Peak Demand Automation

Energy Management System Users Manual

01/10/12

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Features:

The Peak Demand Automation Energy Management System has the following features:

- Suitable for both business and schools.

- Wireless.

- Stores up to three years of holidays.

- Can circulate air for better ventilation.

- Can dynamically change staging to increase efficiency.

Heating, Ventilation and Air Conditioning (HVAC):

The Peak Demand Automation Energy Management System (EMS) is ideal in applications where a simple thermostat does not provide adequate controls and a full-scale building automation system is too complex, cost prohibitive, and requires advanced computer skills.

The Peak Demand Automation EMS was designed to be extremely easy to use, to reduce operating costs, and to deliver increased energy conservation. It is consistent with the guidelines of ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers), and US Department of Energy guidelines.

Although this system is configured and viewed on the Internet, It is a ***standalone*** controller, and once configured, does not require any additional programming.

We use the advanced eZEio Controller from eZE System of Folsom, California to automate HVAC in your facility. The controller which can handle HVAC management for up to 16 zones. Multiple controllers can expand the system to hundreds of zones, all accessible by a single web page. The product allows for grouping which simplifies management, as many thermostats can be put on the same schedule.

The controller is self contained, and does not require a dedicated server or firewall modifications to run. A third party web portal allows users to remotely program control and monitor HVAC systems as well as to identify, analyze, and troubleshoot performance issues from anywhere in the world by computer, tablet, or smart-phone. On-site time is virtually eliminated.

Multiple users can be set up with different permissions and users can be easily added or deleted as employees come and go.

Users can also configure the Peak Demand Automation EMS to send alerts and service reminders via email, text message, or telephone voice alerts.

Dedicated technicians are not required to maintain the system.

The system saves energy primarily through two means, automating a thermostat schedule, and disabling inefficient heater stages when they are not needed.

A complete manual for the eZE controller can be found at www.ezesys.com.

Manuals for the thermostats and the motion detectors can be obtained directly from Peak Demand

Automation.

The User Interface:

First, please observe the environment, there are four (4) tabs on the top of the screen By pressing the tabs at the top of the page each of the following screens may be accessed:

Dashboard:

The dashboard is a user configurable screen which can be used for quick status information. It can be configured for the user or for individual accounts by clicking on the links at the top of the page. "Widgets" are items which can be added to the page to display information regarding the various inputs of the system. The dashboard only updates every 15 seconds.

Figure 1. The Dashboard

Status:

The status screen gives more detailed information about the account. The left side of the status screen shows the controllers which are assigned to the account. The center of the status screen has a quickly updating level status for each of the inputs. This status screen updates approximately once per second. Below this are the outputs and the thermostats and an area that shows any logged events.
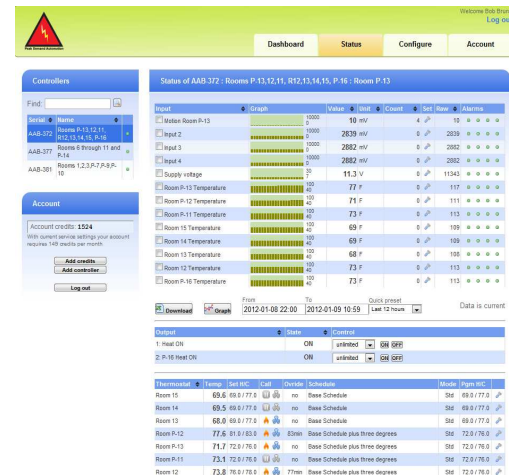
Please note that the thermostat display only updates every 15 seconds even though the status display at the top of the page updates every second.

Configure:

The configure screen is not available to all users. The configure screen is where the controller is set up and programmed. The center of the configure screen has tabs which can be expanded to show <u>Inputs</u>, which are devices that show up on the status screen, <u>Outputs</u> such as the relays, <u>Schedules</u> which are generally used for repeating events,

Figure 3. The configure screen

Timers, which are generally used for one-time events and Thermostats. Everything physical that attaches to the controller is defined under Devices, and the controller configuration itself is set under System. The controller is greatly expandable by adding devices, inputs outputs and additional thermostats on the configure page.

If you add the something on the configure page remember to push the button "**_Save changes_**" with each change that you want to retain. The "**_Save changes_**" button is found on both the configure and account pages and is a requirement for retaining changes that are made to the system.

Account:

The account page shows information about the account and user permissions. It is under the *Users* tab that other people can be given permission to log into and control the system. It is also here where users can be removed.

Common Tasks:

Adding a user:

Users can add **_themselves_** to the account if they know both the controller number, like AAB370, and the controllers registration code which is 12 characters long and is located on the label on the front of the controller. Anybody who knows these two items can be added to the account by answering a few questions and receiving an e-mail. It is up to the master user then to define the permissions for that user on the account page.

Setting permissions:

Figure 4. The account screen

Figure 5. Setting permissions

Once a new user has established an account the master user can change the permissions of that user by going to the account tab under users. Please use caution whenever enabling the user to edit controller settings, remote control outputs and timers and manage other users.

Allowing access to configure the controller

If a user is allowed to edit controller settings, that user will have access to the configuration tab and they may make permanent changes to the operation of the controller. If that box is not checked that they will not have access to the configuration page.

Adding a thermostat:

A thermostat is a device and is added on the configure tab under devices. Just follow the directions, set the Modbus polling address and make sure you save your changes. The only thermostat currently supported by the eZEio controller is the Jackson T-32-P, a variant of which is used by Peak Demand Automation for HVAC control.

Setting a thermostat schedule:

Under the configure tab is a call out for thermostats. Here the thermostat schedule can be set. There is a standard (day) schedule and an alternate (night) schedule. The conditions for using the alternate schedule are given in the area under the schedule name. In this way the thermostat can be made to be responsive to inputs, outputs, schedules or timers. The thermostat schedule also has settings for flushing the air and for allowing overrides which is when someone pushes the buttons on the thermostat to change the temperature. The override can be set from zero to 240 minutes. Once the override is complete the machine will again set the thermostat temperature.

It is important to note that there is a maximum of **four thermostats per schedule**. Do not put more than four

Figure 6. A typical thermostat schedule

thermostats on a schedule as the results will be erratic and unpredictable.

Do not set the temperature below 46 degrees Fahrenheit, or the system will assume that you are inputting temperatures on the Celsius (Centigrade) scale.

A typical thermostat schedule is shown in Figure 6.

Fresh air can be enhanced by setting the fan mode to on" whenever the space is occupied. The fan will stay on even if heating or cooling is not required.

Note that to add holidays to the thermostat schedule, make an output named "Holiday" and apply it to the script as is described later.

Changing temperature of a zone:

There are two methods to change the temperature of a zone. They are:

1. Create a thermostat schedule for that zone.
2. Move a thermostat from one schedule to a different one.

Method two is used when thermostat schedules have been established, and you want to move a thermostat from one schedule to another.

The eZEio controller can have a maximum of four thermostat schedules, and each schedule can have up to four thermostats. Please do not exceed this limit.
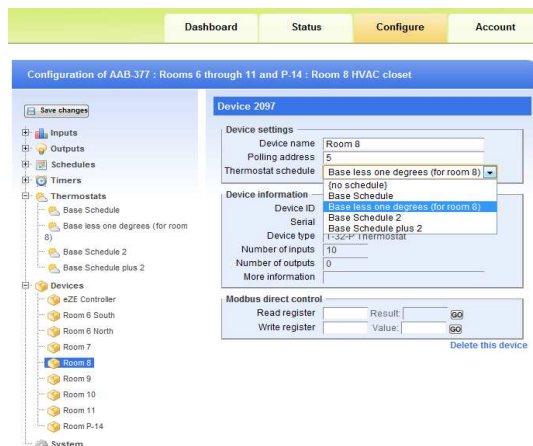
Figure 7. Moving a thermostat to a different schedule

On the configure tab, select the device you wish to change by clicking on that device. In the right column use the pull down selector to place that device on another schedule.

Remember to press *"Save changes"* when you are done.

If none of the currently programmed schedules are suitable, you can add one as described, then assign it to a device, all on the configure page.

Remember: *The eZEio controller can have a maximum of four thermostat schedules, and each schedule can have up to four thermostats. Please do not exceed this limit.*

Setting a manual button to control thermostats:

On the configure page under the *Output* tab, and output can be configured. There are two two amp relays in the controller. The output can also be left unconnected and used only for control purposes. If one configures an output button with the name "Heat ON" or similar name it can be used as a selector for the alternate state of the thermostat schedule. In this way an entire bank of thermostats can be turned on or off with a single button on the status screen. Use of the output state as a selector for thermostat settings is shown in the following figure.

Just log in over the Internet and you can push the button in your web browser or smart-phone to control a bank of thermostats from anywhere in the world.
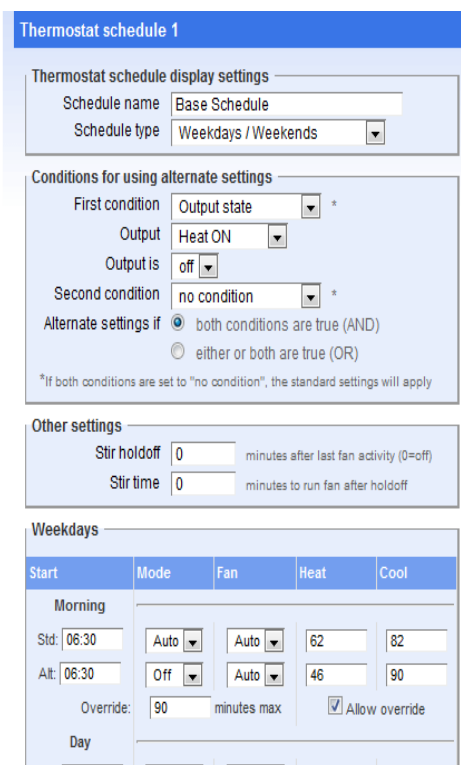
Figure 8. Manual button control

Holiday schedules:

```
new const year2[366] = {2013, // the first entry is the year
// January
1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,
//February
0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,    // there are 28 days in February of 2013 it is not a leap year.
// March
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,  // 31
// April
1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,    // 30
// May
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,        // 31
// June
0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,        // 30
// July
1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,        // 31
//August
1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,        // 31
//September
0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,        // 30
//October
0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,        // 31
// November
0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,0,        // 30
//December
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,1} // 31
```

Figure 9. A sample year in the script file.

Holiday Schedules are kept in the scripting section of the controller. Scripting is described in detail in the eZeio user manual, but the script contained in the controller is

This is accomplished in just three simple steps:

1. Establish a schedule with expected occupancy.
2. Program the holidays into the script arrays. Do not change the code! The process is documented in the code and can be done in any browser, such as Firefox or Chrome.
3. Make the conditions for "Alt" mode: *"Holiday"*

Step 1:

Figure 10. Make an output, call it "Holiday"

Step 3:

Figure 11. Make "holiday" be the condition for the alternate mode in the thermostat schedule

Step 3:
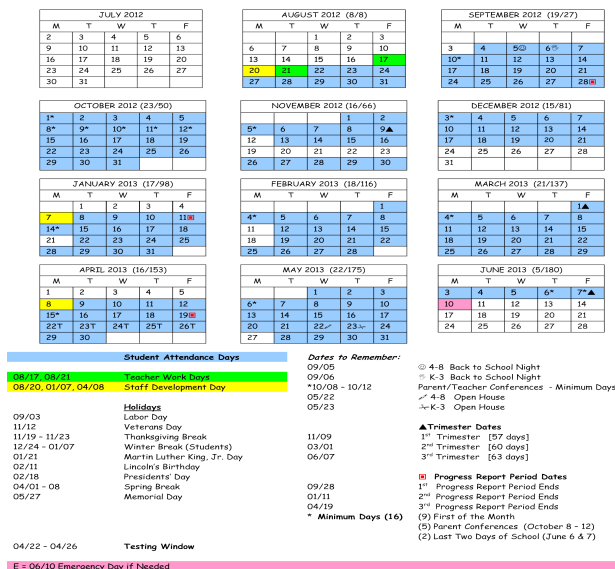
Figure 12. This is the example calendar set by the script.

Remember: Always push the *"Save changes"* button after you make the changes!

Disabling second stages:

The Peak Demand Automation building automation system saves energy through two primary methods. The first is to automate the thermostats so that they are always turned off when the building is not occupied. The second method is to selectively disable second stage heating when that heating element is energy inefficient. There are no other systems on the market that can do this.

It is very common for two stage heat pump systems to have an electrical resistive second stage. While the first stage of the heat pump has a mechanical advantage of about three to one, the second stage has none. It is common to see heaters that can heat a room at a rate of 8000 watts, yet consume less than 3000 watts of electrical power. Then the second stage kicks in and adds 7000 more watts, with an additional 7000 watts of power. Thus it is 180% (45% savings!) more efficient to run with the first stage only rather than let the second stage come on. Since the second stage call is done in the thermostat, this efficiency step requires that the thermostat be dynamically modified to suppress the second stage call.

This is done in two steps:

1. Build a schedule to suppress the second stage
2. Send a command on schedule on the command wire to the thermostat to disable the second stage call:
3. OPTIONAL: Make the call contingent on an input alarm, such as the outside temperature.
4. OPTIONAL: Make the same call as steps two and three later in the day. Up to four attempts are

supported on the same schedule.

Step 1:

Figure 13. Schedule suppressing inefficient stages.

Step 2:

Figure 14. Step two suppress inefficient stages.

To disable the second stage, a value of one (1) is sent by Modbus to thermostat address 40042. To enable the second stage, a value of zero (0) is sent by Modbus to thermostat address 40042. Thus the second stage can be enabled or disabled dynamically as required during day or night hours without any human intervention. If you choose to disable the stage dynamically, make sure you put the conditions for re-enabling it in the "out action" portion of the schedule.

The energy savings from this step is significant, but can only be done on the thermostats supplied by Peak Demand Automation. Other thermostats do not have this feature and sending values to this Modbus address may be ineffective or cause damage.

Dealer Access:

As the system owner, you control dealer access. You will find a check-box on the system portion of the Configure tab. If you uncheck this box, your dealer will no longer ave access to your system. Many of the issues with your system can be resolved quickly by a qualified dealer, so checking this box when making a phone call about the system will help your dealer quickly identify any issues.

Figure 15. Enabling dealer access.

Optional additions:

Air quality:

Air Quality measurement, either by measuring CO_2 content or VOC (volatile organic content) can assure that the air quality in your space is maintained at healthy levels or compliant with California's Title 24 specifications for air quality. Sensors, such as the one shown on right can be added anytime and can be used to control airflow, often without additional blowers because the thermostat function of the controller can operate the HVAC fan independently of heating and cooling. When setting the thermostat schedules, make sure you turn the fan mode to "on" for occupied periods to maximize air freshness.

Figure 16. CO_2 sensor

Maintenance alerts:

Because the controller has an alert capability, emails can be sent if any system requires maintenance, often without human detection. For example, should a system fail or a filter need replacement a telephone call or an email can be automatically generated to the responsible person and the problem fixed quickly.

Custom programming:

Custom programs can be added to the controller for other purposes. Some applications have included calculation of Sunrise and Sunset for automatically setting lights based on solar time, or calculation of air enthalpy in humid conditions for economizer control.

Note: Air Quality sensors, maintenance alerts and custom programming will require additional costs.

Advanced functions:

The controller can be programmed to send messages, either by alarm or on a schedule or at times defined by the timers. These messages can be emails, text messages to smart-phones or voice alerts. The controller can also be used as a logger and can log data from any input and produce reports. For more detail how to accomplish any of these this please consult the controller manual at www.ezesys.com.

Server functions have been enabled for your controllers, which will allow you to participate in demand response programs and smart-phone control.

Computer management and vampire loads:

PDAShutdown!

is a tool for placing your computer in an active hibernate mode. In this mode your computer will respond to network requests to wake up, so it is compatible with the network management software that is found in many multi-user environments. Unfortunately, not all PC's have a "sleep" mode, and for a desktop the savings from going into "standby" mode are minimal. A desktop consumes about 100 Watts of power, and a monitor about 50 Watts. Keeping these on all year would cost over $130 a year for a single computer, just for electricity! With older desktop PCs monitors can remain powered, the definition of a "vampire load." And while the disk drives are powered down the main computer board can still draw substantial power. If the computer is off 12 hours a day, savings of $65 or so per year may not be enough justification to upgrade your hardware and operating system to a newer model.

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Figure 17. PDAShutdown!

It's faster: Booting up from hibernate mode is also much faster that restarting a computer that has been turned off, usually taking only about 30 seconds, and all the work that was in progress is preserved.

If *PDAShutdown!* is already installed:

Just start **PDAShutdown!** from the desktop shortcut or by double clicking the program icon in "C:\Program Files\PDA." Click on the tab "*Set Shutdown*" and select the time of day, from 3 PM to midnight. Click the button "Add Shutdown" and the hibernation time for that computer will be set. You can add as many shutdown times as you wish. There are other tabs for review of the times set for hibernate and removal of the times (the removal feature is disabled in the Lite version, which is free). Using a "Smart Powerstrip" such

Figure 18. A typical "Smart Power Strip

as the one pictured in Figure 1. will eliminate the vampire loads of the monitors and other peripherals are plugged into the controlled outlets. Smart Power Strips like the one pictured are available from a number of sources and are quite reasonably priced.

If you are installing *PDAShutdown!* for the first time:

Just install the program using the installer. It can be removed with the Add/Remove Programs tool in the Control Panel.

For the technically minded:

Some older operating systems (before 2005) disabled remote operation of the hibernate mode due to security issues. **PDAShutdown!** uses Microsoft's "*.NET 2.0 Framework*" to restore this function. If your machine does not have this Framework (or newer Framework) installed it is available for free on the Internet. The file "*hibernate.exe*," which must remain located in the folder "C:\Program Files\PDA" uses the Framework to force hibernation. It can be safely run by itself, and provides a five second abort feature.

Lighting:

Lights are replaced on a priority basis based on energy usage. Florescent lights are changed from size T-12 to T-8 or T-5. Ballasts are changed from magnetic to electronic types which are more efficient. The combination of changing lights and ballasts reduces energy use from 40% to 60% in lighting without any changes to the operation of the facility. Many facilities already have motion detectors on their switches, which can remain in place during and after the change. A sample of the energy study for a school is shown in the following figure along with projected energy savings.

LIGHTING RETROFIT SUMMARY

PROJECT NAME:		PROJECT DATE:	12-22-11		VOLTAGE: 120/208
ADDRESS:		AUDITOR:	JHM		ROI 9.3
CITY STATE ZIP:		KW/H RATE	$0.20		INC. $6,214
TEL:		UTILITY:	PGE	(BLANK FOR OTHER)	
FAX :		LEASE TERM	Own		

RY AND PROPOSED MODIFICATIONS

#		EXISTING FIXTURE TYPES				PROPOSED MODIFICATIONS				
	Area	Fixture Description & Lamp Type	Annual Hours	Qty	Watts Each	Fixture Description & Lamp Type	Annual Hours	Qty	Watts Each	
1	Lighting									
2	P-9	2L 4' T12, Std Ballast	2500	20	71	2L 4' 25 T8 5000K, Sylvania Std-EB	2500	20	47	
3	P-10	3L 4' T12, Std Ballast	2500	20	106	2L 4' 25 T8 5000K, Sylvania Std-EB	2500	20	47	
	P-14	3L 4' T12, Std Ballast	1800	12	106	2L 4' 32W T8 5000K, Sylvania Std-EB	1800	12	59	
	P-15	3L 4' T12, Std Ballast	1800	12	106	2L 4' 32W T8 5000K, Sylvania Std-EB	1800	12	59	
5	Cafeteria	3L 4' T12, Std Ballast	1800	50	106	2L 4' 32W T8 5000K, Sylvania Std-EB	1800	50	59	
6	School Office	2L 4' T12, Std Ballast	2500	8	71	2L 4' 32W T8 5000K, Sylvania Std-EB	2500	8	59	
7	Administration	2L 4' T12, Std Ballast	2500	4	71	2L 4' 32W T8 5000K, Sylvania Std-EB	2500	4	59	
	Nurse	2L 4' T8, Std Ballast	1800	4	71	2L 4' 32W T8 5000K, Sylvania Std-EB	1800	4	59	
	Kitchen	3L 4' T8, Std Ballast	1800	8	90	2L 4' 32W T8 5000K, Sylvania Std-EB	1800	8	59	
				138				138		
8										
9										
10										
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16										
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18										
19										

Figure 19. Projected energy savings from lighting changes.

Appendix: Sample quick start page

<u>**System:**</u> _____

Congratulations on your recent purchase of a building automation system from Peak Demand Automation. Portions of your building's systems are now available to you online via the Internet and you can use your system to:

1. Conserve electricity by automatically managing energy consuming resources.
2. Monitor performance and set alarms when performance parameters are not met.
3. Add control to functions which will enhance energy reduction.

Your system is expandable so you may add capabilities as you wish to perform certain other functions such as electric power consumption monitoring, economizer control, and even plug load power control and timer functions.

Although your system has been completely pre-configured and is fully operational certain resources are available to you to monitor your system and expand its capabilities. You may add capabilities to your system at any time and for any purpose. Should you have any questions, comments or require help, please contact Peak Demand Automation at the toll free number listed below, or by email at: support@peakdemandautomation.

Your system uses an advanced controller from eZE System Inc. of Folsom California. You can find a complete manual for this controller at www.ezesys.com.

<u>**Logging in:**</u>

Your system comes pre-programmed with three login accounts. They are:

1. Master User
2. Admin user
3. Facility/Maintenance user

The master user and the facility/maintenance user are fully functional accounts which allow for programming, configuration, adjustment and management of other users, including the addition of more users to the account, changing of users passwords,or deletion of other users. The admin user is an observer only.

Always login at www.ezecontrol.com. The account number for this system is: _____.

Master User: login name: "master." Password is not published but can be reset by calling Peak Demand Automation at 800-503-1123.

Admin User: login: "admin." Password can be obtained by adding the user city in lower case with the five digit zip code of the location, for example: "lodi95242."

Facility/Maintenance User: User login:_____
                                        Password:_____

For security purposes it is recommended that you change your password as soon as possible to one that only you will be able to use.

<u>**Logging:**</u>
Your system comes with of logging and e-mail reports enabled. These reports and logging can help you identify trends and problems before they become otherwise apparent. There is a moderate fee to continue logging after the initial six month period.