



# Course Workbook

1<sup>st</sup> Edition

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## Succeed in this course

We've created several training courses for our students. As we look back at our past students we've pinpointed two things that make our students successful:

1. Access the program, watch the videos three times, and comment on the videos. The action of watching the videos will naturally increase the amount of information you retain.
2. Work through this workbook. This workbook was designed to help you retain key pieces of information that have a direct impact on your ability to install, startup, and checkout building automation systems. As you move through each lesson we will ask you questions in the workbook that will help you to further expand your knowledge.

Don't skimp on these two actions. The reality is learning anything takes work. Fortunately for you, we've condensed that learning into the shortest time possible.

When you follow the two steps above you will see massive results as you work through this course.

Remember, we are here for you at any time via the discussion section.

We look forward to hearing about your success story.

To your success,

-The BAM Training Team

## Module 1: Fundamentals

In this module, we will discuss the fundamentals of the startup and checkout process. This modules lessons are:

- Lesson 1: Proper Mindset
- Lesson 2: The BAS project process
- Lesson 3: The startup process
- Lesson 4: The checkout process
- Lesson 5: The configuration process

Over the years we've had the privilege of working with and training thousands of individuals. You would think the that number one skill that separates the best BAS professionals from the average BAS professionals would be knowledge.

Our experience shows however that the “best” BAS professionals (the ones who execute projects under budget and before the finish date) are the “best” because they have clear processes for what they do.

Throughout this course everything you learn will tie back to these processes.

Let's get started

# **Lesson 1: Proper Mindset**

## **Lesson Objectives:**

- Embrace the BAS installer mindset
- Identify common pitfalls in thinking that lead to failure

Why is mindset so important?

What is meant by the big picture?

How can hyper focusing be bad? How can it be good?

What is the number habit you must adopt?

## **Lesson 2: The BAS project process**

### **Lesson Objectives:**

- Explain your role in the BAS project process

What are the 5 steps of the BAS project process?

- 1.
- 2.
- 3.
- 4.
- 5.

What is a cornerstone step?

What step is the cornerstone step?

What one thing could you do right now that would improve all aspects of your BAS work? (not in the lesson, this is a personal answer for you).



## **Lesson 3: The startup process**

### **Lesson Objectives:**

- Describe the startup process

What are the three steps of the startup process?

- 1.
- 2.
- 3.

## **Lesson 4: The checkout process**

### **Lesson Objectives:**

- Describe the checkout process

What are the three steps of the checkout process?

- 1.
- 2.
- 3.

What do you always do during checkout?

What do you sometimes do during checkout?

## **Lesson 5: The configuration process**

### **Lesson Objectives:**

- Describe the configuration process

What are the four steps of the configuration process?

- 1.
- 2.
- 3.
- 4.

What important prework must you do before starting configuration?

Do you need to have a “server” to do configuration? Why/ why not?

How can you provide immense customer value during the configuration process?

## Module 2: Site Prep

In this module, we will discuss how to properly prepare prior to visiting the site. This modules lesson is:

- Lesson 1: Sales to Operations Handoff
- Lesson 2: Document Overviews
- Lesson 3: Document Review
- Lesson 4: Project Review
- Lesson 5: Contractor Lineout
- Lesson 6: Requests and Clarifications
- Lesson 7: Create P2P Checkout Sheets

Proper preparation will help you avoid many of the common pitfalls faced by building automation professionals.

While some of these processes may seem unnecessary for a “small” job it is the small jobs that need these processes the most! On larger projects there is margin flexibility for mistakes however, smaller projects will point out if you are weak in any part of the startup and checkout process.

So, do yourself a favor, start implementing these processes now.

# **Lesson 1: Sales to Operations Handoff**

## **Template Documents:**

- Sales to operations Handoff Document
- Project Contract Documents.Zip
- Scope of Work.Zip

## **Lesson Objectives:**

- Understand what the sales to operations handoff is
- Explain each step of the sales to operations handoff
- Conduct the sales to operations handoff

What is the purpose of a sales to operations handoff?

Who should be at the sales to operations handoff?

What documents does the sales team need to provide during the handoff process?

## **Lesson 2: Document Overviews**

### **Lesson Objectives:**

- Describe the common documents used during a project
- Explain how to look at specification

What are the four main documents used during the project?

- 1.
- 2.
- 3.
- 4.

What does the acronym MEP mean?

What are the main types of mechanical plans?

How do you avoid feeling overwhelmed by plans?

What is a floorplan?

What are notes?

What are details?

What is an equipment schedule?

Why is it important to clarify the sequence if it exists both in the drawings and spec?

What should you always assume before looking at a specification?

What are four main parts of a specification?

What is the importance of understanding related sections?

Where in the specification will you usually find the submittal requirements?

What is the purpose of the products section of the specification?

How do parts of the specification interrelate?



## **Lesson 3: Document Reviews**

### **Template Documents:**

- Project information checklist
- Sample Project Files.zip

### **Lesson Objectives:**

- Review project documents and identify key information for proper project execution

### **Hands on exercise with project files**

## **Lesson 4: Project Review**

### **Template Documents:**

- Project review checklist

### **Lesson Objectives:**

- Describe the project review process
- Execute a project review using the project review checklist

What is the purpose of the project review?

What are four pieces of information do you need?

- 1.
- 2.
- 3.
- 4.

## **Lesson 5: Contractor Lineout**

### **Template Documents:**

- Electrician Checklist
- Mechanical Checklist

### **Lesson Objectives:**

- Describe the contractor lineout process
- Utilize the contractor lineout checklists

What are the three steps of the contractor lineout process?

- 1.
- 2.
- 3.

What areas commonly impact the electrical part of a controls installation?

What areas commonly impact the mechanical part of a controls installation?

## **Lesson 6: Requests and clarifications**

### **Template Documents:**

- IT Request Checklist
- RFC Sample Document

### **Lesson Objectives:**

- Describe the RFC/RFI process
- Demonstrate utilization of the IT request checklist

What are RFI and RFC's?

Where do you commonly identify the RFI/RFC process?

What are the five most common IT requests?

- 1.
- 2.
- 3.
- 4.
- 5.

## **Lesson 7: Create P2P Checkout sheets**

### **Template Documents:**

- P2P Checkout Template
- Sample Project Files.zip

### **Lesson Objectives:**

- Describe the purpose of point-to-point checkout
- Create P2P checkout sheets

When would you want to create point-to-point checkout documents early in a project?

### **Hands on exercise with project files**

## Module 3: Electricity and Power

In this module we will discuss the how to power our controllers. This modules lessons are:

- Lesson 1: Electrical Fundamentals
- Lesson 2: Wiring Fundamentals
- Lesson 3: Powering Controllers

In order for your controllers to run they require power. Power is a complex topic fortunately for us the level of knowledge we need to have on the topic of electricity is simple at best.

In this module you will learn how to power up your controllers, how electricity works and how to determine electrical loads.

Let's get started.

# **Lesson 1: Electrical Fundamentals**

## **Lesson Objectives:**

- Understand the basic electrical terms
- Explain how power functions
- Describe primary and secondary sides of transformers

What is electricity?

What is ohms law?

What are the three measurements of “electricity”?

- 1.
- 2.
- 3.

What is the difference between DC and AC Voltage?

## **Lesson 2: Wiring Fundamentals**

### **Lesson Objectives:**

- Explain the different types of wire
- Describe how to prepare wire

What are the two main types of wire?

- 1.
- 2.

What are the two methods of protecting wire?

- 1.
- 2.

What are individual wires inside a sheath called?

What is the purpose of a shield?

How is wire thickness measured?

What does 18 AWG/2 UTP mean?



## **Lesson 3: Powering controllers**

### **Exercise Document:**

- Controller power requirement research exercise

### **Lesson Objectives:**

- Describe the different purposes of power with controllers
- Explain the different thoughts on powering controllers and devices
- Understand the impact of loaded and unloaded circuits on controllers

Why do controllers need power?

What are the two different methods of powering controllers and outputs?

What is load?

How do you calculate load?

Why is calculating load important?

## **Controller power requirement research exercise**

## Module 4: Field Trunks

In this module we will discuss the how to properly install and configure field trunks. This modules lessons are:

- Lesson 1: Trunk overviews
- Lesson 2: Trunk wiring
- Lesson 3: Trunk termination

Field trunks are arguably the most important part of the building automation system. In this module we will be diving into the step-by-step processes for installing and configuring your field trunks.

Now here's the deal.

Manufacturers like to implement field trunks differently. But, at the end of the day there's only so many ways to install a field trunk.

Once you understand the installation and configuration process you will be able to work with a variety of field trunks. After all, field trunks are simply a pair of wires that act to transfer data from a field controller to “somewhere else”.

If you understand this principle then you will be able to easily, install, configure and troubleshoot field trunks.

## **Lesson 1: Trunk overviews**

### **Template Documents:**

- Trunk Checklist

### **Lesson Objectives:**

- Explain how communication trunks work

What is a communication trunk?

What is the purpose of a trunk?

What are the most common “configuration variables of a trunk”?

What is RS-485?

What are the three common BAS trunk topologies?

## **Lesson 2: Trunk wiring**

### **Exercise Document:**

- Manufacturer requirements exercise

### **Lesson Objectives:**

- Understand the process of wiring communication trunks
- Explain how to interpret manufacturer requirements for trunk installation
- Identify the potential issues that can cause trunks to fail

What are the four steps in the wiring process?

- 1.
- 2.
- 3.
- 4.

What is the “most common” trunk wire?

What is the purpose of a shield?

How does polarity factor into your wiring?

## **Manufacturer requirements research exercise**

## **Lesson 3: Trunk termination**

### **Exercise Document:**

- Wiring exercise

### **Lesson Objectives:**

- Perform trunk wiring and termination

What is the purpose of trunk termination?

How are end of line resistors utilized? When are they needed?

### **Hands on wiring exercise**

## Module 5: Controller Overview

In this module, we will discuss the installation and configuration of controllers. This modules lessons are:

- Lesson 1: Controller overview
- Lesson 2: Mounting controllers
- Lesson 3: Controller addressing
- Lesson 4: Controller external setup
- Lesson 5: Controller internal setup
- Lesson 6: Advanced controller prep

Controllers are relatively simple devices. They (controllers) consume data from inputs and then make decisions based on that data (logic) to then drive outputs.

There are two primary types of controllers; application specific controllers and free programmable controllers.

In this module we will be focusing on the installation and configuration of free programmable controllers (FPC). FPC will make up the majority of field controllers that you will work with in your career.

## **Lesson 1: Controller overview**

### **Exercise Document:**

- Controller capabilities research exercise

### **Template Documents:**

- Controller Checklist

### **Lesson Objectives:**

- Describe the common functions of a controller
- Identify controller configuration options
- Utilize the controller checklist to ensure proper configuration

What are the two types of controllers?

What are the five parts of a controller?

- 1.
- 2.
- 3.
- 4.
- 5.

## **Controller capabilities research exercise**

## **Lesson 2: Mounting controllers**

### **Lesson Objectives:**

- Describe methods for mounting controllers
- Explain the pros and cons of different methods
- Demonstrate the mounting of a controller

What are the 4 methods of mounting a controller?

- 1.
- 2.
- 3.
- 4.

What are the pros and cons of each method?



## **Lesson 3: Controller addressing**

### **Exercise Document:**

- Controller addressing exercise

### **Template Documents:**

- MAC Addressing cheatsheet
- Protocol addressing cheatsheet

### **Lesson Objectives:**

- Describe the different types of controller addressing
- Explain how protocols effect addressing
- Demonstrate the ability to create an addressing scheme

What is the purpose of addressing?

How does addressing effect troubleshooting, servicing, and communication speed?

Why do you need to be aware of the different protocols when addressing?

What are common addressing mistakes?

### **Controller addressing exercise**

## **Lesson 4: Controller external setup**

### **Lesson Objectives:**

- Identify the purpose of external controller configuration
- Describe the risks associated with improper configuration
- Demonstrate the ability to research controller configurations
- Demonstrate the ability to externally configure a controller

Why do you need to configure controllers externally?

What are the most common aspects of controllers that are configured externally?

## **Lesson 5: Controller internal setup**

### **Lesson Objectives:**

- Identify the purpose of internal controller configuration
- Demonstrate the ability to internally configure a controller

Why do you need to configure controllers internally?

What are the most common aspects of controllers that are configured internally?

How does a protocol effect the internal controller configuration?

What is “firmware” and why does it matter?

How can firmware effect existing controllers?

## **Lesson 6: Advanced controller prep**

### **Lesson Objectives:**

- Understand advanced methods of preparing controllers

What is bench batching?

Describe the five steps of the bench batching process?

- 1.
- 2.
- 3.
- 4.
- 5.

## Module 6: Inputs

In this module we are going to explore inputs. The lessons in the module are:

- Lesson 1: Input overviews
- Lesson 2: Common input wiring setups
- Lesson 3: Dry contact (status) input wiring
- Lesson 4: Resistive input wiring
- Lesson 5: DC voltage input wiring
- Lesson 6: mA input wiring
- Lesson 7: Validate and calibrate

Inputs provide the data that controllers use to drive their outputs. Inputs are also a topic that still provide a great deal of confusion for BAS professionals.

Which input do you use? When do you use it? How do you set up the input? All of these questions will be answered in great detail in this module.

## **Lesson 1: Input overviews**

### **Template Documents:**

- Input Cheat Sheet

### **Lesson Objectives:**

- Demonstrate understanding of common input types
- Explain the pros and cons of each input type

What are the four main input types?

- 1.
- 2.
- 3.
- 4.

What is the difference between an externally sourced and internally sourced input?

## **Lesson 2: Common input wiring setups**

### **Template Documents:**

- Electrical Wiring Inputs Details Stencil

### **Lesson Objectives:**

- Describe the different types of wiring for each input

What is the purpose of electrical wiring details?

How would you use electrical wiring details as part of a project?

## **Lesson 3: Dry contact (status) input wiring**

### **Lesson Objectives:**

- Describe how dry contact (status) inputs work
- Demonstrate how to wire and test dry contact (status) inputs

What are the two most common types of dry contact inputs?

What is the difference between normally open and normally closed contacts?

Why is there normally DC voltage across the input hot and input common?



## **Lesson 4: Resistive input wiring**

### **Lesson Objectives:**

- Describe how resistive inputs work
- Demonstrate how to wire and test resistive inputs

What are the two most common types of resistive inputs?

What is the difference between dynamic and static resistance?

When would you use static resistance?

How do you wire resistive inputs?

How do you measure resistive inputs?

## **Lesson 5: DC voltage input wiring**

### **Lesson Objectives:**

- Describe how DC voltage inputs work
- Demonstrate how to wire and test DC voltage inputs

What are the three most common ranges of DC voltage sensors?

- 1.
- 2.
- 3.

What does polarity sensitive mean?

How do you measure DC voltage?

What is the difference between internally sourced and externally sourced power for DC sensors?

## **Lesson 6: mA input wiring**

### **Lesson Objectives:**

- Describe how mA inputs work
- Demonstrate how to wire and test mA inputs

What are the two most common ranges of mA sensors?

- 1.
- 2.

What does it mean to measure current in series?

What are the two ways to measure current?

- 1.
- 2.

What is the difference between internally sourced and externally sourced power for mA sensors?

What are the three most common ways of wiring up mA outputs?

- 1.
- 2.
- 3.

What device must be used on most mA inputs?

## **Lesson 7: Validate and calibrate**

### **Lesson Objectives:**

- Describe how to calibrate different input types

Why do you calibrate inputs?

What are the most common inputs that are calibrated?

What are common reasons for “inaccurate” inputs?

## Module 7: Outputs

Outputs. They turn on fans, command valves, and enable entire HVAC systems. In this module we are going to explore how outputs work. This module's lessons are:

- Lesson 1: Output Overviews
- Lesson 2: Common Output Wiring Setups
- Lesson 3: Internal Sourced Voltage Output Wiring
- Lesson 4: External Sourced Voltage Output Wiring
- Lesson 5: DC Voltage Output Wiring
- Lesson 6: mA Output Wiring
- Lesson 7: Validate and Calibrate

Outputs are part of the “closed loop” system that makes up a BAS.

BAS controllers process data from inputs and then make decisions to drive outputs. In the previous module we discussed how to select, install, and configure various inputs.

In this module we are going to close the loop by discussing the different types of outputs, how to install them, and when to use each one.

# Lesson 1: Output Overviews

## Template Documents:

- Output Cheat Sheet

## Lesson Objectives:

- Demonstrate understanding of common output types
- Explain the pros and cons of each output type

What are the four main output types?

- 1.
- 2.
- 3.
- 4.

What is the difference between an externally sourced and internally sourced output?

What is the danger of sourcing power through your controller's outputs?

Why do we recommend separate transformers for outputs?

## **Lesson 2: Common output wiring setups**

### **Template Documents:**

- Electrical Wiring Outputs Details Stencil

### **Lesson Objectives:**

- Describe the different types of wiring for each output

### **Video Only No Questions**



## **Lesson 3: Internal sourced voltage output wiring**

### **Lesson Objectives:**

- Describe how internally sourced outputs work
- Demonstrate how to wire and test internally sourced outputs

What are the two main reasons for using internally sourced voltage?

- 1.
- 2.

Why do you want to be careful with sourcing power to devices with high amp draw?

## **Lesson 4: External sourced voltage output wiring**

### **Lesson Objectives:**

- Describe how externally sourced outputs work
- Demonstrate how to wire and test externally sourced outputs

What are the two main reasons for using externally sourced voltage?

- 1.
- 2.

Why do you want to be careful with sourcing power to devices with high amp draw? (yes this is the same question from the previous less, BUT there is a different answer for externally sourced power...)

What are relays?

What are poles?

What are throws?

What are the two most common relays?

- 1.
- 2.

## **Lesson 5: DC voltage output wiring**

### **Lesson Objectives:**

- Describe how DC voltage outputs work
- Demonstrate how to wire and test DC voltage outputs

What are the three most common ranges of DC voltage outputs?

- 1.
- 2.
- 3.

What are some examples of devices that utilize DC voltage?

## **Lesson 6: mA output wiring**

### **Lesson Objectives:**

- Describe how mA outputs work
- Demonstrate how to wire and test mA outputs

What are the two most common ranges of mA outputs?

- 1.
- 2.

What are some examples of devices that utilize mA?

Do mA outputs utilize resistors?

## **Lesson 7: Validate and calibrate**

### **Lesson Objectives:**

- Describe how to calibrate different output types

Why do you calibrate outputs?

What are the most common outputs that are calibrated?

What are common reasons for “inaccurate” outputs?

## Module 8: Point-to-point checkout

In this module, we will discuss how to properly execute the point-to-point checkout process. This module's lessons are:

- Lesson 1: The point-to-point process
- Lesson 2: Point-to-point strategies
- Lesson 3: Documenting point-to-point checkout
- Lesson 4: Point-to-point troubleshooting

Now that we have discussed inputs, outputs, and controllers, it's time to make sure that our inputs are providing the right data and our outputs are producing the correct response.

We do this by utilizing a process known as the point-to-point checkout. Point-to-point checkout is more than just checking a box and entering some "data". Point-to-point checkout is your opportunity to validate system performance prior to the warranty period.

Done right point-to-point checkout will free you up from "warranty calls" and will make your life sooo much easier.

# **Lesson 1: The point-to-point process**

## **Lesson Objectives:**

- Describe the point-to-point check out process

What are the four steps in the point-to-point checkout process?

- 1.
- 2.
- 3.
- 4.



## **Lesson 2: Point-to-point strategies**

### **Lesson Objectives:**

- Describe the two methods for point-to-point strategies

What are the two strategies for point-to-point checkout?

- 1.
- 2.

What are the pros and cons of the “every point” strategy?

What are the pros and cons of the “sample” strategy?

When would you use each strategy?

## **Lesson 3: Documenting point-to-point checkout**

### **Exercise Document:**

- P2P documentation exercise

### **Lesson Objectives:**

- Demonstrate the ability to conduct and document a point-to-point checkout

### **Hands on documentation exercise**

## **Lesson 4: Point-to-point troubleshooting**

### **Template Documents:**

- P2P troubleshooting cheat sheet

### **Lesson Objectives:**

- Describe how to identify and resolve the five most common physical point issues

What are the five most common physical point issues?

- 1.
- 2.
- 3.
- 4.
- 5.

## Module 9: IT Setup

In this module, we will discuss information technology. This module's lessons are:

- Lesson 1: Common IT Tasks
- Lesson 2: BAS network setup
- Lesson 3: BAS Server Install
- Lesson 4: Database setup

The first ever course we created was Information Technology for BAS Professionals and for good reason.

In today's building automation system work you cannot avoid IT. Need an IP address, talk to IT.

Need a database spun up, talk to IT.

Trying to get remote access to a site, talk to IT.

In this module we are going to be covering all of the common IT tasks you will be involved with and how to "get them done".

## **Lesson 1: Common IT tasks**

### **Lesson Objectives:**

- Describe the most common IT tasks
- Explain common areas where IT interferes with project success

What are the five most common IT tasks?

- 1.
- 2.
- 3.
- 4.
- 5.

What are the 4 most common issues related to IT that delay BAS projects?

- 1.
- 2.
- 3.
- 4.

## **Lesson 2: BAS network setup**

### **Exercise Document:**

- IP addressing exercise

### **Template Documents:**

- Network setup checklist
- BAS addressing template

### **Lesson Objectives:**

- Describe the common network requirements of a BAS network
- Demonstrate the ability to create a simple addressing scheme

What are the four parts of a local area network?

What are the two absolutely required addresses?

What is the difference between dynamic and static IP addresses?

How do you address a local BAS network?

## **Network addressing exercise**

## **Lesson 3: BAS server install**

### **Exercise Document:**

Server configuration exercise

### **Template Documents:**

- BAS server checklist

### **Lesson Objectives:**

- Describe the 3 types of BAS servers
- Demonstrate a simple server configuration

What are the three types of BAS servers?

- 1.
- 2.
- 3.

What are some of the common issues with server installs?

## **Server installation exercise**

## **Lesson 4: Database Setup**

### **Exercise Document:**

Database configuration exercise

### **Template Documents:**

- BAS database checklist

### **Lesson Objectives:**

- Describe the 2 types of databases
- Demonstrate a simple database configuration

What are the two types of BAS databases?

- 1.
- 2.

What are some of the common issues with database installs?

### **Database installation exercise**



## **Lesson 5: Remote Access**

### **Exercise Document:**

Remote Access Exercise

### **Template Documents:**

- BAS remote access checklist

### **Lesson Objectives:**

- Describe the 3 remote connectivity options
- Demonstrate the configuration of a remote access solution

What are the three remote connectivity options?

- 1.
- 2.
- 3.

What are the pros and cons of each option?

## **Remote Access Exercise**

## Module 10: Supervisory Device Setup

In this module, we will discuss how to work with supervisory devices. This module's lessons are:

- Lesson 1: Supervisory Device Overview
- Lesson 2: Setting up the supervisory device
- Lesson 3: Mapping in controllers
- Lesson 4: Configuring global logic

Supervisory devices collect data from field controllers and allow the end user to interface with the Building Automation System.

Therefore, it is incredibly important that we understand how to work with supervisory devices. In this module we will be getting hands on with supervisory devices and setting up our site.

# **Lesson 1: Supervisory device overview**

## **Lesson Objectives:**

- Describe what a supervisory device is
- Explain the main functions of a supervisory device

What is a supervisory device?

What are the four main functions of a supervisory device?

- 1.
- 2.
- 3.
- 4.

## **Lesson 2: Setting up the supervisory device**

### **Exercise Document:**

- Supervisory device setup exercise

### **Template Documents:**

- Supervisor setup checklist

### **Lesson Objectives:**

- Describe common settings for a supervisory device
- Demonstrate how to setup a supervisory device

What are some of the common settings you will configure in a supervisory device?

### **Supervisory device setup exercise**

## **Lesson 3: Mapping in controllers**

### **Exercise Document:**

- Supervisory device mapping exercise

### **Lesson Objectives:**

- Describe how to map controllers into the supervisory device
- Demonstrate the mapping of controllers into the supervisory device

What is controller mapping?

What needs to be configured to map in devices?

What are the three steps for mapping in controllers?

- 1.
- 2.
- 3.

### **Supervisory device mapping exercise**

## **Lesson 4: Configuring global logic**

### **Exercise Document:**

- Supervisory device logic exercise

### **Lesson Objectives:**

- Describe what global logic is

What is the purpose of global logic?

What are the pros and cons of global logic?

### **Supervisory device logic exercise**

## Module 11: Front-End

In this module, we will discuss the front-end. This module's lessons are:

- Lesson 1: Front-End Overview
- Lesson 2: Tree building
- Lesson 3: Point Extensions Trends
- Lesson 4: Point Extensions Alarms
- Lesson 5: Point Extensions Schedules

The front-end exists to provide the end-user with a graphical interface to the Building Automation System. This graphical user interface, also known as a GUI, enables the user to access data from their BAS, command their BAS, and to perform advanced tasks like trending, alarming, and scheduling.

In this module we will be continuing to build out our site by constructing our front-end.

# **Lesson 1: Front-End Overview**

## **Template Documents:**

- Front-end checklist

## **Lesson Objectives:**

- Describe what a front-end is

What is a front-end?

What are the two types of clients?

- 1.
- 2.

What are the main features of a front-end?



## **Lesson 2: Tree building**

### **Exercise Document:**

- Tree building exercise

### **Template Documents:**

- Tree building checklist

### **Lesson Objectives:**

- Explain what a device tree is
- Demonstrate the ability to build to out a system tree

What is a system tree?

How do you structure a system tree?

## **Tree building exercise**

## **Lesson 3: Point Extensions Trends**

### **Exercise Document:**

- Point extension trend exercise

### **Template Documents:**

- Trend checklist

### **Lesson Objectives:**

- Describe what trends are
- Explain the common trend settings
- Demonstrate the ability to configure trend extensions

What is a trend?

What are the two kinds of trends?

- 1.
- 2.

What are the most common trend settings?

What are the two ways trends are stored?

- 1.
- 2.

What is a repository?

What is a buffer?

## **Point extension trend exercise**

## **Lesson 4: Point Extensions Alarms**

### **Exercise Document:**

- Point extension alarm exercise

### **Template Documents:**

- Alarm checklist

### **Lesson Objectives:**

- Describe what alarms are
- Explain the common alarm settings
- Demonstrate the ability to configure alarm extensions

What is an alarm?

What are the common alarm settings?

What are three ways a BAS can “send” alarms?

- 1.
- 2.
- 3.

### **Point extension alarm exercise**

## **Lesson 5: Point Extensions Schedules**

### **Exercise Document:**

- Point extension schedule exercise

### **Template Documents:**

- Schedule Checklist

### **Lesson Objectives:**

- Describe what schedules are
- Explain the common schedule settings
- Demonstrate the ability to configure schedule extensions

What is a schedule?

What are the common types of schedules?

What do you need to consider when configuring schedules?

### **Point extension schedule exercise**

## Module 12: Graphics

In this module, we will be diving deeper into the front-end by discussing the topic of graphics. This modules lessons are:

- Lesson 1: Graphics Overview
- Lesson 2: Graphics Templates
- Lesson 3: Graphics Creation

Graphics further enhance the capabilities of the front-end and enable the end-user to understand system layout and conditions.

While it is entirely possible to utilize a BAS without graphics, we do not recommend it. Graphics provide context to BAS data especially if the end user is unfamiliar with HVAC and BAS systems.

# **Lesson 1: Graphics Overview**

## **Lesson Objectives:**

- Describe the different types of graphics
- Explain what HTML/5 graphics are
- Describe how use cases effect graphics

What are the purpose of graphics?

What are HTML/5 graphics?

Why is it important to understand the use case behind graphics?

What are two ways to handle multiple user types with graphics?

- 1.
- 2.

## **Lesson 2: Graphics templates**

### **Lesson Objectives:**

- Describe the four most common graphics
- Explain user-centric functions of graphics
- Describe graphical flow

What are the four most common graphics?

- 1.
- 2.
- 3.
- 4.

What are alias or template graphics?

Why is it important to build a graphic library?

What are some user centric design changes you can make to graphics?

What is graphical flow?



## **Lesson 3: Graphics creation**

### **Exercise Document:**

- Graphic creation exercise

### **Template Documents:**

- Graphics checklist

### **Lesson Objectives:**

- Demonstrate the ability to create graphics

What are the five steps for creating a graphic?

- 1.
- 2.
- 3.
- 4.
- 5.

### **Hands on graphics creation exercise**

## Module 13: Test and Balance

In this module we will dive into the topic of test and balance. The lessons in the module are:

- Lesson 1: Test and balance overview
- Lesson 2: Test and balance methods
- Lesson 3: Test and balance graphics

Test and balance (technically Testing, Adjusting, and Balancing (TAB)) is the process of verifying that equipment is supplying the right flow to control the process load.

Ok, that may sound a little bit foreign, but it will make complete sense by the time this module is done. TAB is one of the most important tasks that can be done on a project and it behooves you to learn how to best assist the TAB folks.

# **Lesson 1: Test and balance Overview**

## **Template Documents:**

- Test and balance checklist

## **Lesson Objectives:**

- Explain the purpose of test and balance
- Describe how test and balance ties into BAS

What is the purpose of test and balance?

What is the BAS professional's role in test and balance?

What properties are commonly adjusted as part of the test and balance process?

How can you separate yourself from the test and balance process?

## **Lesson 2: Test and balance methods**

### **Lesson Objectives:**

- Describe the different methods use for test and balance

What are the two types of balancing?

- 1.
- 2.

What are the four main “parts” of the airside system that are balanced?

What are the properties that are balanced at the AHU/RTU level?

What are the properties that are balanced at the box level?

What are the three main “parts” of the water system that are balanced?

What are the properties that are balanced in pumping systems?

What are the properties that are balanced in cooling systems?

## **Lesson 3: Test and balance graphics**

### **Lesson Objectives:**

- Explain why graphics are created for balancers
- Demonstrate the creation of graphics for balancers

What is the purpose of adding a graphic for balancers to access?

What are some ways you can ensure that balancers only have access to the balancing graphic?

What objects (points) do you want to expose on the graphics for the balancers to use?

## Module 14: Commissioning and Functional test

In this module we going to look at the topic of commissioning and functional testing. The lessons in the module are:

- Lesson 1: Commissioning overview
- Lesson 2: Commissioning methods
- Lesson 3: Commissioning documentation
- Lesson 4: Functional testing overview
- Lesson 5: Functional testing methods
- Lesson 6: Functional testing documentation

Commissioning and functional testing are not the same thing. In this module we will look at what commissioning is, how it is done, and your role in the process.

We will then shift to functional testing which is much more common and “should” be done on every project.

Improper functional testing is the single greatest reason for callbacks during the warranty phase.

## **Lesson 1: Commissioning overview**

### **Template Documents:**

- Commissioning checklist

### **Lesson Objectives:**

- Describe what commissioning is

What is commissioning?

What is the difference between an owner's agent and a contracted agent?

What is the difference between project commissioning and retro-commissioning?

Where can you find information about the projects commissioning requirements?

Whose responsibility is it for creating commissioning tests?



## **Lesson 2: Commissioning methods**

### **Lesson Objectives:**

- Describe the different commissioning methods

What are the three different commissioning methods?

- 1.
- 2.
- 3.

What is the BAS professional's role in each method?

What happens if commissioning tests and the controls submittal differ?

## **Lesson 3: Commissioning documentation**

### **Lesson Objectives:**

- Describe the different types of commissioning documentation

What is a commissioning plan?

What are functional tests?

What are Commissioning reports?

What is a Certificate of System Acceptance?

## **Lesson 4: Functional testing overview**

### **Template Documents:**

- Functional Test checklist

### **Lesson Objectives:**

- Describe the functional test process

What is a functional test?

How are functional tests different then commissioning?

Who does functional tests?

When are functional tests completed?

## **Lesson 5: Functional testing methods**

### **Lesson Objectives:**

- Explain the two functional test methods

What are the two types of functional test methods?

- 1.
- 2.

## **Lesson 6: Functional testing documentation**

### **Template Documents:**

- Functional test template

### **Lesson Objectives:**

- Describe how to create and complete a functional test

How do you create a functional test document?

## Module 15: Closeout

In this module we are addressing the final part of the project process. The lessons in the module are:

- Lesson 1: Closeout process
- Lesson 2: The final check
- Lesson 3: Updating Documentation

Closeout is not only the last step in bringing a project to a successful close, but it is also a great opportunity to develop an ongoing relationship with your customer.

If you take only one thing out of this module focus on providing the type of close out that you would want to receive if it was your building.

If you do this, you will stand heads and shoulders higher than others in the industry.

## **Lesson 1: Closeout process**

### **Template Documents:**

- Closeout checklist

### **Lesson Objectives:**

- Explain the steps required for proper closeout
- Identify the contractual requirements for closeout

What are the 3 steps for proper project closeout?

- 1.
- 2.
- 3.

What document covers project closeout requirements?

What are O&M manuals?

What are redlines?

## **Lesson 2: The final check**

### **Lesson Objectives:**

- Demonstrate the ability to execute a final closeout check

### **Review the Closeout Checklist**



## **Lesson 3: Updating Documentation**

### **Lesson Objectives:**

- Describe the documents that are updated as part of project closeout
- Demonstrate the document update process

What documents make up O&M packages?

Where can you find the requirements for O&M packages?

What is the purpose of redlines?

How do you incorporate redlines and adjustments into your final document set?

## **Lesson 4: Customer training strategies**

### **Lesson Objectives:**

- Explain the different methods for addressing customer training

Where are the post project training requirements often found?

What are three strategies to align customer training with customer needs?

- 1.
- 2.
- 3.

# Notes