DT-version)				
Tamper Output	Available (Optical sensor)				
Hold Wire input	Yes				
Panel Interfaces	(all built-in) Wiegand				
IP Rating	IP55				
Warranty**	Limited Lifetime				

\* Typical read range achieved in air. Different types of metal will cause some degradation.

\*\* See Honeywell Security Group's Sales Policy for complete details.

# OmniClass™ Credentials

## Credentials for Contactless Smart Card Readers



Honeywell's OmniClass™ credentials are designed to work with the OmniClass readers. The OmniClass product line, built on 13.56MHz technology, is RFID based and provides excellent contactless sensing range (up to 4.5").

The OmniClass cards are laminated PVC cards that can be printed on both sides using a dye-sublimation or thermal transfer card printer. They can also be slot-punched on the short side for vertical orientation (portrait).

In addition to OmniClass cards, key fobs and stickers are also available. The rugged, molded key fobs include a slot for use with most key rings or badge clips. The stickers are thin, flat polycarbonate discs that have an industrial adhesive backing.

The stickers are non-removable and can be affixed to the back of existing 125kHz proximity, Wiegand or magnetic stripe access cards, non-metallic surfaces of PDA's, cellular phones, briefcases and other personal items.

OmniClass credentials are stocked in popular configurations. Special orders can be placed when the user needs to choose site code and card numbers and custom card orders are also available.

Honeywell can help you create a custom credential that meets your aesthetic and anti-counterfeiting needs. Anti-counterfeiting options include ultra-violet (UV) fluorescent inks, holograms and corporate logos.

## FEATURES

- Multi-technology card configurations are available to help plan migrations and support multiple systems such as OmniClass and HID Prox on the same card.
- Available in 2K-bit and 16K-bit sizes. The 2K-bit size is for access only while the 16K-bit size will support access and other applications.
- The ability to program the credentials in the factory or field.
- The ability to locally store biometric templates on the credential to protect privacy, increase system throughput, and eliminate template maintenance time in local readers.
- Custom options include: custom artwork, UV ink, surface or embedded hologram and an added contact smart chip module.
- Upgrade to OmniClass by adding a sticker to existing 125kHz proximity, Wiegand or magnetic stripe cards.



# OmniClass™ Credentials

Credentials for Contactless Smart Card Readers

## SPECIFICATIONS

	OmniClass 2K & 16K Bits PVC Cards	OmniClass + HID Prox Cards	OmniClass Embeddable Cards <sup>1</sup>	OmniClass Embeddable + HID Prox Cards <sup>1</sup>	OmniClass + Wiegand Cards <sup>1</sup>	OmniClass Key Fobs	OmniClass Stickers <sup>2</sup>
<b>Dimensions</b>	2.125" W x 3.370" H x 0.030" T (5.4cm W x 8.6cm H x 0.076cm T)				2.125" W x 3.370" H x 0.037" T (5.4cm W x 8.6cm H x 0.094cm T)	1.25" W x 1.35" H (3.2cm W x 3.4cm H) x 0.15" T (0.38cm)	1.285" D x 0.070" T (32mm D x 1.78mm T)
<b>Finish</b>	Gloss White					Black	White
<b>Credential Construction</b>	PVC Laminate					Polycarbonate	Lexan
<b>Max Read Range<sup>3</sup></b>							
OM30 Mullion	2.0"-3.0" (5.0 - 7.6cm)	1.0"-1.5" (2.5 - 3.8cm)	2.0"-3.0" (5.0 - 7.6cm)	1.0"-1.5" (2.5 - 3.8cm)	2.0"-3.0" (5.0 - 7.6cm)	1.0" (2.5cm)	1.0" (2.5cm)
OM40 US Single Gang	2.5"-4.5" (6.3 - 11.4cm)	1.5"-2.0" (3.8 - 5.0cm)	2.5"-4.5" (6.3 - 11.4cm)	1.5"-2.0" (3.8 - 5.0cm)	2.5"-4.5" (6.3 - 11.4cm)	1.0" (2.5cm)	1.0" (2.5cm)
OM45 Euro/Asian Single Gang	2.0"-3.0" (5.0 - 7.6cm)	1.5"-2.0" (3.8 - 5.0cm)	2.0"-3.0" (5.0 - 7.6cm)	1.5"-2.0" (3.8 - 5.0cm)	2.0"-3.0" (5.0 - 7.6cm)	1.0" (2.5cm)	1.0" (2.5cm)
OM55 Keypad	3.0"-4.0" (7.6 - 10.1cm)	1.5"-2.5" (3.8 - 6.3cm)	3.0"-4.0" (7.6 - 10.1cm)	1.5"-2.5" (3.8 - 6.3cm)	3.0"-4.0" (7.6 - 10.1cm)	1.0"-1.5" (2.5 - 3.8cm)	1.0"-1.5" (2.5 - 3.8cm)
<b>ISO Standards</b>							
ISO 7810	Yes	Yes	Yes	Yes			
ISO 7811-2,4,5	Yes	Yes	Yes	Yes	Yes		
ISO 7816-1,2			Yes	Yes			
ISO 10373-1	Yes	Yes	Yes	Yes	Yes		
ISO 14443B <sup>4</sup>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ISO 15693	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>Operating Temperature</b>	-40° - 158° F (-40° - 70° C)						
<b>Operating Humidity</b>	5-95%, non-condensing						
<b>Warranty</b>	Limited lifetime warranty <sup>5</sup>						

## ORDERING

<b>OKP0N26</b>	2K bits PVC Card - 26 bit format
<b>OKP0N34</b>	2K bits PVC Card - 34 bit format
<b>OKP2N26</b>	16K bits* PVC Card - 26 bit format
<b>OKP2N34</b>	16K bits* PVC Card - 34 bit format
<b>OKP2M26</b>	16K bits* PVC + Magnetic Stripe Card - 26 bit format
<b>OKP2M34</b>	16K bits* PVC + Magnetic Stripe Card - 34 bit format
<b>OKH2N26</b>	16K bits* PVC + HID Prox - 26 bit format
<b>OKH2N34</b>	16K bits* PVC + HID Prox - 34 bit format
<b>OKH2M26</b>	16K bits* PVC + HID Prox + Magnetic Stripe - 26 bit format
<b>OKH2M34</b>	16K bits* PVC + HID Prox + Magnetic Stripe - 34 bit format
<b>OKK2N26</b>	16K bits* Key Fob - 26 bit format
<b>OKK2N34</b>	16K bits* Key Fob - 34 bit format
<b>OXS2N26</b>	16K bits* Sticker - 26 bit format
<b>OXS2N34</b>	16K bits* Sticker - 34 bit format

\* 16 Application Areas

<sup>1</sup> Offered as custom cards currently.

<sup>2</sup> OmniClass stickers may not be applied to other 13.56MHz smart cards. The RFID from the card and the sticker will interfere with each other if they are both the same frequency.

<sup>3</sup> Actual operating distance will vary depending upon installation environment and proximity to metal.

<sup>4</sup> Only credentials with 16K-bits or more memory are ISO 14443B compliant.

<sup>5</sup> See Honeywell's Sales Policy for complete warranty details.

OmniClass is a trademark of Honeywell International Inc.  
HID is a registered trademark of HID corporation.

For more information: [www.honeywellaccess.com](http://www.honeywellaccess.com)

### Honeywell Systems Group

135 W. Forest Hill Avenue  
Oak Creek, WI 53154  
414-766-1700  
414-766-1798 Fax

### European Office

Böblinger Straße 17  
D-71101 Schönaich  
Germany  
49-7031-637-782  
49-7031-637-769 Fax  
[www.honeywell.com](http://www.honeywell.com)

7-501142 revA  
September 2005  
©2005 Honeywell International Inc.



# LOBBYWORKS®

## Visitor Management Suite Version 4.1



The LobbyWorks Visitor Management Suite enhances your investment in access control and perimeter security by providing a simple and effective way to register, badge and track visitors. It gives you the ability to generate detailed visitor traffic reports and enforce visitor/contractor security policies.

Power and flexibility make LobbyWorks a natural fit for small single-site deployments using the Express Edition or regional WAN-based network deployments using the Premier Edition. System offerings allow you to tailor your visitor management system to best meet your needs.

- Front Desk – register and track visitors
- Reporter – generate reports
- Administrator – control security policies
- Scheduler – coordinate and execute automation activities
- Badge Pre-print – pre-prints badges

The Premier Edition supports optional add-ons as your system grows.

- LobbyWorks Kiosk – self-registration station for visitors
- LobbyWorks Web Center – employees pre-register visitors
- Notify – host notification upon visitor's arrival

Visitor registration is quick and simple and can be performed either at a guard station or using an optional self-registration kiosk. LobbyWorks scans the photo ID or business card of an arriving visitor, then instantly checks whether the visitor is expected or has been in the facility before and makes sure the visitor is not on a watch list. These quick and consistent checks ensure that only the right people are allowed on site. After scanning the information, LobbyWorks takes a digital photo or captures the visitor's signature.

LobbyWorks can automatically contact the visitor's host by email or with real time network messaging to announce the visit. Once the visitor is registered, an individualized badge is generated. Specific visit restrictions may be set, such as clearance level, access area or visit expiry time.

At the end of the visit, LobbyWorks signs out the visitor. If the visitor does not sign out, LobbyWorks can contact the host to check if the visitor has left the site.

This simple yet powerful visitor registration process forms the basis of a very powerful security platform. Registering all visitors through LobbyWorks ensures that you have a centralized and complete record of your visitor traffic, strengthens visitor security, and improves productivity and service to your customers.

## FEATURES AND BENEFITS

### PRE-REGISTRATION

- Entry into system by lobby receptionist
- Outlook® vCalendar integration via POP31
- Web Center add-on for pre-registration by hosts<sup>(1,2)</sup>
- Bar code on email pre-registration notification sent to visitor can be scanned at the kiosk for fast processing

### REGISTRATION

- Process most visitors in 20 seconds or less
- Capture visitor's photo and/or signature
- Scan arriving visitor's photo ID or business card
- Print professional color visitor passes with expiration date, visit area, host, and purpose of visit
- Issue Pro-Watch® access control raids

### HOST LIST

- Entry into system by administrator or lobby receptionist
- Integration with Active Directory<sup>(1)</sup>
- Integration with Pro-Watch

(1) Premier Edition only

(2) Sold separately

# LOBBYWORKS® SYSTEM MINIMUM REQUIREMENTS

LOBBYWORKS CLIENT	
FEATURE	REQUIREMENT
Recommended Processor	Intel Pentium IV or equivalent
PC Model Used for Testing	DELL Optiplex GX280
Recommended Operating System <sup>(3)</sup>	Windows server 2003/2008 1 standard, Windows XP Editions, Windows 7 Editions. (32 and 64 bit)
Recommended PC Type (Server or Workstation)	Workstation or Server
Recommended System Memory (RAM) <sup>(2)</sup>	2 GB for Windows XP SP3, 4 GB for other OS
CD and DVD Drive	Yes
Hard Drives	Capacity: 40 GB Software: Windows Operating System, Microsoft Office software
USB Connection	2.0
Network Connection	100 Mbits/sec or greater
Video Resolution	1024x768 pixels; 24-bit color or higher
Multimedia	Standard VGA Graphics Adapter [Display adapter]

(1) Windows Server 2003/2008 is supported for Administrator and Scheduler only.

(2) Includes RAM required by the client machine to run the Windows operating system.














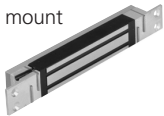
(3) Consult Microsoft® for operating system and database license terms.

MAGNETIC LOCKS



FEATURES

- COMPATIBLE WITH ALL ACCESS/EGRESS SYSTEMS
- ALUMINUM / STAINLESS CASINGS ARE WEATHER AND VANDAL RESISTANT
- SELECTABLE 12V/24V DC OPERATION
- ON BOARD MOV'S PROVIDE PROTECTION AGAINST VOLTAGE SPIKES AND SURGES
- ASSORTED MOUNTING BRACKETS AND FILLER PLATES AVAILABLE

ITEM	MODEL	DESCRIPTION	CURRENT DRAW	DIMENSIONS
<b>1200 LBS. SURFACE MOUNT SINGLE DOOR</b>  	<b>CX-91S-12</b>	Basic	500 mA @12V 250 mA @24V	10 1/2" x 2 7/8" x 1 7/8" (267mm x 73mm x 48mm)
	<b>CX-91S-12TDS</b>	c/w Adjustable Timer, Lock Sensor, Door Status Switch, Relay & LED		
<b>1200 LBS. SURFACE MOUNT DOUBLE DOORS</b>  	<b>CX-92S-12</b>	Basic	2 x 500 mA @12V 2 x 250 mA @24V	21" x 2 7/8" x 1 7/8" (533mm x 73mm x 48mm)
	<b>CX-92S-12TDS</b>	c/w Adjustable Timer, Lock Sensor, Door Status Switch, Relay & LED		
<b>600 LBS. SURFACE MOUNT SINGLE DOOR</b>  	<b>CX-91S-06</b>	Basic	500 mA @12V 250 mA @24V	9 7/8" x 1 7/8" x 1" (251 mm x 48 mm x 25 mm)
	<b>CX-91S-06TDS</b>	c/w Adjustable Timer, Lock Sensor, Door Status Switch, Relay & LED		
<b>600 LBS. SURFACE MOUNT DOUBLE DOORS</b>  	<b>CX-92S-06</b>	Basic	2 x 500 mA @12V 2 x 250 mA @24V	19 5/8" x 1 7/8" x 11/16" (498mm x 48mm x 17mm)
	<b>CX-92S-06TDS</b>	c/w Adjustable Timer, Lock Sensor, Door Status Switch, Relay & LED		
<b>600 LBS. MORTISE MOUNT SINGLE DOOR</b>  	<b>CX-91M-06</b>	Basic	480 mA @12V 240 mA @24V	9" x 1 1/2" x 1 1/8" (229mm x 38mm x 29mm)
	<b>CX-91M-06TLS</b>	c/w Adjustable Timer & Lock Sensor/Relay		
<b>300 LBS. SURFACE MOUNT SINGLE DOOR</b> 	<b>CX-90S-03</b>	Basic	360 mA @12V 180 mA @24V	6 1/2" x 1 3/8" x 13/16" (165mm x 35mm x 21mm)
<b>300 LBS. MORTISE MOUNT SINGLE DOOR</b> 	<b>CX-90M-03</b>	Basic	360 mA @12V 180 mA @24V	8" x 1 3/8" x 13/16" (203mm x 35mm x 21mm)
<b>1200 LBS. SURFACE MOUNT GATE LOCK</b> 	<b>CX-94S-12LS</b>	c/w Lock Sensor/Relay	500 mA @12V 250 mA @24V	8" x 2 1/2" x 1 5/8" (203mm x 63.5mm x 41.5mm)
<b>2600 LBS. SHEAR LOCK</b> <ul style="list-style-type: none"> <li>• Self aligning</li> <li>• Ultra low current draw</li> <li>• Compact mortise mount</li> </ul> 	<b>CX-93M-26LS</b>	c/w Lock Sensor/Relay	480 mA @12V 240 mA @24V	9 1/16" x 1 1/4" x 1 1/16" (230mm x 32mm x 27mm)

ELECTRIC STRIKES

CABINET LOCKS

MAGNETIC LOCKS

DOOR ALARMS

RELAYS & TIMERS

TRANSFORMERS & POWER SUPPLIES

ANNUNCIATORS

# 9500 SERIES

9500 Series Micro-Switch Bar is a non-latching push bar, designed to be installed on emergency doors to release magnetic locks.

The 9500-36DE Delayed-Egress Micro-Switch Bar can be programmed to release the magnetic lock after 15 or 30 seconds



## STANDARD FEATURES

- Heavy duty aluminum (US28) cover
- 34 1/2" in length, designed for 36" doors
- Double pole micro-switch output
- Special key to lock the push bar in closed or open position

## 9500 SERIES MODELS & PARTS

MODELS	DESCRIPTION	MODELS	DESCRIPTION
<b>9500-36</b>	Micro-Switch Bar US28	<b>9500XPCB</b>	Replacement PC Board
<b>9500-36 Black</b>	Micro-Switch Bar in Black	<b>9500 Cover</b>	Replacement Top Cover
<b>9500-36DE</b>	Micro-Switch Bar with Delayed Egress	<b>9500X99</b>	Replacement End Caps Set (Top & Bottom)

## SPECIFICATION (9500-36)

<b>DEMSIONS</b>	34 1/2" x 2 11/16" x 2 1/4"	<b>SWITCH RATING</b>	5 A/125 VAC
<b>VOLTAGE</b>	12/24 VDC	<b>CONTACTS</b>	NO/COM/NC

ELECTROMAGNETS

ELECTRIC STRIKES

EXIT DEVICES

MISC. ACCESS CONTROL

# NIGHTHAWK® Nighthawk® CM1200 Multi-Gig Speed Cable Modem

## Package Contents

- Nighthawk® Multi-Gig Speed Cable Modem—DOCSIS 3.1 (CM1200)
- Ethernet cable
- Quick install guide
- Power adapter

## Physical Specifications

- Dimensions: 6.1 x 3.4 x 10.3 in (155 x 87 x 261 mm)
- Weight: 1.22 lb (553g)

## Standards

- Four (4) Gigabit Ethernet ports
- One (1) WAN coaxial cable connection

## Technical Specifications

- Simple—CD-less installation
- 32 downstream and 8 upstream QAM channels
- 2 OFDM Downstream channels and 2 OFDMA Upstream channels
- DOCSIS Quality of Service (QoS)

## Advanced Features

- Gigabit Ethernet ports support link aggregation for true Multi-Gig speed
- Backward compatible 32x8 channel bonding in DOCSIS® 3.0 mode
- Supports IPv6
- Gigabit Ethernet ports for faster access and downloads

## Support

- 90-day complimentary technical support following purchase from a NETGEAR authorized reseller
- Join the NETGEAR Community Forum. Visit <http://community.netgear.com>

## System Requirements

- Cable Broadband Internet service
- Please check your Cable Internet Service Provider web site for data speed tier compatibility and to ensure it provides DOCSIS® 3.1 service, otherwise this modem will only work as a DOCSIS® 3.0 modem
- Not compatible with Cable bundled voice services

## Warranty

- NETGEAR 1-year limited warranty
- [www.netgear.com/warranty/](http://www.netgear.com/warranty/)

This product comes with a limited warranty that is valid only if purchased from a NETGEAR authorized reseller.

\*10Gbps is the maximum data transfer rate in the DOCSIS® 3.1 standard. In practice, your Internet speeds will be less, as the transfer rate through the link aggregated CM1200 Gigabit Ethernet ports is limited to 2Gbps. The transfer rate may also be reduced by the volume of network traffic or your service plan. Maximum rate is derived from DOCSIS® 3.1 specifications and actual throughput will vary depending on your Internet subscription with your provider.

\*\*Check the CM1200 product page for the Link aggregation compatible router list.

NETGEAR makes no express or implied representations or warranties about this product's compatibility with any future standards.

Customer-owned modems may not be compatible with certain cable networks. Please check with your cable provider to confirm this NETGEAR modem is allowed on your cable network. This product not compatible with Cable bundled voice services.

For indoor use only.

NETGEAR and the NETGEAR Logo are trademarks of NETGEAR, Inc. Mac, Mac OS and the Mac logo are trademarks of Apple Inc. Any other trademarks mentioned herein are for reference purposes only. ©2019 NETGEAR, Inc.

NETGEAR, Inc. 350 E. Plumeria Drive, San Jose, CA 95134-1911 USA, [www.NETGEAR.com/support](http://www.NETGEAR.com/support)

CM1200-1



## What's In the Box?

- One (1) Orbi Router (RBR850)
- Two (2) Orbi Satellites (RBS850)
- One (1) 2m Ethernet cable
- Three (3) 12V/3.5A power adapters
- Quick start guide

## What Do I Need for Orbi to Work?

- High-speed Internet connection
- Connect to existing modem or gateway

## Software Features

- Orbi Mobile App

## Physical Specifications

- Dimensions: 10 x 7.5 x 2.8 in each
- Weight: 2.87 lb each

## Technical Specifications

- Orbi AX6000 Router and AX6000 Satellites (2400 + 2400 + 1200Mbps)<sup>†</sup>
- Simultaneous Tri-band WiFi
  - Radio 1: IEEE® 802.11b/g/n/ax 2.4GHz—1024-QAM support
  - Radio 2: IEEE® 802.11a/n/ac/ax 5GHz—1024-QAM support
  - Radio 3: IEEE® 802.11a/n/ac/ax 5GHz—1024-QAM support

- MU-MIMO capable for simultaneous data streaming
- Implicit & Explicit Beamforming for 2.4GHz & 5GHz bands
- Processor – Router & Satellites
  - Powerful quad-core 2.2GHz processor
- Memory – Router
  - 512MB NAND flash and 1GB RAM
- Antenna – Router & Satellites (each)
  - Eight (8) high-performance internal antennas with high-power amplifiers
- Ports – Orbi Router
  - Four (4) 10/100/1000Mbps Gigabit Ethernet LAN ports
  - One (1) 2.5Gbps multi-Gigabit Ethernet WAN port
  - WAN link aggregation by using 1Gbps LAN port together with 2.5Gbps WAN port
- Ports – Orbi Satellites (each)
  - Four (4) 10/100/1000Mbps Gigabit Ethernet LAN ports
- Security
  - Comprehensive anti-virus & data theft protection for your PC, Mac® and mobile devices with NETGEAR Armor™
  - Standards-based WiFi Security (802.11i, 128-bit AES encryption with PSK)
  - Guest WiFi Network is easy to setup separate & secure Internet access for guests
- Voice Control
  - Amazon Alexa™
  - The Google® Assistant

This product comes with a limited warranty that is valid only if purchased from a NETGEAR authorized reseller. [www.netgear.com/warranty](http://www.netgear.com/warranty)

\*90-day complimentary technical support following purchase from a NETGEAR authorized reseller.

<sup>†</sup>Maximum wireless signal rate derived from IEEE standard 802.11 specifications. Network conditions and environmental factors, including volume of network traffic, building construction, and network overhead may decrease actual data throughput rate.

<sup>1</sup> NETGEAR Armor™ is free during the trial period. A yearly subscription, after the trial period, protects your connected devices. Visit [www.netgear.com/armor](http://www.netgear.com/armor)

For regulatory compliance information, visit <http://www.NETGEAR.com/about/regulatory>

The country settings must be set to the country where the device is operating.

For indoor use only.

NETGEAR, the NETGEAR Logo, NETGEAR Armor, and Orbi are trademarks of NETGEAR, Inc. Apple and the Apple logo are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc., registered in the U.S. and other countries. Google Play and the Google Play logo are trademarks of Google LLC. Any other trademarks mentioned herein are for reference purposes only. © 2020 NETGEAR, Inc.





<b>Brand</b>	Polk Audio
<b>Color</b>	Black
<b>Speaker Type</b>	Subwoofer, Multi-Room, Bookshelf, Center Channel
<b>Mounting Type</b>	Bookshelf
<b>Speaker Maximum Output Power</b>	100 Watts

#### About this item

- MASSIVE SOUND FROM 15 SPEAKERS – Each bookshelf features a 5.25" driver & a 0.75" tweeter, center has (2) 5.25" driver & a 1" tweeter, and each tower has a 6.5" driver, 1" tweeter & (2) 6.5" Bass Radiators that produce a well-balanced, room-filling sound
- A POWERED SUBWOOFER FOR EXTRA BASS & PUNCH (up to 100 watts) – A 10-inch subwoofer with a uniquely configured directed port provides accurate bass with added depth that brings your music and movies alive. A perfect solution for your small-to-mid size room
- All speakers, including the sub, are equipped with POLK'S PROPRIETARY DYNAMIC BALANCE TECHNOLOGY with wider dispersion & minimal distortions so every listener in the room hears UNSURPASSED THREE-DIMENSIONAL SURROUND SOUND WITH HEART-THUMPING BASS
- Polk speakers are COMPATIBLE WITH MOST HOME THEATER AV RECEIVERS giving you many setup options. Use this 5.1 channel system as is or upgrade to an immersive multi-room setup with 7.1, 9.1 or more channels
- POLK'S UNMATCHED QUALITY AT AN AFFORDABLE PRICE. With these value-priced speakers, you can now enjoy premium acoustics, high quality construction, easy setup and a spectacular theater experience right at home

<b>T Series Specifications</b>			
	<b>T15</b>	<b>T30</b>	<b>T50</b>
<b>Speaker Use</b>	Bookshelf	Center	Floor standing
<b>Driver Complement</b>			
Mid/Woofer	5.25"	5.25"	6.5" Diameter 6.5" Bass Radiator (x2)
Tweeter	0.75"	1" Wave Guide Tweeter	1" Wave Guide Tweeter
<b>Electrical</b>			
Overall Frequency	60Hz - 24kHz	38Hz - 24kHz	38Hz - 24kHz
Crossover	2-way	2-way	2-way
<b>Response</b>			
Lower	-3db Limit 65Hz	-3db Limit 40Hz	-3db Limit 40Hz
Upper	-3db Limit 20kHz	-3db Limit 20kHz	-3db Limit 20kHz
Nominal Impedance	8 ohms	6 ohms	6 ohms
Recommended Watts / Channel	20 - 100 Watts / Channel	20 - 100 Watts / Channel	20 - 100 Watts / Channel
<b>Amplifier Power</b>			
Efficiency	89 dB	90 dB	90 dB
Inputs	5-way binding posts	5-way binding posts	5-way binding posts
Maximum Power Handling	150W	100W	150W
<b>Dimensions</b>			
Cabinet Size	10.625" H x 6.5" W x 7.25" D	6.5" H x 19" W x 8.5" D	36.25" H x 9.25" W x 10.25" D
Mounting Options	Wall mount with integrated key-hole slot	N/A	N/A
Enclosure Type	Vented	Vented	Bass Reflex
Shipping Unit	Pair	Each	Each
Speaker Warranty	5 years parts and labor (original purchaser)	5 years parts and labor (original purchaser)	5 years parts and labor (original purchaser)
Recommended Optional Accessories	30 - 36" speaker stands	N/A	N/A

## SPECIFICATIONS

Model	PSW10	PSW12
Subwoofer Complement	(1) 10" (25.4cm)	(1) 12" (30.5mm)
Overall Freq. Response	35Hz - 200Hz	26Hz - 200Hz
Power Output Dynamic	100 Watts	260 Watts
Power Output RMS	50 Watts	100 Watts
Crossover Frequency	80Hz - 160Hz	60Hz - 160Hz
Magnetic Shielding	No	Yes
Available Finish	Black Oak & Cherry woodgrain	Black Oak & Cherry woodgrain
Dimensions (H"xW"xD") (Hcm x Wcm x Dcm)	14-3/8 x 14 x 16-1/8 36.5 x 35.6 x 41	16-3/8 x 16 x 17-5/8 41.6 x 40.6 x 44.8
Product Weight- Pounds each	26	34
Product Weight- Kilograms	11.7	15.3

For more complete specifications visit [www.polkaudio.com/home](http://www.polkaudio.com/home)

## ESPECIFICAÇÕES

Modelo	PSW10	PSW12
Complemento de subwoofer	(1) 10" (25.4cm)	(1) 12" (30.5mm)
Resposta de freq. geral	35Hz - 200Hz	26Hz - 200Hz
Dinâmica da potência de saída	100 Watts	260 Watts
Potência de saída (RMS)	50 Watts	100 Watts
Frequência de transição	80Hz - 160Hz	60Hz - 160Hz
Blindagem magnética	Não	Sim
Acabamento	Madeira de carvalho escuro e cerejeira	Madeira de carvalho escuro e cerejeira
Dimensões: Em pol. (A x L x P) Em centímetros (A x L x P)	14-3/8 x 14 x 16-1/8 36.5 x 35.6 x 41	16-3/8 x 16 x 17-5/8 41.6 x 40.6 x 44.8
Peso de cada unidade-- Em libras	26	34
Peso de cada unidade-- Em quilos	11.7	15.3

Para obter especificações mais completas, visite [www.polkaudio.com/home](http://www.polkaudio.com/home)

## CARACTÉRISTIQUES TECHNIQUES

Modèle	PSW10	PSW12
Complément haut-parleur d'extrêmes graves	(1) 25.4 cm (10")	(1) 30.5 cm (12")
Réponse globale en fréquence	35Hz - 200Hz	26Hz - 200Hz
Puissance de sortie dynamique	100 Watts	260 Watts
Puissance de sortie efficace	50 Watts	100 Watts
Fréquence de coupure	80Hz - 160Hz	60Hz - 160Hz
Blindage magnétique	Non	Oui
Fini disponible	Imitation chêne noir et cerisier	Imitation chêne noir et cerisier
Dimensions (H" x L" x P") (H cm x L cm x P cm)	14-3/8 x 14 x 16-1/8 36.5 x 35.6 x 41	16-3/8 x 16 x 17-5/8 41.6 x 40.6 x 44.8
Poids du produit- Livres	26	34
Poids du produit- Kilogrammes	11.7	15.3

Vous trouverez des caractéristiques techniques complètes sur le site [www.polkaudio.com/home](http://www.polkaudio.com/home)

## ESPECIFICACIONES

Modelo	PSW10	PSW12
Dotación de subwoofer	(1) 10 plg. (25.4cm)	(1) 12 plg. (30.5mm)
Respuesta general de frecuencias	35Hz - 200Hz	26Hz - 200Hz
Rendimiento de potencia dinámica	100 vatios	260 vatios
Rendimiento de potencia RMS	50 vatios	100 vatios
Frecuencia de crossover	80Hz - 160Hz	60Hz - 160Hz
Blindaje magnético	No	Sí
Acabados disponibles	Apariencia de madera de roble negro y cerezo	Apariencia de madera de roble negro y cerezo
Dimensiones (alto x ancho x prof. en plg.) (alto x ancho x prof. en cm)	14-3/8 x 14 x 16-1/8 36.5 x 35.6 x 41	16-3/8 x 16 x 17-5/8 41.6 x 40.6 x 44.8
Peso del producto- libras c/u	26	34
Peso del producto- Kilogramos	11.8	15.4

Para ver especificaciones más completas visite [www.polkaudio.com/home](http://www.polkaudio.com/home)

## DATI TECNICI

Modello	PSW10	PSW12
Complemento subwoofer	(1) 10" (25.4cm)	(1) 12" (30.5mm)
Risp. frequenza complessiva	35Hz - 200Hz	26Hz - 200Hz
Potenza uscita dinamica	100 Watts	260 Watts
Potenza uscita RMS	50 Watts	100 Watts
Frequenza crossover	80Hz - 160Hz	60Hz - 160Hz
Schermatura magnete	No	Sì
Finitura disponibile	Quercia nera o ciliegio	Quercia nera o ciliegio
Dimensioni (AxLxP in pollici) (AxLxP in cm)	14-3/8 x 14 x 16-1/8 36.5 x 35.6 x 41	16-3/8 x 16 x 17-5/8 41.6 x 40.6 x 44.8
Peso prodotto- libbre ciascuno	26	34
Peso prodotto- chilogrammi	11.7	15.3

Per ottenere le specifiche tecniche complete, visitare il sito [www.polkaudio.com/home](http://www.polkaudio.com/home)

## TECHNISCHE DATEN

Modell	PSW10	PSW12
Subwoofer-Komplement	(1) 10 Zoll (25.4 cm)	(1) 12 Zoll (30.5 cm)
Gesamt- Frequenzgang	35Hz - 200Hz	26Hz - 200Hz
Dynamische Leistung	100 Watts	260 Watts
RMS-Leistung	50 Watts	100 Watts
Crossover-Frequenz	80Hz - 160Hz	60Hz - 160Hz
Magnetische Abschirmung	Nein	Ja
Verfügbare Oberflächen	Eiche schwarz und Kirsch (Folie)	Eiche schwarz und Kirsch (Folie)
Abmessungen (H x B x T, Zoll) (H x B x T, cm)	14-3/8 x 14 x 16-1/8 36.5 x 35.6 x 41	16-3/8 x 16 x 17-5/8 41.6 x 40.6 x 44.8
Produktgewicht- in US-Pfund	26	34
Produktgewicht- kg	11.7	15.3

Ausführliche Daten finden Sie bei [www.polkaudio.com/home](http://www.polkaudio.com/home)

---

## Product information

Color Name:**2 Stations Black**

## Technical Details

---

Product Dimensions	18.29 x 10.92 x 4.83 cm; 498.95 Grams
Item model number	57026
Wireless communication technologies	Wi-Fi
Connectivity technologies	Wireless
Other display features	Wireless
Colour	2 Stations Black
Included Components	No
Item Weight	499 g

---

## Product information

### Technical Details

---

Brand	Epson
Manufacturer	Epson
Place of Business	LONG BEACH, CA, 90806 US
Model Name	HC2200
Mounting Hardware	Projector
Number Of Items	1
Display Technology	LCD
Display Type	LCD
Image Brightness	2700
Aspect Ratio	16:9
batteries required	No
Refresh rate	60 Hz
Contains Liquid Contents	No
Manufacturer	Epson
Parcel Dimensions	41 x 38 x 18 cm; 4.82 Kilograms
ASIN	B08LQR3BF1

## Product information

### Technical Details

---

Brand	VIVO
Manufacturer	VIVO
Model	PS-M-100
Part Number	PS-M-100
Display Technology	DLP/LCD
Standing screen display size	100 Inches
Color Screen	No
Aspect Ratio	16:9
Batteries included	No
batteries required	No
Includes Rechargeable Battery	No
Remote control included?	No
Manufacturer	VIVO
Item model number	PS-M-100
Product Dimensions	241.3 x 12.7 x 12.7 cm; 8.16 Kilograms
ASIN	B00MR57IBK

---



## Product information

Size :40 inch | Style:Android TV

## Technical Details

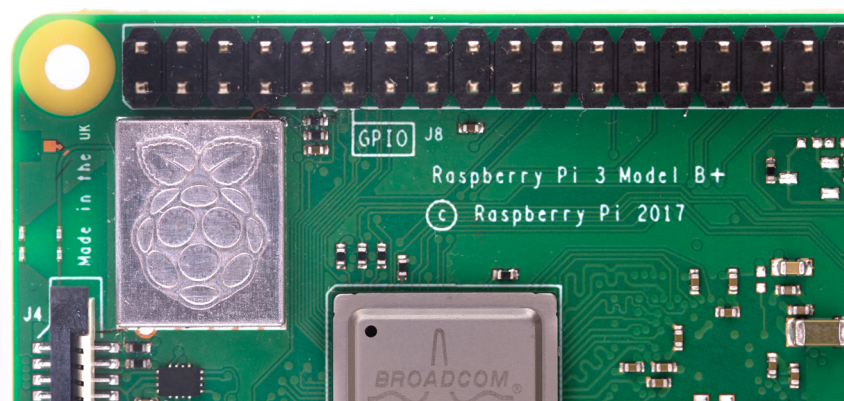
Brand	TCL
Manufacturer	TCL
Model	40S334-CA
Model Year	2021
Part Number	40S334-CA
OS	Android
Hardware interface	HDMI
Scanner Resolution	1080p
Mounting Hardware	Power Cable, Voice Remote Control, Stand
Number Of Items	1
Standing screen display size	40
Display Type	LED
Image Aspect Ratio	16:9
Batteries included	Yes
batteries required	Yes
Battery cell composition	Alkaline
Refresh rate	120 Hz
Connector Type	Bluetooth, USB, Ethernet, HDMI
Contains Liquid Contents	No
Includes Rechargeable Battery	No
Remote control included?	Yes
Manufacturer	TCL
Item model number	40S334-CA
Product Dimensions	18.54 x 90.42 x 57.66 cm; 8.89 Kilograms
ASIN	B08NTR2XL

Motion Type	Tilting
Placement Type	Wall
Max Compatible TV Weight	68 kg
Min TV Size	32 in
Max TV Size	90 in
VESA Compliant	Yes
Mounting Bolt Patterns	100 x 100 to 600 x 400
Minimum Distance from Wall	3.5 cm
Tilt Range (Up/Down)	+12 / 0
Swivel Range (Left/Right)	None
Roll Range (Left/Right)	None
Centering Range (Left/Right)	None
Adjustment Method	Tools Required
Integrated Cable Management	None
UL Certified	Yes
Colour	Black
Primary Material	Steel
Width	68.4 cm
Height	42.5 cm
Depth	3.5 cm
Width (Inches)	26.92 in
Height (Inches)	16.73 in
Depth (Inches)	1.37 in
Weight	3.4 kg

- Accommodates most 32" to 90" flat panel TVs
- 68kg (150lb.) maximum TV weight capacity
- Offers up to 12 degree adjustable forward tilt to enhance the line-of-sight, as well as reduce glare
- Sits just 3.5cm (1.38") from the wall for a low-profile design
- Extra-wide 89cm (35") wall plate designed for up to 40.6cm (16") and 61cm (24") stud spacing
- Two adjustable screws let you level your TV after installation
- Torx screws allow you to lock your TV in place to prevent theft
- Quick release cords make removing TV when unlocked simple and easy
- Constructed from solid steel with a powder-coated finish for optimal strength and durability
- Includes all the hardware needed for wood stud and concrete installations

# Specifications

<b>Processor:</b>	Broadcom BCM2837B0, Cortex-A53 64-bit SoC @ 1.4GHz
<b>Memory:</b>	1GB LPDDR2 SDRAM
<b>Connectivity:</b>	<ul style="list-style-type: none"><li>■ 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE</li><li>■ Gigabit Ethernet over USB 2.0 (maximum throughput 300Mbps)</li><li>■ 4 × USB 2.0 ports</li></ul>
<b>Access:</b>	Extended 40-pin GPIO header
<b>Video &amp; sound:</b>	<ul style="list-style-type: none"><li>■ 1 × full size HDMI</li><li>■ MIPI DSI display port</li><li>■ MIPI CSI camera port</li><li>■ 4 pole stereo output and composite video port</li></ul>
<b>Multimedia:</b>	H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics
<b>SD card support:</b>	Micro SD format for loading operating system and data storage
<b>Input power:</b>	<ul style="list-style-type: none"><li>■ 5V/2.5A DC via micro USB connector</li><li>■ 5V DC via GPIO header</li><li>■ Power over Ethernet (PoE)–enabled (requires separate PoE HAT)</li></ul>
<b>Environment:</b>	Operating temperature, 0–50 °C
<b>Compliance:</b>	For a full list of local and regional product approvals, please visit <a href="http://www.raspberrypi.org/products/raspberry-pi-3-model-b+">www.raspberrypi.org/products/raspberry-pi-3-model-b+</a>
<b>Production lifetime:</b>	The Raspberry Pi 3 Model B+ will remain in production until at least January 2023.



## Product information

Size :FHD | Color Name:8GB Full HD Video 10-Pack

## Technical Details

Brand	Gigastone
Manufacturer	Gigastone
Part Number	GST- Full HD
RAM	8 GB
Memory storage capacity	8 GB
Digital Storage Capacity	8 GB
Hardware interface	MicroSD
Batteries included	No
batteries required	No
Manufacturer	Gigastone
Manufacturer reference	GST- Full HD
Parcel Dimensions	18.4 x 11.8 x 0.7 cm; 20 Grams
ASIN	B0876H387X

OP-RHF-STD, OP-RLF-STD  
 OP-RHF-MULB, OP-RLF-MULB  
 Standard and Mullion Smart Readers



### HF Door Reader

#### Card Compatibility

- Openpath DESFire EV2
- MIFARE Classic/DESFire/Ultralight (ISO14443A) CSN

### LF Door Reader

#### Card Compatibility

- Openpath Proximity
- HID® Proximity
- LenelProx®

	HF Reader	LF Reader
Cloud Managed	Yes	Yes
Form	Standard, Mullion	Standard, Mullion
Color	Black, White*	Black, White*
Frequency	13.56 MHz	125 kHz
Openpath Bluetooth	Yes	Yes
NFC	Yes	No
Wave to Unlock/Touch	Yes	Yes
Auto Proximity Unlock	Yes	Yes
Openpath Prox Cards/Fobs	No	Yes
HID® Prox	No	Yes
LenelProx®	No	Yes
Openpath DESFire EV2	Yes	No
MIFARE/DESFire (CSN)	Yes	No
Standards	ISO 14443A	Prox
Certification	FCC, UL 294, CE	FCC, UL 294, CE
Environmental	IP65	IP65

\*White only available for Standard Smart Readers

### Features

- Snap-on faceplate (standard reader only)
- Modern design, can seamlessly blend into or upgrade the aesthetics of any entry
- Indoor/outdoor design
- Supports auxiliary Wiegand readers connected through the Openpath reader
- Functions seamlessly with the mobile application
- Available on both Android and iOS
- Integrates with Smart Watches in addition to the mobile app
- Supports remote unlocking with user-level privileges
- Lifetime warranty

### Installation

- Easy installation via RS-485 wiring, compatible with legacy Wiegand wiring, to the Openpath Smart Hub access control unit (ACU). Wiring details:

PIGTAIL color	Name (short)	Name (full)	
Gray	GND	Ground (RTN)	Primary ACU Connections
Blue	+B	RS485-B	
Violet	-A	RS485-A	
Orange	VIN	+12V IN	
Red	VO	Wiegand Voltage	Connections to Auxiliary Wiegand Reader
Black	GND	Wiegand RTN	
Green	WD0	Wiegand Data 0	
White	WD1	Wiegand Data 1	
Brown	LED	Wiegand LED	
Yellow	BUZZER	Wiegand Buzzer	

Temperature should not exceed -22°F to 140°F (-30°C to 60°C)

### Security

- Fully encrypted communication between mobile app and ACU
- Fully encrypted communication between Openpath key cards and reader
- Eliminates the threat of copying or cloning Openpath key cards

### System Compatibility

- Reader works with Openpath Access System including Openpath ACUs, Cloud Management Software, and Mobile App
- Reader works with legacy access control systems via Mobile Gateway option

### Standard Reader Dimensions

- With back cover, no gang box: 2.9 x 4.7 x 0.9 in (7.4 x 12.0 x 2.3 cm)
- No back cover, on gang box: 2.9 x 4.7 x 0.43 in (7.4 x 12.0 x 1.1 cm)

### Mullion Reader Dimensions

- 1.7 x 4.7 x 0.86 in (4.3 x 11.9 x 2.2 cm)

### Power Rating

- 0.25A @ 12VDC





# netZtouch Laundry Master

*A convenient, cashless system designed to indicate machine availability, charge-for-use, and track washer and dryer operation in multi-machine laundry facilities.*

## Functionality

ITC Systems' netZtouch Laundry Master delivers the convenience of an unattended and cashless laundry room, reducing operating costs, and leveraging your existing investments. This unit can be mounted on any secure wall and is TCP/IP enabled with WIFI and cell based communication options.

## netZtouch Laundry Master

For online operations, the Laundry Master transmits transaction information to an account-based system, such as the ITC Systems' **netZcore** Commerce Solution to update the account over a TCP/IP network. The 7830 Laundry Master accepts magnetic stripe, barcoded or contactless account cards to operate the machines.

## Laundry Master for Stored Value Cards

For offline operation we offer a stored value magnetic card operated unit. The transaction amount of the wash or dry is deducted from the stored value card and the balance is updated.



netZtouch  
Model 7830W

## Laundry Machine Interface

A single Laundry Master can control 32 individual machines, each equipped with the Laundry Machine Interface. These interfaces communicate to the Laundry Master via a Wireless connection. Additional features include configurable price per machine, stacked dryer times and the ability to monitor usage of each laundry machine or individual user.

### Benefits

- Complete online laundry solution
- Compatible with most electronic coin drop laundry machines
- Offers configurable price and tracking per machine
- Displays cardholders balance and current transaction details
- Stores online and offline transactions with flexible reporting capabilities
- Makes installation simple with a wireless connection to each machine
- Option available for customers to view machine status via the Web

### Applications

- Apartment Buildings
- University & College Campuses
- Condominiums
- Self-Serve Laundromats
- Hotels



### Comparison Features

Features	7830W-SW	7830W-SVM
Touch Screen	●	●
Card Types Accepted	ABA Mag Stripe, Barcode, Prox, HID, Mifare	Cash Card, ITC, ACT, XCP, Debitek, Danyl
TCP/IP Connection	●	●
Cell Option	●	
Wireless Laundry Machine Interface	●	●
Interface to Campus Solutions	●	
Laundryview Interface	●	●

### Specifications

LCD	7.5" Color Touch Screen
Power Supply	Input; 100-240VAC, Output; 24VAC, 2.7A UL   CSA   CE approved
Communication	Wireless between Master and Slave
Cards Accepted	Magnetic Stripe   MiFare   Barcode   Prox   iClass   SVM
Dimensions	8"H x 11"W x 5.5"D
Weight	11 lbs



### Laundry Machine Interface

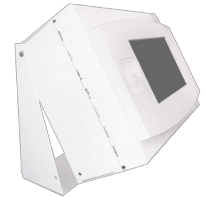
Model 4130W communicates via a Wireless connection with the Laundry Master (one interface per laundry machine)



4130W Interface

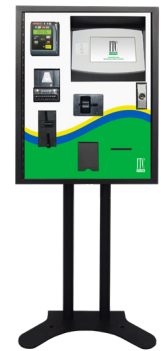
### Mounting Bracket

We supply the mounting bracket specially designed for the netZtouch Laundry Master.



### Value Adding and Card Dispensing

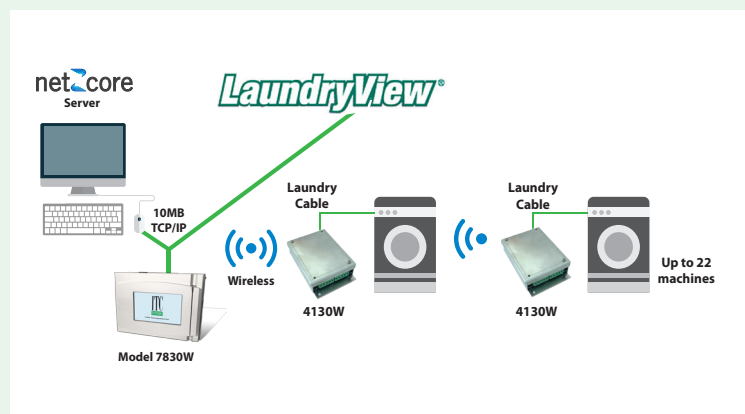
ITC Systems' 7880 netZtouch Loader allows clients to add value to their online account or card at anytime using credit/debit cards, bills, or coins. Both Loaders have the option for a card dispenser and receipt printer.



Loader Model 7880 (shown here with base)

### LaundryView Online Application

LaundryView™ is an internet application that allows users to monitor the status of washers and dryers in connected laundry rooms through a Web browser. Since many people tend to do their laundry during similar time periods, it results in busy rooms. This software provides information on which laundry machines are available and which are in use, enabling users to better plan their laundry trip times. Review the diagram on the right to see how it works hand in hand with our backend netZcore database server!



For more information, please contact [sales@itcsystems.com](mailto:sales@itcsystems.com)



# FINALLY, ANALYTICS THAT AREN'T INTIMIDATING

Analytics offer amazing possibilities for HVAC control and energy efficiency — as long as you know how to use them. As one of the leaders in the development of analytics solutions, Honeywell is proud to offer WEBS-N4 Analytics. It provides real-time information to help protect and improve operations, and builds on your Niagara N4 knowledge. It's advanced analytics made simple.

## KNOW MORE. DO MORE.

As devices and systems communicate with each other, they generate data. WEBS-N4 Analytics turns that data into actionable insights so that you can proactively identify and mitigate problems at both the local and enterprise levels.

With WEBS-N4 Analytics, you'll be able to provide your customers with the "three Ps" of system protection and performance:

- Preventing system shutdowns
- Predicting maintenance calls
- Prescribing building optimization metrics



## Easy to Use

WEBS-N4 Analytics begins with the familiar. It's built on the same Niagara Framework® as the WEBS-N4 solutions already used worldwide, so there isn't new programming to learn. It's an open system that supports third-party apps and easily integrates a range of devices and systems.

Best of all, it makes staff and buildings more efficient by gathering and analyzing both real-time data and historical information you've already saved for energy optimization and performance optimization. WEBS-N4 Analytics installation is easy, and it comes with a library of tools for fast setup, data selection, and reports.

### INTEGRATED WEBS-N4 APPLICATION

- Reduce design time by leveraging WEBS-N4 histories, hierarchies and tags

### INTUITIVE PROGRAMMING

- Familiar WEBStation programming

### DEFINED BASE ALGORITHMS LIBRARY

- Variety of predefined algorithms provided
- Building blocks for custom algorithms

### REAL-TIME, ON-PREMISE ANALYTIC CONTROL

- Full analytics functionality on embedded controllers
- Energy optimization

### AUTOMATED CONTROL STRATEGIES

- Advanced alarming
- Fault detection and diagnostics (FDD)

### POWERFUL VISUALIZATIONS

- HTML5-based
- User-specific dashboards

# a modular approach 4 global design

## EFFICIENT GLOBAL DESIGN

The new, modular design of the WEB-8000 controller makes them easy to install, integrate and deploy. Tool-less installation with expansion capability reduces installation complexity and improves flexibility. Systems integrators can focus on engineering solutions, not assembling components. And their lives will be simplified with a global power supply and improved access to standard enclosures.

## WIRELESS CAPABILITY

Standard Wi-Fi offers enhanced wireless capability when interfacing with the next generation of wireless sensors and devices. The WEB-8000 controller also are configurable as an access point so that mobile phones and tablets can display information and advanced graphics. Expansion also is available when interfacing with other wireless fieldbuses seen in connected buildings.

## OPTIMIZED FOR WEBS-N4

WEB-8000 controllers leverage the exciting new features of Niagara 4. It adds to the enhanced user experience, maximizing WEBS-N4 key advantages: pure Web interface based on HTML 5 with HTML 5 views, charting and data visualization, a common design language, better reporting, robust security and improved device management.

## Automation and Control Solutions

In the U.S.:  
Honeywell  
1985 Douglas Drive North  
Golden Valley, MN 55422-3992  
www.honeywell.com



## WEB-8000 Controllers key features

### Global capacity licensing and upgrade capability

Determine the number of devices that will be integrated and select the right capacity license from the start. License upgrades can be purchased in the future as your needs grow.

### Modular hardware design for fast and easy installation

Controller and option modules are designed for easy mounting on a 35mm-wide DIN rail.

### Expandable with up to four option modules

Option modules directly attach to the controller for additional communications ports, including types for LonWorks®, RS232 and RS485 networks.

### 24VAC/DC—standard global power supply

### Intuitive user interface

Users can easily check system status by glancing at the front panel LEDs to diagnose network issues.

### Connectivity profiles

Native Wi-Fi capability (WAP or Client)  
A, B, G or N networks  
Two 10/100Mb Ethernet ports  
Two isolated RS485 ports  
Optional LON FTT10 & RS232 expansion



# Honeywell



## GENERAL

CIPer model 50 is a BACnet-compliant heating, ventilation, air conditioning (HVAC) building controller.

It runs the WEBs-N4 framework, integrating all trades in a building.

Thus, CIPer model 50 is the ideal solution for HVAC controls requiring combination with lighting, shading, access control, and security applications.

It provides unparalleled energy efficiency through a vast HVAC Application Library.

CIPer model 50 enables uniform graphical operation, control, data logging, alarming, scheduling, and network management functions for HVAC and non-HVAC applications. Through its integrated web server, it allows real-time access to all information through web-based graphical views.

CIPer model 50 supports full remote engineering, including changes to the control program and the graphical user interface. This greatly supports reduction of life cycle and maintenance cost.

## OPERATION IN IP NETWORKS

When operating CIPer model 50 in IP networks, either private (e.g., VPN) networks must be used or protection against the open Internet (e.g., by means of external firewalls) must be ensured. See "Network Security" on pg. 6.

## FEATURES

- **Reduced total installed cost:** Existing standard Ethernet/LAN infrastructure is used for communication between CIPer model 50 controllers, 3<sup>rd</sup>-party BACnet® controllers, and BACnet® front-ends. Costs are further reduced by the flexible and optional use of Panel Bus I/Os (which allow manual override independent of the controller, thus obviating the need for external switches) and of onboard I/Os. Panel Bus I/Os allow for wiring lengths of up to 2625' (800 m), thus obviating the need to lay wire from field devices all the way back to the controller.
- **Reduced life cycle cost:** CIPer model 50 supports the highly reliable Honeywell Panel Bus I/O modules, which allow for plugging and replacing without any need for re-wiring or engineering, thus minimizing system downtime. The Panel Bus is polarity-insensitive, thus reducing potential wiring errors. Furthermore, Panel Bus I/O modules allow the predefinition of output safety positions, ensuring safe operation even if communication with CIPer model 50 is disrupted.
- **Universal operation:** Via Internet browser, CIPer model 50 can be operated from any place, from any PC and/or mobile device connected to the (CIPer model 50) network! (Optionally, via the onboard or detached HMI, the controller can be operated independently of any network connection.)
- **Vendor independence:** Multiple international communication standards are supported, e.g.: BACnet/IP (ISO 16484-5); BACnet MS/TP (ISO 16484-5); LONWORKS (ISO 14908); Modbus RTU and Modbus TCP; M-Bus (EN 1434-3); oBIX; SNMP; etc.
- **Trending:** Datapoints can be trended and historical values stored and viewed.
- **Reliable control performance:** Embedded QNX ensures reliable, independent, and secure operation, especially for systems with Internet access.
- **Embedded e-mail alarming:** Configurable e-mail alarming options allow alarms to be sent (via network or Internet-DSL connection) to e-mail accounts and thus also to mobile device using SMTP protocol.
- **Optional SMS alarming:** SMS alarming via GSM modem using the optional SMS driver.
- **HVAC application library:** Enables highly-effective application generation for optimal energy-efficient control applications.
- **Flexible mounting options:** Mounting onto wall or onto panel back wall, into panel door, onto panel rail, and into sub-panels (fuse boxes).
- **Direct 24 VAC power supply:** No batteries, no movable parts – thus does not require regular maintenance.

**⚠ WARNING**

## NETWORK SECURITY

Honeywell hereby expressly states that the CIPer model 50 is not inherently protected against cyber-attacks from the Internet and that it is therefore intended solely for use in private, protected networks.

Unprotected Internet connections can expose the controller to cyber-attacks from third parties who can then damage it and connected facility components or cause them to malfunction, or who can misuse it for illegal purposes for which the operator may then be held liable.

When directly connected to the Internet, the CIPer model 50 automatically becomes a potential target for cyber-attacks. Corresponding protective measures are therefore essential if safe and reliable operation is to be ensured. If it is not necessary for the CIPer model 50 to be accessible from the Internet, the CIPer model 50 should be isolated from the Internet via a suitable firewall. If it is necessary for the CIPer model 50 to be accessible from the Internet (e.g., in order to perform remote maintenance), the use of a coded VPN connection is indispensable. Suitable VPN routers are available from numerous third-party manufacturers in a wide variety of designs, for operation at 230 V or 24 V.

## CONTROLLER SPECIFICATION

### General

Table 1. Controller specifications

<b>Ambient temperature</b>	32 ... 104 °F (wall-mounting) 32 ... 122 °F (cabinet/door mounting)
<b>Storage temperature</b>	-4 ... 158 °F
<b>Humidity</b>	5 ... 95% r.h. non-condensing
<b>Dimensions</b>	See Fig. 10 and Fig. 11.
<b>Degree of protection</b>	IP20 (mounted on walls, with two accessory MVC-80-AC1 covers) IP30 (mounted in cabinet doors, with accessory MVC-80-AC2)
<b>Fire class</b>	V0
<b>Shock protection</b>	Class II
<b>Pollution degree</b>	2
<b>Installation</b>	Class 3
<b>Rated impulse voltage</b>	330 V for SELV, 2500 V for relay outputs
<b>Overvoltage category</b>	II
<b>Automatic action</b>	Type 1.C
<b>Software class</b>	Class A
<b>Ball-pressure test temperature</b>	housing parts >167 °F terminals >257 °F

## Electrical Data

Table 2. Electrical data

<b>Power supply</b>	19 ... 29 VAC, 50/60 Hz, or 20 ... 30 VDC
<b>Power consumption</b>	typically DC: 7 W; max. 9 W typically AC: 10 VA; max. 12 VA
<b>Heat dissipation</b>	Max. 9 W at DC power supply max. 9 W at AC power supply
<b>Current consumption</b>	typically DC: 300 mA; max. 375 mA typically AC: 400 mA; max. 500 mA

Due to the risk of short-circuiting (see Fig. 9), it is strongly recommended that the CIPer model 50 controller be supplied with power from a dedicated transformer. However, if the CIPer model 50 controller is to be supplied by the same transformer powering other controllers or devices (e.g., the PW M-Bus Adapter), care must be taken to ensure that correct polarity is observed.

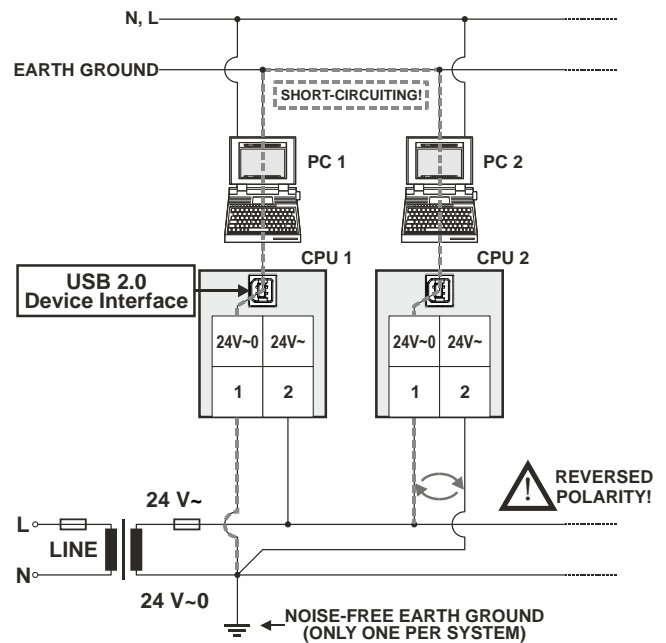


Fig. 9. Incorrect polarity → SHORT-CIRCUITING!

## Mechanical Data

**Housing Dimensions (L x B x T):** 8.5 x 4.3 x 2.4 inches (215.5 x 110 x 61 mm)

**Housing Material:** ABS blend; flame retardant V0

**Weight:** 0.88lb (400 g) \*without packaging

**Protection Class:** IP 20

## CPU

### Processor

- ARM 9 32-bit processor, 1 GHz

### Operating System

- QNX

### Memory

- 1 GB DDR3-RAM
- 512 KB MRAM
- 4 GB Flash Memory

### Real-Time Clock

- accuracy:  $\pm 2$  minutes per year (at, typically, 77 °F)
- buffered typically for 72 h by gold capacitor

## Standards, Approvals, etc.

- Device meets EN 60730-1, EN 60730-2-9, UL60730, and UL916.
- The device complies with Ethernet Protocol versions IEEE 802.3.
- The device supports BACnet IP and BACnet MS/TP communications as per ANSI / ASHRAE 135-2012.

## Mounting

The CIPer model 50 controller is suitable for mounting as follows:

- ▶ in cabinets;
- ▶ in fuse boxes conforming with standard DIN43880, and having a slot height of max. 45 mm;
- ▶ on walls (using accessory MVC-80-AC1 covers);
- ▶ in cabinet front doors (using accessory MVC-80-AC2).

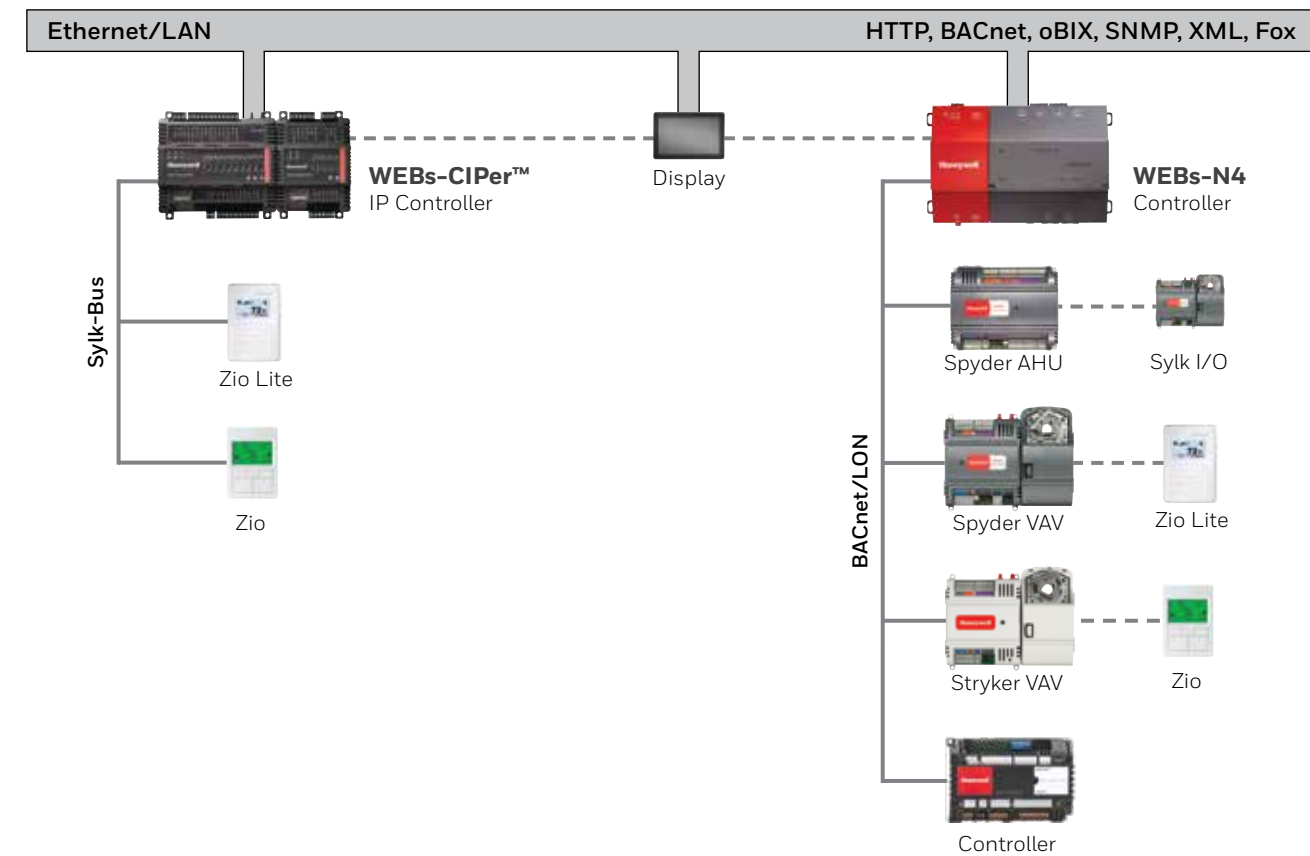


# WEBs Connected System Integration Software Platform

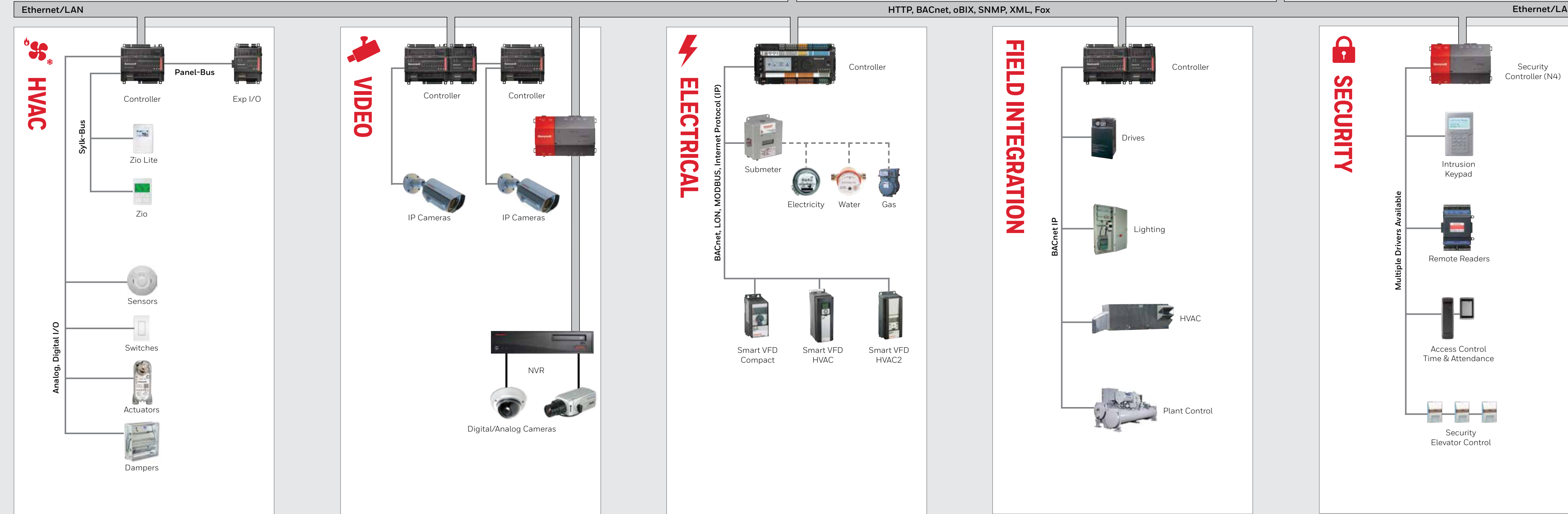
## CIPer family of "Internet Protocol" Controllers

This "next-generation" controller platform is a dramatic evolution in connecting and controlling devices worldwide, featuring a new global design that functions with legacy systems and has the ability to scale for future needs.

CIPer controllers leverage the exciting new features of Niagara 4. Adding to the enhanced user experience, maximizing WEBS-N4 key advantages: Web interface based on HTML 5 with views, charting and data visualization, a common design language, better reporting, robust security and improved device management.



# WEBs Connected System Integration



## Internet Protocol Controllers (CIPer™)

Unprecedented integration



## HVAC Field Devices

Select from a full range of Honeywell components for a completely interoperable system.

<p><b>Communicating and Fan Coil Commercial Thermostats</b> T7350H, SuitePro, TB76</p>	<p><b>Sensors</b> Wired and Wireless Temperature, Humidity, CO2, Differential Pressure, Wet Differential Pressure, Current Sensors and Switches</p>
<p><b>Variable Frequency Drives (VFD's)</b> CORE, Compact VFD, SmartVFD HVAC and BYPASS</p>	<p><b>Economizers &amp; Economizer Sensors</b> WT212, WT220</p>
<p><b>Submeters</b></p>	<p><b>Dampers</b> D1, D2, D3 Rectangular and D690 Round</p>
<p><b>Actuators</b> Low to High Torque Non-Spring Return and Low to High Torque Spring Return</p>	<p><b>Valves</b> Rotary Valve, VRN, Control Ball Valves, Globe Valves, Cartridge Globe Valves, Cartridge Cage Valves, Fan Coil Valves, Butterfly Valves and Control Valves</p>
<p><b>Fire/Smoke Actuators</b></p>	