Building Automation Systems

Energy Zone®

User's Manual

Enertec/BAS Corporation
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360-943-2952

Building Automation Systems

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9. It is the responsibility of the installing dealer to fill out and return the warranty registration card.

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628 Plymouth St. SW
Olympia, WA 98502
360-943-2952

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Energy Zone® Warranty Registration

Installation Date _____
Energy Zone® Software Version _____
RSC EPROM Version Number _____

Installing Dealer

Name _____
Address _____
City, State, Zip _____
Phone Number _____
Contact Person _____

Installation Address

Project Name_____
Address _____
City, State, Zip _____
Phone Number _____
Contact Person _____

System Information

Brief Description of Equipment Controlled _____
_____
Number of Buildings Controlled _____
Total Building Square Footage _____
Building Use _____
Number of RSCs Installed _____
Equipment Schedules Used _____

Mail To:

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628 Plymouth St. SW
Olympia, WA 98502
360-943-2952

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Warranty Repair Request

Date Problem First Noticed_____
RMA # (from **BAS**)_____

Installing Contractor

Name _____
Address _____
City, State, Zip _____
Phone Number _____
Contact Person _____

Installation Address

Project Name_____
Address _____
City, State, Zip _____
Phone Number _____
Contact Person _____

System Information

Brief Description of Equipment Controlled _____
_____
Equipment Schedule Used _____
Brief Description of Problem _____
_____
_____
_____

Note: This Warranty Request must be included with any equipment warranty returns. See **Energy Zone®** End User License and Warranty for additional warranty information.

Ship To:

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628 Plymouth St. SW
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Part I

Introduction

Chapter 1

The Energy Zone® System

Overview

Energy Zone® (EZ) is a Direct Digital Control (DDC) Building Energy Management and HVAC Control System. The **EZ** system was developed with several goals in mind. In addition to all features expected in a modern DDC system such as remote communication, trend logging, load shedding, smart recovery, outside air reset control, alarm functions, password security, and a dynamic graphical User interface, several unique features were added. Among those features are:

1. **Easy set-up.** The system can be configured for any HVAC system with no prior programming experience. This allows the installer to set up the software in a very short time.
2. **Pre-Engineered.** The Dealers of the **Energy Zone®** system are provided with CADD generated schematics for all Equipment Schedules and allowed unlimited royalty free use the files. The files are available in both AutoCAD and GenericCADD formats. This reduces engineering time by at least half, compared to other DDC systems.
3. **Versatile default control.** Positioning a dip switch is all that is necessary to set up the Remote System Controller (RSC) for sophisticated default control.
4. **Single Universal Controller.** A single universal controller design, the Remote System Controller (RSC), handles all necessary control and data acquisition. The Command Center communicates directly with each RSC through a single twisted pair cable.
5. **Unnecessary Hardware Components Eliminated.** The BAS System architecture includes no external field interface device or network managers. By reducing the number and complexity of System hardware components, reliability is increased and installation costs are lowered.
6. **Alarm Callout.** System alarms can be configured to callout to both digital pagers and/or fax machines
7. **Multitasking.** The **EZ** software was designed to operate in the Microsoft Windows environment. The **EZ** software will operate in the background concurrently with any other Windows compatible software. This includes such software as Microsoft Excel and Microsoft Word.
8. **Microsoft Windows Operating System**. The **EZ** system is fully integrated into the Microsoft Windows environment and all Systems are delivered with an IBM PC compatible computer and a retail version of Windows. This feature is unique to the control industry. BAS uses no obscure operating systems or computer platforms.
9. **Microsoft technical support.** Microsoft sets the industry standard for software technical support.. Because of the integration with Windows, Microsoft can answer many of the common User questions.
10. **Local testing.** An optional Handheld Tester, powered by the RSC, is used to test all RSC outputs and monitor all RSC inputs. All test functions are accessed by function keys.
11. **Warranty.** All components in the **EZ** system are provided with a full 2-year warranty.

All of these features result in an overall lower installation and maintenance cost compared to competitive DDC systems.

System Highlights

When the BAS System architecture was first planned, the conventional structure of a DDC system was ignored. The resulting BAS System architecture is unique in that no external field interface device or network managers are needed. This is accomplished by using innovative software to take on tasks commonly performed by hardware components. The potential for System software failure has been nearly eliminated as a direct result of the years of field tests and refinements implemented after initial development and de-bugging was completed in 1986. Countless years of System operation have been accumulated since that time with no significant impact on System operation as a result of software failure. By using fewer, less complex, and more readily available hardware components, reliability is greater and installation costs are lower for BAS than every other system available on the market. Both the potential for System failures and the cost of operation and maintenance is significantly lower with BAS. This is a result of other systems long term reliability and costs tied directly on the longevity of expensive custom-built hardware components. By investing significant research and development effort in structure and programming of the software component of the BAS System, features and functionality did not have to be compromised. The BAS System can meet or exceed any available product in terms of functions, feature list, reliability, and capabilities.

The heart of the **Energy Zone® (EZ)** system is the Remote System Controller (RSC). The RSC is an 8 bit microcontroller, with full stand alone capability. The **EZ** system networks RSCs to the Command Center over an RS-485 communication trunk line. Each RSC has a capacity of thirty control points and can control up to four Heating, Ventilating, and Air Conditioning (HVAC) zones. The Command Center host computer can network up to 256 RSCs on a single network card, providing a system capacity of 1024 HVAC control zones with 7168 points. Larger numbers of RSCs can be controlled by networking Command Centers together.

The RSC is field configurable for control of most types of commercially available HVAC equipment. The RSC contains built-in control algorithms referred to as Equipment Schedules. An Erasable Programmable Read Only Memory (EPROM) or optional battery backed SRAM located on the RSC contains all Equipment Schedule control algorithms. Dip switches located on the RSC select which Equipment Schedule is used for RSC default control. On initial startup, or any time that communication with the Command Center is lost, the RSC takes over equipment control using pre-programmed heating and cooling setpoints. Additional versions of the EPROM and SRAM chips are available for custom applications.

The Command Center contains the control algorithms for each RSC connected to the trunk line. Because the **EZ** User interface operates in the Microsoft Windows environment, the system can be installed and operated with no computer programming experience. The System has the capacity for 128 separate Equipment Schedules, with the appropriate control algorithms for that equipment. During system configuration, an Equipment Schedule is chosen for each RSC. When an Equipment Schedule is chosen, the **EZ** software will prompt the User to input those parameters necessary for proper equipment control.

Software Features

Command Center - The Command Center includes all software and algorithms for normal system control. A communication link is established between an RSC and the Command Center within 8 seconds of power-up. The Command Center retrieves a data packet the RSC once every 8 seconds and uses the data provided by the RSC to determine the correct state for all outputs. All decisions are controlled by the configuration file for that RSC. Each RSC in the System is monitored and the proper output state determined once every eight seconds. When the communication link is lost for any reason, both the RSC and the Command Center will attempt to reestablish the link for three minutes. After three minutes, the Command Center reports the RSC as off-line and the RSC will control its outputs based on factory default control algorithms and setpoints stored in the EPROM.

Microsoft Windows - **EZ** software operates in the Microsoft Windows environment and provides a very fast, easy to use, menu driven graphical User interface. Most System operations can be performed entirely with a mouse, without requiring the use of a keyboard. In addition to a copy of Microsoft Windows, **BAS** also includes several useful Windows applications with the **EZ** system. **EZ** is compatible with any other Microsoft Windows based application and can operate simultaneously with those applications in true multitasking fashion. No previous programming experience is needed to configure or operate any aspect of the system. All system configuration is User-prompted, fill-in-the-blank. The System monitors all User input and alerts the User to any invalid entries.

Data Exchange - Access to all System RSC's inputs, outputs, and configuration data is made available to any Windows application that conforms to the Dynamic Data Exchange specification.

Dynamic Graphics - With the Graphics Builder, graphics display screens can be easily and quickly setup. Floor plans can be imported from CADD or paint programs. Dynamic graphic icons for standard HVAC components such as fans, dx coils, pumps, economizers, boilers, chillers, etc. are all built into the System and menu selectable. These icons are all dynamic, and can be linked to any data in the system. With the Graphics Viewer, the User can quickly view the status of any site, building, floor, zone, or HVAC unit. All Graphics Viewer inputs are performed with a mouse, requiring no keyboard input.

Remote Communication - An identical User interface to that on the Host system (the building being controlled) is available from a Remote Client site (any location remote to the Host site). The only real difference between the Remote and the Local interface is the source of the System data. When accessing the System locally at a BAS Site, all information is provided to the User interface (Building.exe) by the control program that manages System operation in the background (RSCPC.exe) after the data is retrieved directly from the EnerNet. When a Remote connection to a Host Site is made through a modem, the Remote Server application (RemSvr.exe) provides the link between RSCPC.exe and a modem. Remote Server responds to requests for data and processes new configuration information delivered by the Remote Monitoring version of Building.exe. RSCPC.exe is notified of and is responsible for implementing any changes delivered by modem that would impact System operation. The System communicates over standard phone lines at 14400 baud, which provides for rapid data transfers and nearly transparent screen updates.

Password Security - Seven levels of security built into the System. All software features and menu items are pre-set to a security level. A security log is maintained to keep a record of the date, time, and name of all Users logged onto the system.

Equipment Schedules (ES) - Control of all equipment is based on pre-programmed control algorithms referred to as Equipment Schedules. Extensive research and development efforts were invested in developing individual control algorithms that optimize the operation of each equipment type in all known applications. The Equipment Schedules provided with each System covers virtually all commercially available HVAC equipment. Once perfected, the control strategy for each ES is integrated into in each new System. This strategy has eliminated the need for BAS and our Dealers to develop custom control strategies at each new installation. BAS has established standards that are used as the basis for control at each Site. The structure of the software used as the foundation of the BAS System eliminates the variables in reliability, maintainability, quality and equipment operating efficiency that is all too common to the control industry. These problems are nearly impossible to avoid when the programming for each new Installation is done by different individuals with different backgrounds, levels of experience and knowledge of mechanical systems.

The Command Center contains advanced control algorithms used by all RSCs when connected to a trunk line. A simplified version of each control algorithm is stored at the RSC in an EPROM. The software in the EPROM is used for equipment operation when the Command Center can not communicate with the RSC for any reason. An Equipment Schedule for each equipment type supported by BAS is provided both in every Command Center and in the EPROM of every RSC delivered by BAS. The RSCs are fully interchangeable without modification between all equipment that uses a supported Equipment Schedule. Equipment Schedules, with each control algorithm delivering optimum equipment operation, are available for up to 128 different types of HVAC equipment. When a type of equipment is found that is not supported, an Equipment Schedule is developed and the System upgrade is distributed to all installed Sites free of charge.

During system configuration, an Equipment Schedule is chosen for each RSC. When the correct Equipment Schedule is selected, a configuration file will be created using factory defaults for the RSC at that address. The User can then choose to accept factory defaults or customize the Zone configuration. The System will use the configuration file to customize the control algorithm for that Zone. All System configuration information is stored in configuration files on the System hard disk. This makes the System virtually immune to data loss resulting from power outages. The System will automatically return to full operation within 1 minute after power is restored. The configuration files can be changed at any time and the changes will take effect immediately without requiring the software to be compiled or the full System to be re-started.

All Equipment Schedule control algorithms are also contained in an EPROM located on the RSC. Dip switches located on the RSC are used to select which Equipment Schedule is used for RSC default control. On initial startup, or any time that communication with the Command Center is lost, the RSC takes over unit control using preprogrammed heating and cooling setpoints.

Equipment Schedule Editor - The Equipment Schedule editor can be used to change the factory default control algorithm of any Equipment Schedule, or a new Equipment Schedule can be created. Changing the control sequence for any piece of equipment is as easy as a point and click with the mouse. Any custom Equipment Schedules developed by Dealers can be easily copied and used at a new site. Because this tool is so simple to use, and the results can have a major impact on the operation of the equipment, this feature should be limited to use by the Installer only.

Auto Configuration on Startup - The quickest building configuration can be performed by simply setting an address and equipment schedule at each RSC, connecting them to a trunk line, and energizing the system. If the Command Center finds an RSC on-line with no existing configuration file, a configuration file is created using a field defined default or, if none exists, system defaults. The System and all Zones are fully functional at this point and additional effort by the user is only necessary if changes are to be made to the automatic settings (such as a unique description for each Zone).

Sophisticated Alarm Configuration - Each Control Zone in the system can have up to 16 alarm or special control functions configured, in addition to 64 Global Alarms, for a total of 16,400 total System alarm or control functions. All inputs and outputs at each RSC can be configured to take any combination of alarm actions. The factors that determine activation of an alarm or control function include:

1. The input or output point and the desired trigger level. For digital I/O points this can be either On or Off. For analog points, the selected reading is compared to either a fixed value or set to be some amount above or below the configured Zone setpoint.
2. The time-of-day mode during which the alarm can be activated.
3. The number of seconds that the monitored value must exceed the alarm setpoint before an action is taken.

Once all conditions for an alarm or control function are met, the available actions are

1. Screen display of message
2. Printer output
3. Log to hard disk
4. Callout to fax machine terminal
5. Callout to a digital pager
6. Take a specific action.

The specific action feature can act on output in the System and is not limited to the originating Zone. The specific action can turn on or off any digital output or Master Alarm and position any analog output to either a specific percentage open or a relative +/- change from the current position. Specific actions can also be used to shutdown or re-initialize a Zone, place an individual Zone or the entire building into Setback Override, and start the lag pump in a Lead/Lag pump configuration. Master Alarms also can be configured selectively throughout the system, with all regular alarm features available. This feature provides the User with a simple-to-use yet powerful scripting language that can be used for those unique control situations not covered by an Equipment Schedule.

Alarm Callout to Fax and Digital Pager - Any system alarm can be configured to be sent to a remote fax machine and/or sent to a digital pager. The fax machine will display detailed information about the alarm condition and the status of the all inputs and outputs at that RSC at the time of the alarm. The pager will display a four digit number corresponding the Host Site Number set up at configuration.

Global Alarms - The System allows configuration of up to 64 Global Alarms. These Alarms are configured identically to Zone alarms, except that they may only be triggered by global values such as outside air temperature or enthalpy and Master Alarms. Even though Alarm or Control Functions that have an effect on System-wide operation can be configured at any Zone, they should be configured as a Global Alarm. This will allow for easier troubleshooting of System operation.

Master Alarms - A System total 32 Master Alarms are available to all Zones. Each Master Alarm can have an accumulated value anywhere from 0-255. Each of the 16 specific actions at any Zone and any Global Alarm can be configured with a specific action to raise or lower the value of any Master Alarm by 1. Any Zone or Global Alarm can also monitor any Master Alarm as a test point and take actions based on the accumulated value of a Master Alarm. This feature allows for fast and easily configured communication of System or Zone status to all System RSCs simultaneously.

The Trend/Alarm Logging - All RSC inputs and outputs at any zone can be stored on the hard disk for later retrieval and review. All parameters flagged in the initial system setup are logged to the hard disk once every ten minutes. A new trend log is started each month. The Trend Log Viewer utility allows for screen display or printer hard copy of any User selected parameters. The Trend Log also monitors and stores all setback override conditions, which can be useful in billing tenants for off hours HVAC operation.

Any alarm condition that has been configured for logging will be stored in the Alarm Log. The Alarm Log is in a text format and can be viewed by the text editor provided with the System, or any other standard text editor. .The Alarm Log can also be printed by any standard text editor with printing capabilities, such as Notepad.

Weekly Schedules - Up to 32 weekly schedules can be configured, each with two occupied and two unoccupied times per day. Each weekly schedule can be configured for eight days, including seven weekdays and a holiday. Any HVAC equipment or miscellaneous equipment can use any weekly schedule.

Pre-Configured Holidays - All 10 US federal holidays through the year 2010 are pre-configured and provided with the system. Any of these holidays may be modified or any new holidays easily added.

Time Schedule Override Capabilities - The standard time of day schedules for all HVAC equipment and miscellaneous equipment can be overridden in one of three ways. All System overrides are logged to the Trend Log for review and reporting. The three overrides types are listed in order of least to greatest priority:

1. All Zones Override, a pre-programmed one time override event to either the occupied or unoccupied mode
2. Single Zone Override, a pre-programmed one time override event to either the occupied or unoccupied mode available for each Zone
3. Setback Override, an input activated from the zone that will override the zone to occupied for a preset amount of time.

Override Reports - Override reports can be printed for any single Zone or the entire building. This report will show start and stop times, length of override, and total override hours for the entire month. This report is useful for property managers to bill tenants for off-hours HVAC operation.

Zone Setpoint Override - Each Zone can be equipped with an optional Setpoint Override control for use by the Tenant in modifying the temperature of the space. The control is mounted to the face of the wall sensor. This control will change the setpoints used for temperature control of the Zone when in the Occupied mode. The configured base setpoints are not affected. The range of the allow setpoint modification is from +/- 0° to +/- 10° F. Each Zone can be individually configured for the amount of override allowed.

Smart Recovery (Warmup/Cooldown) - All Equipment Schedules that use different setpoints for the unoccupied mode can use Smart Recovery. If the space is in unoccupied mode and below the occupied setpoint, the system will calculate a time to enter warmup mode. This time will be based on actual space temperature, desired occupied setpoint, outside air temperature, and recovery history for the zone. If the space is in unoccupied mode, above the occupied setpoint, and has an economizer the system will enter Cooldown mode. The software tracks actual setback recovery conditions and adjusts startup times for subsequent recoveries.

Dual Enthalpy Economizer Control - All systems with economizers installed use dual enthalpy to determine the economizer mode. One outside air enthalpy sensor is used for all economizers in the system. Each HVAC unit with an economizer has an enthalpy sensor installed in the return air duct.

Pressure Independent Damper Control - All VAV and VariZone Equipment Schedules can be selected to use either pressure dependent or pressure independent damper control.

Terminal Regulated VAV Control - The latest development in VAV server control is known as TRAV (Terminal Regulated Variable Air Volume). This concept uses input from all of the clients (zone dampers) to reset a variable frequency drive on the VAV server (rooftop air handler). The duct static pressure is allowed to vary, within preset limits, to the minimum necessary to satisfy the clients. This control strategy provides for a significant energy reduction with a corresponding increase in comfort and air quality.

Outdoor Air Reset Control - Reset of controlled temperature, based on outside air temperature, is available for several schedules. All parameters are User defined. These include outside air shutoff temperature, maximum outside air temperature, minimum controlled temperature, maximum controlled temperature, reset ratio, and unoccupied degrees offset.

KW Load Shedding - Any piece of HVAC equipment and any piece of miscellaneous equipment can be configured for KW load shedding. All equipment configured for load shed are assigned a priority from 1-32 by the User. Any number of pieces of equipment can be given the same load shed priority. If building KW exceeds the preset level, the system will begin to shed equipment belonging to successively higher priority levels until KW falls below the preset demand level. Up to 16 KW meter input locations are available and any Zone may be assigned to any meter. Load Shed temperature setpoints will maintain reasonable comfort at each Zone that has been Shed.

Temperature Control - Proportional, integral, and derivative control modes are standard. Each of these three factors may be modified by the User at each Zone.

PID Loop Tuning - Proportional, integral, and derivative gains can all be changed for each control zone. The User can also change the cycle rate (cycles per hour) and derivative look back time. Default PID control parameters are provided for all Equipment Schedules and should rarely require adjustment. A Zone History graph is available for all zones. The Zone History will show a graph of the temperature over the most recent PID cycle time to aid the User in PID loop tuning.

Outside Air Temperature and Enthalpy - Both sensors can be input at any convenient RSC location. These are global values and can be used by any RSC in the System through the EnerNet.

Miscellaneous Equipment Control - Any digital output not used by an Equipment Schedule can be configured to be used for miscellaneous equipment such as exhaust fans, lighting control, hot water tanks, etc. Each piece of equipment can be configured for weekly schedule, load shedding, and any System digital input to be used for setback override.

Completely Configurable Main System Screen - The main system screen can be easily modified to select the configuration and data items displayed in the Main List Box. Any I/O point or configuration item selected is displayed for all Zones in the System.

Troubleshooting Screen - Any RSC can be placed in Troubleshooting mode from the Command Center. A detailed display of all RSC inputs, outputs, and communication status is displayed. Any input or output can be overridden by the User to any desired state or value. The Troubleshooting screen will override all other software control functions. A custom label can be assigned to each of the inputs and outputs for clarity.

Optional Fahrenheit/Celsius Display - The temperature display mode can be selected from the system settings screen. All system displays including the main system screen, troubleshooting screen, trend log, alarm log, and configuration files will be automatically scaled to the selected format.

System Troubleshooting - The software is capable of convenient monitoring and temporary override of all system parameters from the Command Center. A custom label can be assigned to each of the inputs and outputs for clarity.

Data Backup/Restore Tools - The standard User interface program, Building, offers a menu selectable automatic backup of all System configuration files. The backup will be saved to both an alternate directory on the Command Centers hard drive and to a floppy disk for safekeeping at an off-site location. All but the largest installations can be backed up to a single floppy disk. The data can be restored from either location. The User is prompted for a confirmation before any existing configuration files are overwritten by the backup.

Hardware Features

These descriptions are applicable to Version 3 hardware only. There are several significant differences and improvements over Version 1 hardware. Version 2 hardware was produced in prototype quantities only and not distributed. All versions are software compatible. They can all be connected on the same trunk line and communicate with any software version at the Command Center. The hardware version can be identified at the Command Center by viewing the ROM version. Version 1 hardware will use ROM Version 3.x. Version 3 hardware will use ROM Version 4.x or greater.

Command Center - The EZ system Command Center is an IBM PC-AT compatible computer. The minimum configuration comes with a 33 MHz 80486SX microprocessor, 4 MB RAM, 1.44MB floppy drive, 250MB hard drive, VGA color monitor, mouse, and a 14,400 baud fax modem.

Advanced Communication Link (ACL) - The ACL is the link between the RSC and the Command Center. Each ACL can control 256 RSCs and resides in the Command Center using one full length standard ISA expansion slot. The ACL is actually a microcomputer using an 8088 microprocessor. On initial boot up, the operating system is loaded onto the ACL. The ACL then directs communication traffic to all RSCs connected to it. This reduces overhead on the Command Center and allows for very fast cycle times.

Remote System Controller (RSC) - The BAS System revolves around the RSC. The design of the RSC circuit board is based on the NEC 78C10 microcomputer. Each RSC has a total capacity of thirty I/O points including eight digital outputs, eight digital inputs, eight analog inputs, four analog outputs, and two remote LCD display modules. The Analog Outputs(AO) are controlled by the RSC but require the use of a separate AO board.

The RSC meets all onboard power requirements with a standard 24 VAC power supply. When power reaches the RSC it is first passed through a pair of automatic resetting solid state fuses and an isolation transformer. This combination provides the RSC with almost complete immunity to fluctuations and noise in the 24 VAC power supply. It also protects vital components against faults that could affect RSC operation and reliability. All DC voltages necessary for system operation are generated by two onboard regulated power supplies, 18 Vdc for external components and 5 Vdc for onboard digital logic circuits. All field wiring connects to the RSC with de-pluggable compression type screw terminal strips. These de-pluggable terminals allow for rapid change-out of damaged RSCs.

RSCs can be mounted in a central location, but are usually distributed throughout the facility and mounted near the equipment they serve. The RSC is 5 1/2”w x 7”h and is mounted in a 7 1/2”w x 9”h NEMA 1 metal enclosure. Electrical conduit knockouts are provided in both 1/2” and 3/4” sizes. The RSC must be either mounted in a dry location or a field supplied enclosure used. RSCs are available from BAS without an enclosure and can be mounted directly to any flat surface using plastic standoffs. The RSC and all devices supplied by BAS, except the Command Center, are rated as Class 2 limited energy electrical devices. UL does not require UL certification of any component manufactured and sold by BAS as long as the installation conforms to the NEC for a Class 2 circuit installation.

One RSC can control up to 4 HVAC control zones. Equipment Schedules are the control sequences for a given type of HVAC equipment. Equipment Schedules are stored on an EPROM that resides on the RSC. Positioning a dip switch on the RSC will determine which Equipment Schedule is used for RSC default control. Two banks of dip switches are located on the RSC. One switch bank determines the Equipment Schedule and the other set is used for the RSC address and troubleshooting.

Two forms of communication interface are available at each RSC. Communication between each RSC and the Command Center follows the RS-485 specification. Up to 32 RSCs can be placed on each of eight trunk lines. Communication is on a standard 2-conductor, 18 AWG, twisted shielded pair (tsp), with all RSCs on a trunk line wired in parallel. An RS-232 interface is also available at each RSC and is the communication standard used to communicate with the Handheld Tester.

Several status LEDs are provided on the RSC. A great deal of troubleshooting can be performed by simply checking the status of these LEDs. A heartbeat LED monitor is located on the RSC and will indicate the operational status and mode of the RSC. Two LEDs indicate the status of all incoming and outgoing communication from the RSC to the trunk line. One additional LED is provided at each digital output to indicate the commanded state of the output.

Digital Inputs - Digital Inputs are activated by routing 18 Vdc from the RSC power supply to the appropriate RSC input terminal through a field device. This field device could be anything with a set of dry contacts.

Digital Outputs (DO)- Control of loads connected to Digital Outputs is provided by triacs mounted on the RSC. Each output can directly switch loads up to 1 A @ 24 Vac. Loads that exceed these ratings should be provided with a pilot duty relay for interface to the RSC. Each DO is accompanied by an LED that indicates the state of the DO. The 8 DOs are divided into two banks of 4 DOs each (Bank A (DO1-4) and Bank B (DO5-8)). The power supply common to each bank can be shared with the RSC or each bank can use an individual common, isolated from the rest of the RSC. This allows for control of up to two different pieces of HVAC equipment having a factory transformer from one RSC without the use of field installed isolation relays.

Analog Inputs (AI)- All analog inputs are jumper selectable as 0-5 Vdc or 4-20 mA. All 8 AI locations are provided with a separate 18 Vdc power supply terminal and a dc common terminal.

Analog Output Conversion Cards (AO) - All modulating analog outputs are provided by an AO card. AO cards receive digital control data from the RSC and use the data to generate 4 individual modulating current or voltage outputs. Each output is jumper selectable as either 4-20 mA or 0-10 Vdc. The AO card connects to the RSC by means of a factory provided 16 pin ribbon cable and connector.

Standard Wall Sensor - The standard Zone temperature sensor is housed in a wall mounted enclosure and senses temperature using an LM-34 solid state device. These sensors have a guaranteed minimum error not to exceed +/-1° F. The sensor's output is offset and amplified to a provide a total range seen by the System of 32-96° F. The comparatively small range of the wall sensor (64° F) was chosen to provide maximum temperature resolution at normal comfort temperatures. This sensor also allows much more accurate PID load calculations. The accurate load determination will provide more accurate temperature control than sensors which span large temperature ranges.

The sensor uses an 18 Vdc power supply from the RSC and generates a linear output of 0-5 Vdc output. An amplifier, noise filter and calibration pot are included on the LM-34 circuit card. A Class 2 three conductor cable connects the sensor to the RSC. A twisted shielded cable should be used to connect the RSC to sensors that are located in electrically noisy environments. A push button extends from the cover for setback override. The sensor is 2 1/2"h x 2" w designed for direct mounting to drywall.

Wall Sensor Options - Wall sensors can be provided with an attractive backplate designed for horizontal mounting to standard 2" x 4" electrical enclosures. Vandal-proof wall sensors are also available. These are mounted to the back of a 2" x 4" stainless steel plate for flush mount applications. All wall sensor styles can be provided with a front mounted setpoint offset control. This option requires the use of a four conductor cable between the RSC and the sensor rather than the standard three conductor cable.

Duct, Well, and Outside Sensors - The LM-34 solid state device is available from BAS in three additional temperature ranges, 30-157° F in both duct and well mounted configurations, 0-255° F in both duct and well mounted configurations, and (-12)-115° F in a weatherproof enclosure for input of outside air temperature. These ranges will provide the necessary input for nearly all standard HVAC applications. Range adjustment, calibration, and screw terminals are provided on a circuit card mounted to the back of the box cover of each sensor type. These cards are manufactured and calibrated to a specific temperature range and are not interchangeable with other sensor types.

Third Party Analog Input Devices - BAS welcomes the use of sensing devices provided by third party suppliers. Industry standard voltage and current devices are supported without modification. The requirements for an Analog Device to be fully compatible with an RSC are:

1. The device must be able to operate on an 18 Vdc supply
2. The device consumes no more than 0.7 VA
3. The signal delivered to the RSC does not fall outside the limits of 0-5 Vdc for a voltage device or 4-20 mAdc for a current device.

HandHeld Test Device (HTD) - The HTD communicates with the RSC through a 6 pin RJ-11 connector by means of a 9600 baud standard RS-232 serial data port. The HTD is a menu driven RS-232 “dumb” terminal that gives instantaneous access to all RSC data and allows manual override of all RSC outputs. The RSC delivers 5 Vdc regulated power to the HTD, eliminating the need for an external HTD power supply. When the HTD is connected to an RSC, the presence of the HTD detected by the RSC. The RSC will sever its connection to the EnerNet and accept commands from the HTD after it first notifies the Command Center that it is entering local HTD mode. The RS-485 driver is disabled while in HTD mode and no communications will take place between that RSC and the EnerNet.

An optional cable is available that allows the RSC to communicate with any standard RS-232 terminal through a standard serial cable using either a nine pin or a twenty-five pin serial connector. It is possible to connect the HTD to an RSC from a remote location up to 250’ away. A six conductor wire must be run from the RJ-11 HTD connector on the RSC to a remotely mounted RJ-11 jack.

Chapter 2

Energy Zone® Software Features

Overview

The **Energy Zone®** (**EZ)** System was designed to be **EZ** without sacrificing any of the advanced features and capabilities found in a modern control system. By using the System defaults, a new installation can be up and running in seconds. For more advanced Users, the System can be customized to meet a building owner's special needs for control, comfort, and energy savings.

Features Described In This Chapter

- Microsoft Windows Compatibility
- Equipment Schedules
- Smart Recovery (Warmup/Cooldown)
- Dual Enthalpy Economizer Control
- Outside Air Reset Control
- Optional Fahrenheit/Celsius Display

Features Described In More Detail Elsewhere

- Password Security
- Pre-Configured Equipment Schedules
- Dynamic Graphics
- Auto Configuration on Startup
- Equipment Schedule Editor
- Remote Communication
- Trend/Alarm Logging
- Sophisticated Alarm Configuration
- Alarm Callout to Fax and Digital Pager
- KW Load Shedding
- Miscellaneous Equipment Control
- Weekly Schedules
- Pre-Configured Holidays
- Completely Configurable Main System Screen
- Troubleshooting Screen
- Dynamic Data Exchange
- Convenient Override Capabilities
- PID Loop Tuning

Microsoft Windows Compatibility

Any software designed to operate in the Microsoft Windows environment will operate on the Command Center at the same time as **EZ**. Any alarm conditions which occur and are configured for screen display will be displayed on top of the active window.

Precautions for Multitasking with EZ

1. The amount of available RAM is one of the most important criteria when operating in Windows. This can be determined by selecting About Program Manager...from the Help menu in Program Manager. The amount of memory should not be allowed to fall below about 250KB free. Memory can be made available by closing applications not actually in use.
2. It is also important to use caution with applications that make extensive use of the processor. Some processes such as file copying, database sorting, printing large documents, or calculating large spreadsheets can take a long time to complete. **EZ** will not be communicating with the RSCs during this time. If these processes take more than 30 seconds of continuous operation to complete, building control may begin to be adversely affected. If any operation takes longer than 3 minutes to complete, the RSCs will enter default mode.
3. Do not run any DOS application while running Windows in Standard Mode. This will cause all Windows applications to be temporarily suspended. This is not a problem if Windows is run in Enhanced Mode. All Systems are shipped from **BAS** setup to operate in Enhanced Mode.
4. Use caution when using any DOS application from Windows. It is always safest to test the application for a short time to verify that **EZ** is not affected by the DOS application.

Equipment Schedules

An Equipment Schedule is the combination of all control functions necessary for a given type of HVAC equipment. Equipment Schedules are provided for all commonly available commercial HVAC equipment. Equipment Schedules are set by adjusting a dip switch on the RSC and through the configuration screen at the Command Center. The RSC is then controlled by that Equipment Schedule locally when in default and by the Command Center when on-line.

Command Center Based Equipment Schedules -The following is an example of an Equipment Schedule under Command Center control:

EQUIPMENT SCHEDULE #7

Heat Pump, 2 Stage, Backup Heat, Economizer, Reversing Valve Cooling

DIGITAL OUTPUTS	**DIGITAL INPUTS**
DO1 - Fan	DI1 - Setback Override
DO2 - Compressor #1	
DO3 - Reversing Valve	**ANALOG INPUTS**
DO4 - Backup Heat	AI1 - Space Temperature
DO5 - Economizer Min Pos/Pwr Supply	AI2 - Return Air Enthalpy
DO6 - Economizer Cooling	
DO7 - Compressor #2	

OCCUPIED MODE CONTROL SEQUENCE - ECONOMIZER ACTIVE

Stage	Fan	Cmp 1	RV	B/U Ht	M Pos	Econo	Cmp 2	DO8	AO1	AO2	AO3	AO4
Econo 3	ON	ON	ON		ON	ON	ON					
Econo 2	ON	ON	ON		ON	ON						
Econo 1	ON				ON	ON						
At Set	ON				ON							
Heat 1	ON	ON			ON							
Heat 2	ON	ON			ON		ON					
Heat 3	ON	ON		ON			ON					

UNOCCUPIED MODE CONTROL SEQUENCE - ECONOMIZER ACTIVE

Stage	Fan	Cmp 1	RV	B/U Ht	M Pos	Econo	Cmp 2	DO8	AO1	AO2	AO3	AO4
Econo 3	ON	ON	ON		ON	ON	ON					
Econo 2	ON	ON	ON		ON	ON						
Econo 1	ON				ON	ON						
At Set												
Heat 1	ON	ON										
Heat 2	ON	ON					ON					
Heat 3	ON	ON		ON			ON					

Those inputs and outputs listed above are dedicated to the use of this Equipment Schedule. All inputs and outputs not listed can be programmed at the Command Center for auxiliary functions such as exhaust fan control, air flow switch input for alarm, outside air temperature input, etc.

Default Control Equipment Schedules -The default control algorithms are located in the EEPROM onboard the RSC. Because the EEPROM is non-volatile memory, the control algorithms are not lost when power is cycled to the RSC and battery backup is unnecessary. The desired algorithm to use is selected by the dip switch position on the RSC.

The following is an example of an Equipment Schedule default control:

EQUIPMENT SCHEDULE #7

DIGITAL OUTPUTS	**DIGITAL INPUTS**
DO1 - Fan	DI1 - Setback Override
DO2 - Compressor #1	
DO3 - Reversing Valve	**ANALOG INPUTS**
DO4 - Backup Heat	AI1 - Space Temperature
DO5 - Economizer Min Pos/Pwr Supply	AI2 - Return Air Enthalpy
DO6 - Economizer Cooling	
DO7 - Compressor #2	

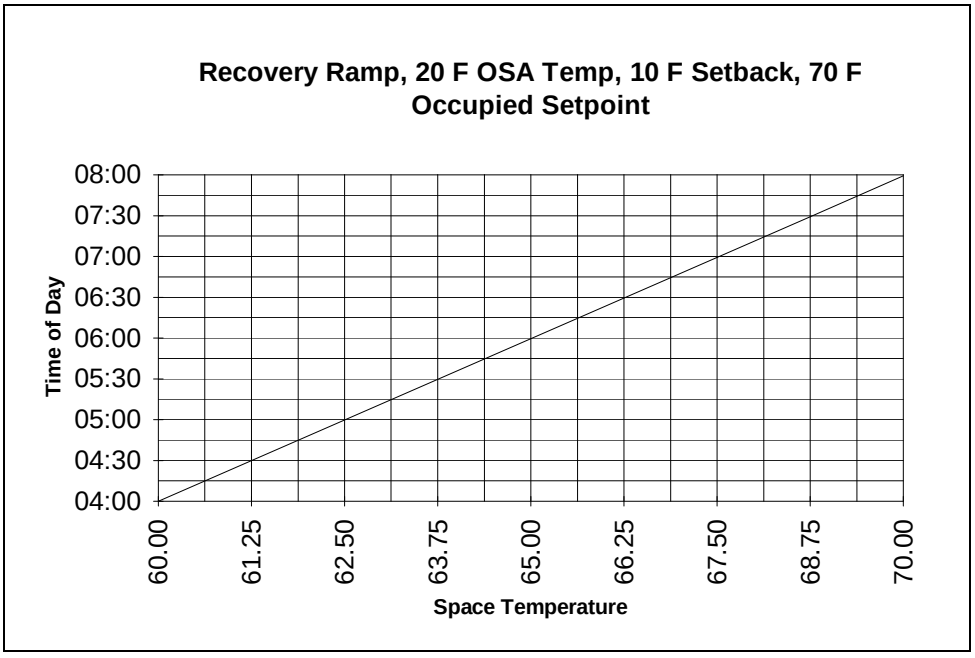
DEFAULT MODE CONTROL SEQUENCE

Temp	Fan	Cmp 1	RV	B/U Ht	M Pos	Econo	Cmp 2	DO8	AO1	AO2	AO3	AO4
>76	ON	ON	ON				ON					
>75 <=76	ON	ON	ON		ON		ON					
>74 <=75	ON	ON	ON		ON							
>=71 <=74	ON				ON							
<71 >=70	ON	ON			ON							
<70 >=69	ON	ON			ON		ON					
<69	ON	ON		ON			ON					

Smart Recovery

Warmup Mode Sequence of Operation

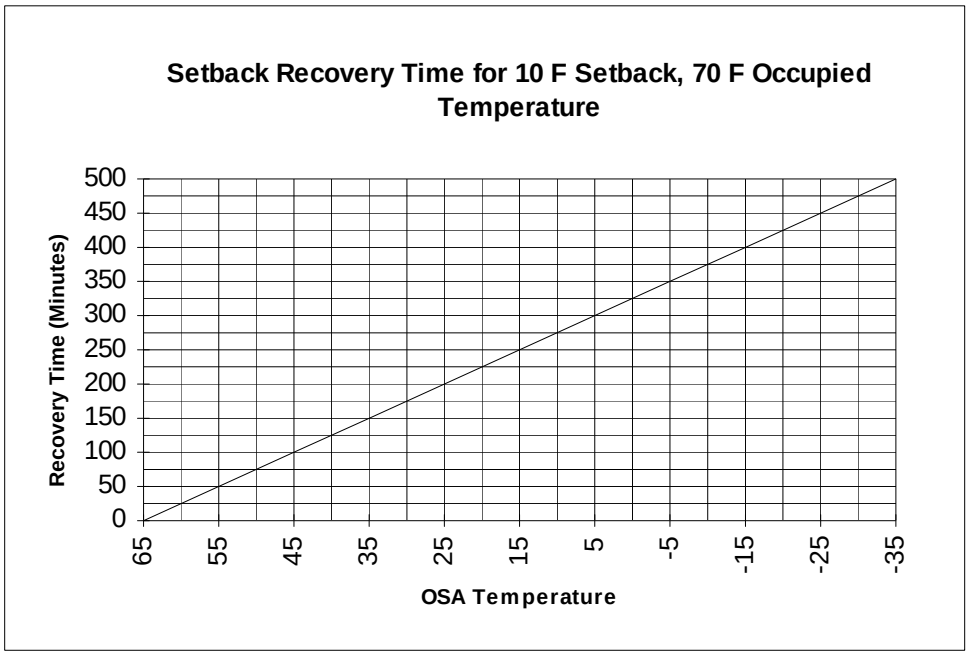
1. The first time an RSC needs to calculate a start time for recovery from night setback, the start time is based only on outside air temperature, occupied setpoint, and degrees of setback. Higher occupied setpoint temperatures, greater amounts of setback and lower outside air temperature will all require longer recovery times.
2. The System is configured to start all available heat stages on Warmup stage 1, except for heat pumps. Only compressor heat will be used for stage 1, and backup heat will be used for stage 2. The System will be maintained in Warmup stage 1 or 2 until the space has reached occupied setpoint. At this time, the space will be controlled using normal occupied control sequences.
3. On the basis of the calculated startup time, the System will generate a ramp of time versus temperature. This ramp is used in determining the number of Warmup stages to be used at any point in the recovery. If the Warmup is progressing normally, only Warmup stage 1 is energized. If the space temperature falls more than 2° F below the ramp, the System will activate Warmup stage 2 and maintain this stage until the temperature comes within 1° F of the ramp.



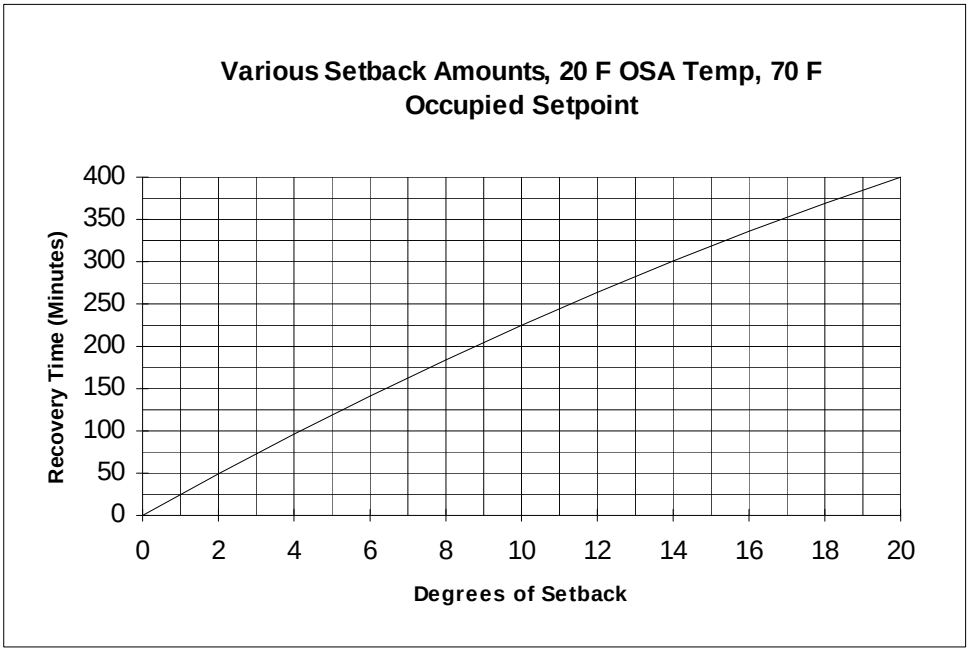
4. The System will track the actual setback recovery conditions and adjust startup times for subsequent recoveries. The following will cause the startup times to be modified:
   a. Setpoint not achieved at occupied time, subsequent startups increased by 2% for every ° F below setpoint.
   b. Occupied setpoint achieved early, subsequent startups decreased by 1% for every 5 minutes early.
   c. Warmup stage 2 required to be activated, subsequent startups increased by 1% for every minute stage 2 was activated.

Graphs of Various Warmup Recovery Conditions

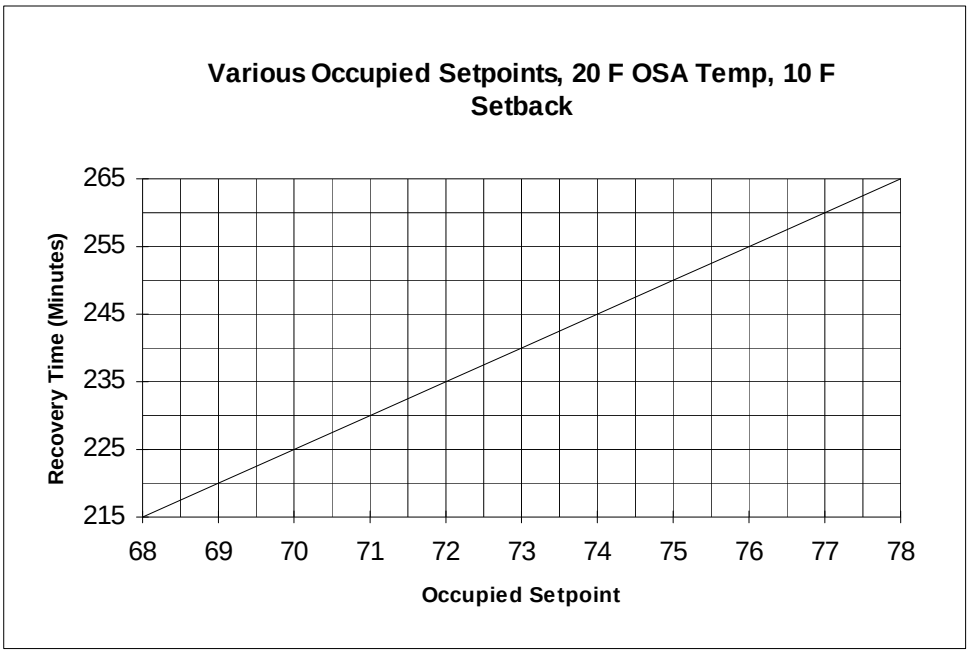
The first graph will show the amount of recovery time calculated for various outside air temperatures with a 60° F space temperature and a 70° F occupied setpoint.



The next graph shows the amount of recovery time calculated for an outside air temperature of 20° F, a 70° F occupied setpoint and varying degrees of setback.



The last graph shows the amount of recovery time calculated for an outside air temperature of 20° F, a space temperature 10° F below occupied setpoint and increasing high occupied temperatures setpoints.



Cooldown Mode Sequence of Operation

1. Cooldown is a mode in which an economizer is used to cool a building during the night prior to Occupied start time.
2. In order for any zone to enter and remain in Cooldown mode, all of the following conditions must be met:
   a. The temperature in the zone is greater than the Occupied cooling setpoint, but less than the Unoccupied cooling setpoint.
   b. The zone has economizer capability.
   c. Time of day is within 4 hours of Occupied start time.
   d. Outside air temperature is greater than 50 F.
   e. Outside air enthalpy is less than return air enthalpy.
3. When in Cooldown mode, the System will remain in full Economizer mode. No other cooling stages are allowed to operate.
4. If the Occupied cooling setpoint is achieved prior to Occupied start time, the zone will re-enter Unoccupied mode.

Software Setup

1. The only setup necessary is to check the Smart Recovery checkbox on the RSC configuration screen for that zone. All other operation is automatic.

Dual Enthalpy Economizer Control

General

1. Description - An economizer is a combination of outside air, return air, and sometimes relief air dampers. The outside and relief dampers work in the same direction and the return damper operates in the opposite direction. These dampers are generally connected through a common linkage to a single actuator. The outside air dampers are capable of providing 100% outside air to the system air handler. If no motorized relief damper exists, relief is generally provided through a barometric relief damper.
2. Factory economizer packages generally perform very well. It is often best to use the factory economizer package, rather than building an economizer in the field. The actuator would be 24 Vac powered, spring return to closed, and include both a minimum position pot and a discharge air temperature sensor. One digital output is used to make or break the 24 Vac power to the actuator. The second digital output is used to either make the circuit to the discharge air sensor allowing the actuator to operate or break the circuit to the discharge air sensor forcing the actuator to drive to minimum position.
3. **EZ** will also allow for use of built up economizer packages, using either an analog actuator or 3 point floating actuators. With this setup, the System will directly control the actuator position and minimum position is set in software. A discharge sensor must be installed by the Dealer and wired to Analog Input 4.

Sequence of Operation

1. If the zone needs cooling and the outside air enthalpy is lower than the return air enthalpy, the economizer will be activated on first stage cooling.
2. The action taken in Economizer Mode will be dependent on the type of economizer being used:
   a. If override of a factory economizer package is used, the economizer output is activated.
   b. If either an analog actuator or a 3 point floating built up economizer is used, the actuator will be opened 100% and be maintained open unless discharge air temperature falls below 55° F. The damper will close 5% per minute until the temperature returns to above 55° F.
3. The economizer will be maintained at minimum position when not active and in the Occupied mode.
4. The economizer will be closed when not active and in the Unoccupied mode.

Software Setup

1. No setup is necessary. Any schedule with economizer capability will control automatically.

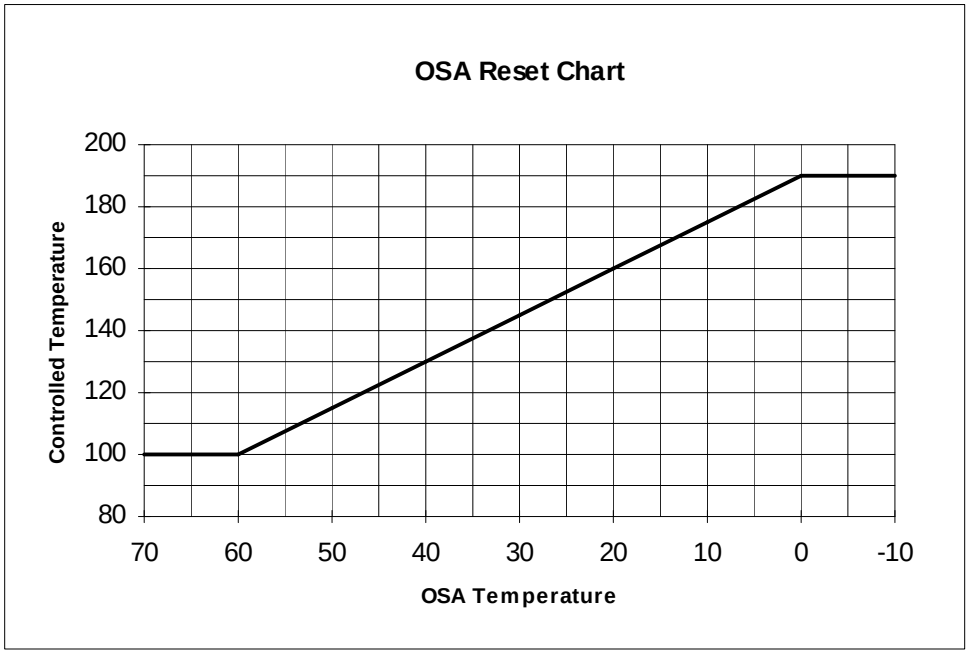
Outside Air Reset Control

Description

1. Outside Air (OSA) Reset Control is available for heating equipment only and only when the RSC is on-line.
2. When using OSA Reset, the setpoint used for RSC control is adjusted based on the outside air temperature. The parameters used for setup are:
   a. Shutoff Temperature is the outside air temperature at which heat is no longer needed and all stages of heat are shut off. When this setpoint is reached, the Zone is forced to AtSet. If an actuator is configured for the Zone, the actuator will close when the OSA cutoff temp is reached
   b. Maximum Outside Air Temperature is one of the points used for calculation of the reset ramp.
   c. Reset Ratio is the number of degrees by which the Controlled Setpoint will increase above the Minimum Controlled Temperature for each degree of OSA temperature decreases below the Maximum OSA Temperature. This number can be anywhere from 0.05 to 12.75 in increments of 0.05.
   d. Unoccupied Offset is the degrees offset below the calculated daytime control ramp to be used in the Unoccupied mode.
   e. Minimum Controlled Temperature is used for calculation of the reset ramp and corresponds to maximum outside air temperature on the ramp.
   f. Maximum Controlled Temperature is the highest allowed temperature of the controlled device, regardless of calculated reset temperature.

Outside Air Reset Example

Shutoff Temperature - 70° F
Maximum OSA Temperature - 60° F
Reset Ratio - 1.50
Minimum Controlled Temperature - 100° F
Maximum Controlled Temperature - 190° F



Optional Fahrenheit/Celsius Display

Description

All temperature display ranges can be optionally selected for Fahrenheit or Celsius display. The desired display range can be selected at any time. Once selected, all temperature displays will be in the correct range. The System default is Fahrenheit. Manual conversion can be done using the following formulas:

° F = (1.8*° C) + 32
° C = (° F - 32) / 1.8

Part II

Software

Chapter 1

Main Window

Overview

All actions that configure, monitor or modify the operation of an **Energy Zone®** (**EZ**) Site are accessed from the Main Window of the Building program. This chapter provides a description of the Main Window components and instructions for configuration functions available to Access Level 1.

Features

- Graphical Representation of Zone Status
- Simple Point-and-Click Mouse Interface

Specifications

Password Security - **EZ** allows for six levels of Password Security. See the Main Window chapter for a detailed description of the menu items available at each access level.

Passwords can only be edited for those Users at the same or lower levels as the current User. Dealers are given a Level 4 password with every System and are responsible for setting up a password file for each installation. It is important that the password level matches the ability of the User. Damage to controlled equipment can occur if the User is not qualified to be making the changes allowed by the password level.

The current User level is displayed on the status bar at the bottom of the Main List box. The Access menu has a Log Off option, allowing for return to Level 0. The System will automatically return to Level 0 after a period of no keyboard of mouse activity. This time is configurable, and would typically be 15 minutes. The Access Timeout is configured under the Options / Settings menu.

The levels and their intended use are:

0 No System parameters can be changed at this level. This is designed to be used for System monitoring only. The Main List box, Miscellaneous Equipment status, and the Trend Log can all be monitored.

1 The ability to change Setpoints, program Overrides, and view both Active Alarms and the Alarm Log is added at this level. This level is designed to be used by building managers with minimum qualifications.

2 This level adds editing of Weekly Schedules, Holiday Schedules, Phone book, and Zone List options. This level is designed to be used by building managers with moderate qualifications.

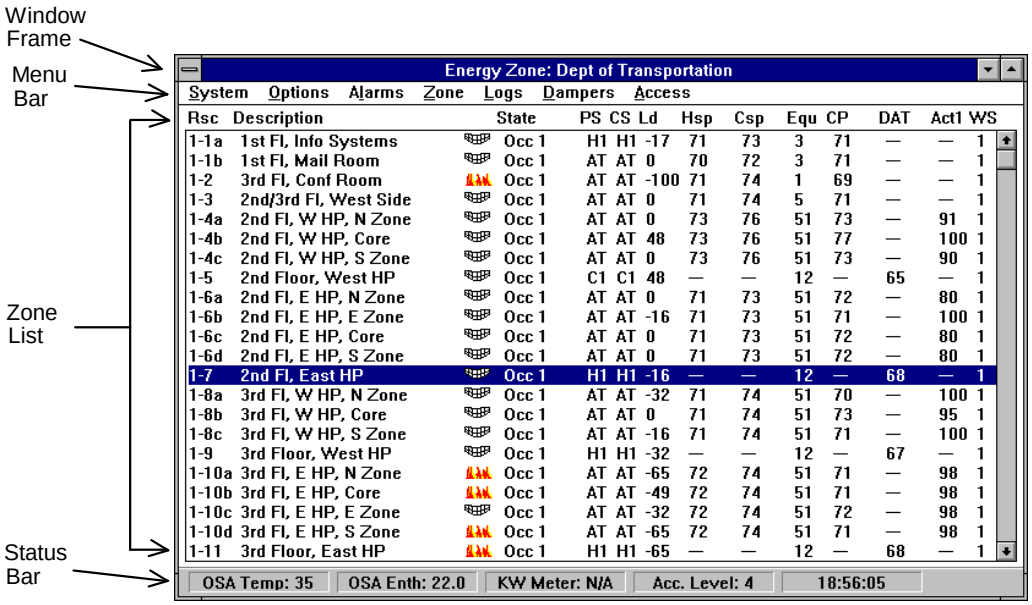
3 This level allows for complete System configuration and troubleshooting. This level is designed to be used by design engineers, technicians, and building managers with significant qualifications.

4 This level allows access to the Equipment Schedule Editor. This level is designed to be only used by design engineers or technicians with extensive background in control theory and mechanical equipment.

Note: A Level 5 and Level 6 Access are used for **BAS** internal testing and configuration only.

Main Window

The Main Window of the Building program is automatically displayed when the program is activated. This is done by clicking on the Building icon in the **Energy Zone®** group. This window is used as the primary User interface.



Energy Zone Main Window

Main Window Components

Window Frame - This component is the same for most Microsoft Windows applications. The frame includes items such as the caption (which names the site), minimize and maximize buttons. The window frame allows the Energy Zone window to be sized as desired.

Menu Bar - Just below the caption resides the menu bar. All System operation and configuration can be accessed through the menus found here. The menu items included on the menu bar are determined by the System mode (on-site or Remote Monitoring) and the Access Level of the User.

Zone List - At the center of the **EZ** window is the Zone List Box. This List Box contains an entry for every Zone in the System. The data columns displayed in the Zone List Box are User selectable and can be modified at any time. The Zone List Options include configuration data, Zone input and output values, and operational status. Startup, monitoring, and troubleshooting operations can be completed on any Zone from within the List Box. All individual Zone operations require that the Zone first be selected in the Zone List Box by pointing and clicking at the Zone with the mouse.

Status Bar - The status bar is located at the bottom of the Main Window. The status bar displays the current outside air temperature, outside air enthalpy, KW demand level (from the meter that is configured for the currently highlighted Zone), User Access Level, and time of day. If connected remotely, the System can also be configured to display communication errors. This number is the total of all errors that have occurred since connecting to the Host Site.

Using the System Interface

These rules apply to all operations in the **Energy Zone®** System.

Menu Selections - All Menu selections can be made by both the mouse and the keyboard. Mouse selections are made by pointing and clicking on the desired selection. The keyboard can be used by pressing both the Alt key and the letter that is underlined in the Menu.

Pop-Up Menu - A Pop-Up menu is also provided for the most frequently used System actions. This menu is accessed by pointing anywhere inside the Zone List and holding down the right mouse button.

Selecting a Zone - The System will direct all individual Zone actions to the Zone that is currently selected in the Zone List Box. To select a Zone, use the mouse to point and click anywhere on the that Zone's line in the Zone List. The current selection is indicated by highlighting the entire line for that Zone in the Zone List.

Selecting Multiple Zones - Several System operations can be performed simultaneously on multiple Zones. To select multiple Zones that are listed consecutively in the Zone List, click on the first Zone, hold down the Shift key, and then click on the last Zone. All Zones between and including the two selected are then highlighted. To select multiple Zones that are not listed consecutively in the Zone List, click on the first Zone, hold down the Control key, and then click additional Zones one at a time.

Selecting a List Item - Item displayed in List Boxes must be selected in order to performing an edit action. Use the mouse to point and click on the item in the List. The selection is indicated by highlighting the item in the List Box.

Dialog Box Buttons - The following buttons will provide the same action in all Dialog Boxes.

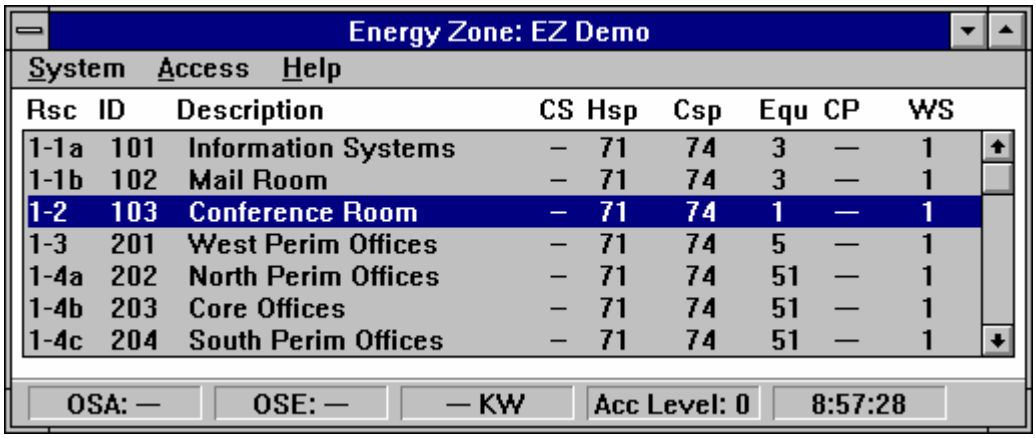
- Ok - This will accept all entries. When necessary, this will update the stored configuration files. There is no provision to undo any entry that has been accepted by selecting Ok.
- Reset - This will undo any current entries and restore all items in the Dialog Box to their original values. This feature will not work after the entries have been accepted by selecting Ok.
- Cancel - This will allow User to exit the Dialog Box without making any changes.
- Add - This is used to add a new item to the group in the currently displayed List Box.
- Delete - This is used to delete the currently selected List Box item.
- Edit - This is used to edit the currently selected List Box item. Most Dialog Boxes will also enter the edit screen when the item is double-clicked in the List Box.
- Close - This will exit the Dialog Box.
- Defaults - This will set all Dialog Box entries to factory defaults.

Edit Shortcut - Most List Boxes will enter edit mode for any item that is double-clicked from inside the List Box.

Change Setpoints Shortcut - When a Zone is double-clicked in the Zone List Box from Access Level 1 or higher, the Change Setpoints Dialog is activated for that Zone.

System Log In

To Log In to the System, select Access from the Menu Bar.



Access Menu

Enter a valid password. The screen will display an * for all keyboard entries.

System Access Screen

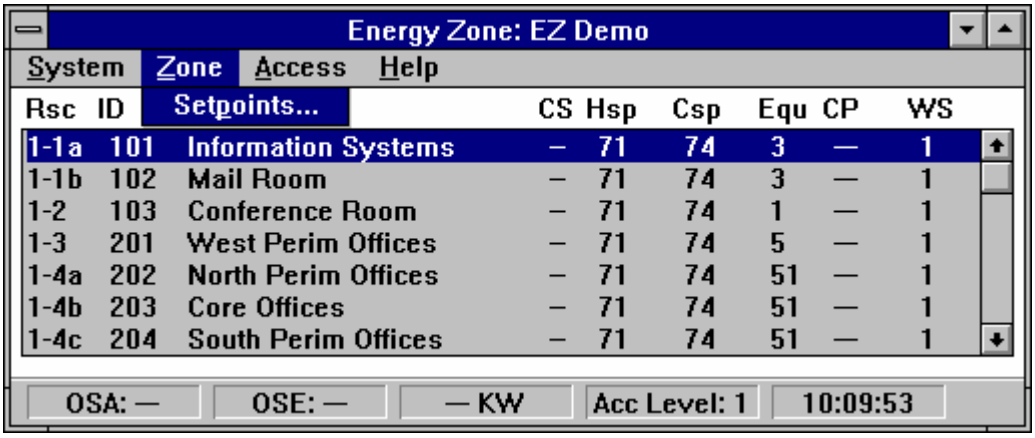
System Log Out

At the completion of an **EZ** session, it is important for the User to Log Out of the System. This will prevent unauthorized changes being made to the System. The Log Out menu item will return the System access to Level 0. To Log Out of the System, select Access and then Log Out from the Menu Bar.

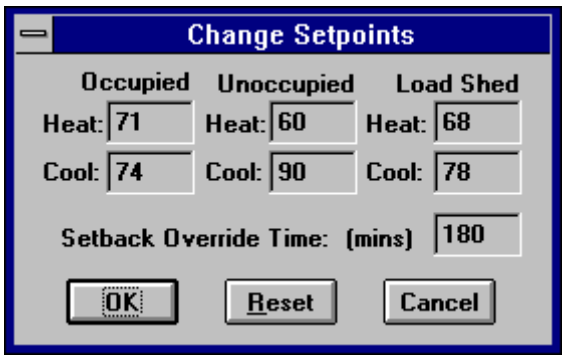
Automatic Log Off: If there is no mouse or keyboard activity for a pre-set number of minutes, the System will automatically Log Out the current User and set Access to Level 0. The default time delay setting is 30 minutes. This can be modified using System / Site Configure / General Settings... from Access Level 3.

Changing Zone Setpoints & Setback Override Time

To display the Change Setpoints dialog, first select the Zone in the Zone List Box. Then select Setpoints ... from the Zone menu. Access Level 1 is required to change Setpoints.



Zone Menu



Change Setpoints Screen

Occupied Heat: and Cool: Enter the desired temperature control setpoints for the Occupied time-of-day mode.

Unoccupied Heat: and Cool: Enter the desired temperature control setpoints for the Unoccupied time-of-day mode.

Load Shed Heat: and Cool: Enter the desired temperature control setpoints to be used when this Zone is in KW Load Shed mode. Load Shed setpoints are grayed out unless the Zone has been configured to allow KW Load Shedding.

Setback Override Time (mins): This is the length of time that the Zone will be placed in Occupied mode if the setback override button on the wall sensor is pushed while Unoccupied. This time can be set from 0 to 65,535 minutes.

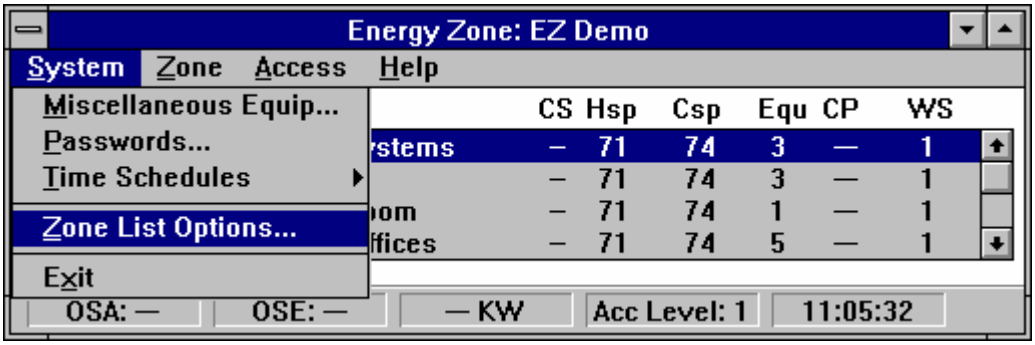
Setpoint Entry Limits - The System will verify that the setpoints entered do not exceed the following limitations. An error message will be displayed if an invalid entry is made.

1. The setpoint must be within the range of the sensor being used for Zone control. The standard wall sensor is scaled to a range of 32-96° F.
2. The heating setpoint must always be lower than the cooling setpoint for each mode. The required separation is set by the DeadBand value configured for the site. The default DeadBand is 2° F. This can be modified using System / Site Configure / General Settings... from Access Level 3.
3. The Load Shed Heat setpoint can not be higher than the Occupied Heat setpoint.
4. The Load Shed Cool setpoint can not be lower than the Occupied Cool setpoint.

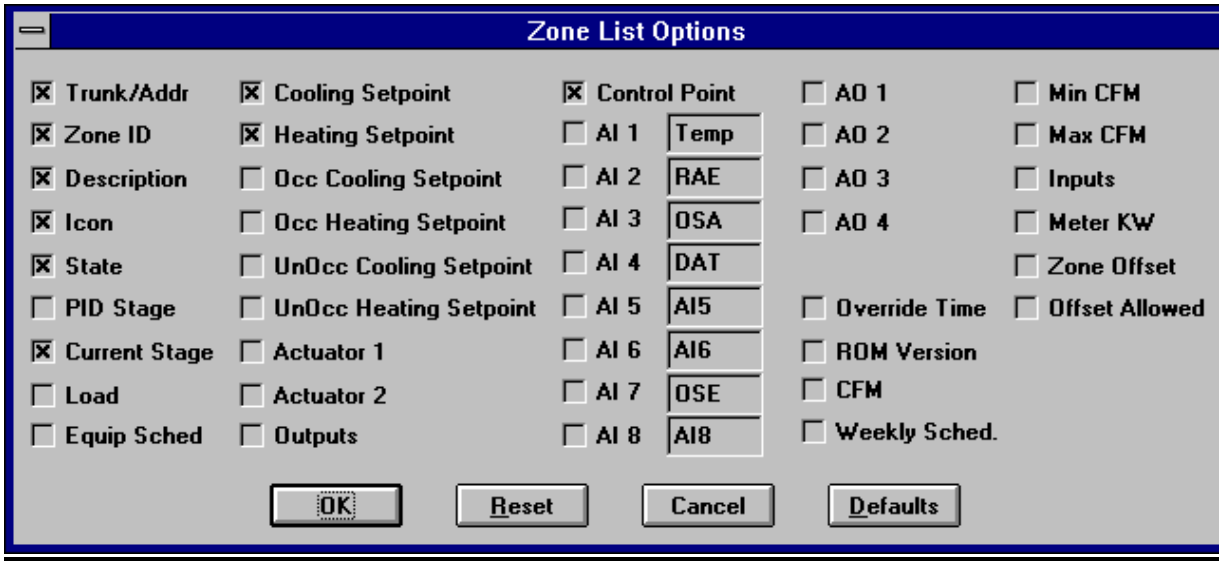
Note: To change Setpoints in multiple Zones, all selected Zones must use the same Equipment Schedule.

Zone List Options

Zone List Options... are accessible from the System menu.



System Menu



Zone List Options Screen

The options shown are the default Zone List Options. To select information for display, simply click on the desired information box with the mouse.

Note: The User must be logged onto the System at Access Level 1 to modify the Zone List Options.

Description of Zone List Options

- **Trunk/Addr** - Trunk (1-8), Address (1-32), and if applicable SubZone (a-d).
- **Zone ID** - Usually is the room number, but will display information entered as the ID: item of Zone Configuration.
- **Description** - This is a text description and comes from the Description: entry in Zone Configuration.
- **Icon** - This is a graphical representation of the status of the Zone. The possible Icons and their meanings are:


Cheshire Cat Grin - Zone is on-line and at setpoint.


Flames - Zone is in heating. (PID Load is <= -48). This Icon will only display if the Zone has heating capability, as configured in the Equipment Schedule Editor.


Icicles - Zone is in cooling. (PID Load is >= +48). This Icon will only display if the Zone has cooling capability, as configured in the Equipment Schedule Editor.


Fireman's Hat - Zone is in alarm.


Circuit Board - Zone is off-line.


Handheld Tester - Zone is in local Test mode with a Handheld Tester.

- **State** - This is the current state of the zone. The valid states are:

AlmDis	Display of Alarm messages configured for screen or printer output is disabled.
Az Occ	All Zones Override into Occupied mode.
Az UnOcc	All Zones Override into Unoccupied mode.
Calibrate	System is calibrating the Zone CFM airflow sensor zero offset.
CoolDwn	Smart Recovery Cool Down mode.
DmprMax	All dampers are forced to the maximum position as configured for that Zone.
DmprMin	All dampers are forced to the minimum position as configured for that Zone.
EarlyOcc	Completion of Smart Recovery prior to Occ 1.
Init...	Zone has just come on-line with the Command Center and is being initialized.
SetbkOvr	Local Setback Override to Occupied mode.
ShedOvr	Zone has been placed in KW Load Shed mode.
Sz Occ	Single Zone Override into Occupied mode.
Sz UnOcc	Single Zone Override into Unoccupied mode.
Occ 1	First programmed occupied time of the day.
Occ 2	Second programmed occupied time of the day.
offline	Zone is not communicating with the Command Center.
UnOcc 1	First programmed unoccupied time of day, from midnight to Occ 1.
UnOcc 2	Second programmed unoccupied time of day, between Occ 1 and Occ 2.
UnOcc 3	Last programmed unoccupied time of day, from Occ 2 to midnight.
WarmUp	Smart Recovery Warm Up mode.

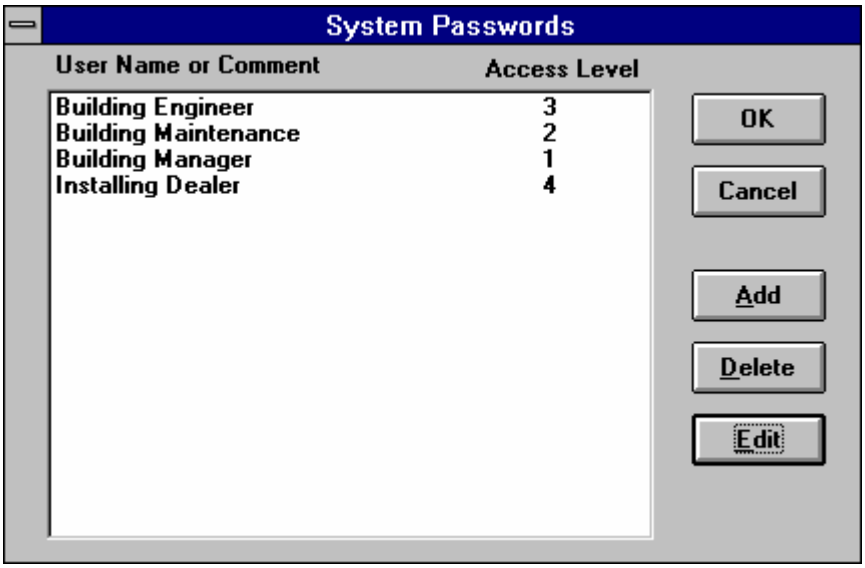
- **PID Stage** - The calculated PID stage. The valid stages are:

C1 - C4	Cooling stage 1 through cooling stage 4.
H1 - H4	Heating stage 1 through heating stage 4.
AT	Zone is at setpoint.
FA	Zone is forced at setpoint. This occurs when the Zone reaches setpoint prior to the end of the stage time calculated by the System.

- **Current Stage** - The present operating stage. The valid stages are the same as the valid PID stages.
- **Load** - The PID load. This will be a number from -255 (maximum heating need) to +255 (maximum cooling need). If the Zone is configured as a Server and the source of the Load is its Clients, a ‘c’ will be displayed after the number.
- **Equip Sched** - The number of the Equipment Schedule.
- **Cooling Setpoint** - The cooling temperature setpoint for the current time-of-day mode for the Zone. The displayed value will automatically change as the time-of-day modes change.
- **Heating Setpoint** - The heating temperature setpoint for the current time-of-day mode for the Zone. The displayed value will automatically change as the time-of-day modes change.
- **Occ Cooling Setpoint** - The cooling temperature setpoint for the Occupied mode.
- **Occ Heating Setpoint** - The heating temperature setpoint for the Occupied mode.
- **UnOcc Cooling Setpoint** - The cooling temperature setpoint for the Unoccupied mode.
- **UnOcc Heating Setpoint** - The heating temperature setpoint for the Unoccupied mode.
- **Actuator 1** - The percentage open position of the first 3 point floating actuator.
- **Actuator 2** - The percentage open position of the second 3 point floating actuator.
- **Outputs** - The current state of all outputs for the Zone. A display of 0 indicates the output is off, and 1 indicates the output is on. All 8 outputs are listed in order from 1 to 8.
- **Control Point** - The scaled value of the Control Point. This is normally the same as AI1, but could be a calculated value as configured for that Zone.
- **AI1** thru **AI8** - The value of the Analog Input, scaled correctly based on the Zone configuration. The edit box on the right is used to enter a label to be used at the top of the Zone List.
- **AO1** thru **AO4** - The percentage open position of the Analog Output.
- **Override Time** - The time remaining for a User activated local Setback Override.
- **ROM Version** - The version number of the EPROM located at the Zone.
- **CFM** - The calculated Cubic Feet per Minute (CFM) airflow rate for pressure independent Zones.
- **Weekly Sched.** - The Weekly Schedule number being used at that Zone. If the Zone is a Parent, the Weekly Schedule ## will be followed by a 'p' (i.e. 13p). If a Child, the Weekly Schedule ## will be followed by a 'c' (i.e. 13c).
- **Min CFM** - The Minimum CFM configured for that Zone.
- **Max CFM** - The Maximum CFM configured for that Zone.
- **Inputs** - The current state of all inputs for the Zone. A display of 0 indicates the input is off, and 1 indicates the input is on. All 8 inputs are listed in order from 1 to 8.
- **Meter KW** - The KW level reported by the meter configured for Load Shedding at this Zone
- **Zone Offset** - The amount of offset being applied to the configured Occupied setpoints.
- **Offset Allowed** - The maximum amount of offset to the configured setpoints allowed to be input from the Zone.

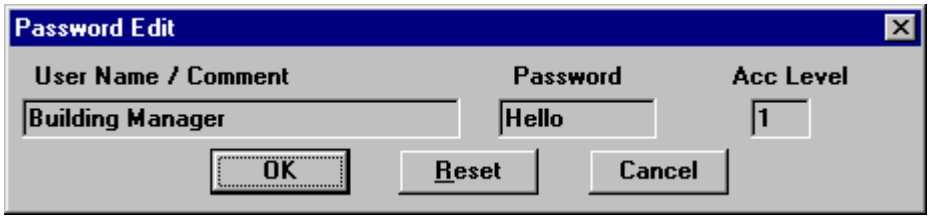
Passwords

The System will only allow Passwords to be Added or modified at the same or lower Access Level as the current User. To add, delete, or edit any password, first select System and then Passwords... from the Menu Bar. This will bring up the System Passwords list box.



System Passwords List Box

To Delete or Edit any password, select that password from the list and then select the Delete or Edit button. To add a new password, select the Add button.



Password Edit Screen

User Name/Comment - The User Name/Comment is used both for display in the System Password list box and for entries made in the Security Log.
Password - The Password can be any combination of numbers, letters, or symbols from the keyboard.
Acc Level - The Access Level can be 1-4.

Menu Configurations

The available selections in the Menu Bar of the Main Window are determined by the Access Level of the User and the operating mode of Building. The menus shown here apply to standard operation with Building running at the Site. When connected to a Host Site using Remote Building, a Communication menu item is added and a couple of items that are not supported Remotely are deleted.

Access Level 0

System	Access	Help
Miscellaneous Equip...		About Energy Zone...
Exit	

Access Level 1

System	Zone	Access	Help
Miscellaneous Equip...	Setpoints...	Log Out	About Energy Zone...
Passwords...		
Time Schedules ->
- Weekly Schedules...
- Holiday Schedules...
- Building Override...
- Zone Override...

Zone List Options...
Exit

Access Level 2

System	Zone	Logs	Alarms	Access	Help
Miscellaneous Equip...	Setpoints...	Trend Logs...	Active Alarms...	Log Out	About Energy Zone...
Passwords...		Alarm Logs...	Active Control Functions...	
Phone Book...			
Time Schedules ->
- Weekly Schedules...
- Holiday Schedules...
- Building Override...
- Zone Override...

Zone List Options...
Exit

Access Level 3

System
Miscellaneous Equip...
Passwords...
Phone Book...
Time Schedules ->
Weekly Schedules...
Holiday Schedules...
Building Override...
Zone Override...
Set Parent...
Undo Parent...
Zone List Options...
Site Configure ->
Comm Settings...
General Settings...
VAV/VariZone Settings...
Outside Air RSC...
KW Load Shed...
Exit

Zone
Setpoints...
Configure...
Troubleshoot...
History
Status
New...
Copy...
Delete...
Set Server...

Logs
Trend Logs...
Alarm Logs...
Security Log...
Comm Error Log...

Alarms
Active Alarms...
Active Control Functions...
Global Alarms...
Master Alarm Status...
Enable Alarm Messages...
Disable Alarm Messages...

Tools
Site Database...
Edit EZ.INI...
Backup Data to A&C
Restore Data from A
Restore Data from C
Damper Override ->
Normal
Minimum
Maximum

Access
Log Out

Help
About Energy Zone...

Access Level 4

System
Miscellaneous Equip...
Passwords...
Phone Book...
Time Schedules ->
Weekly Schedules...
Holiday Schedules...
Building Override...
Zone Override...
Set Parent...
Undo Parent...
Zone List Options...
Site Configure ->
Comm Settings...
General Settings...
VAV/VariZone Settings...
Outside Air RSC...
KW Load Shed...
Equipment Schedules...
Exit

Zone
Setpoints...
Configure...
Troubleshoot...
History
Status
New...
Copy...
Delete...
Set Server...

Logs
Trend Logs...
Alarm Logs...
Security Log...
Comm Error Log...

Alarms
Active Alarms...
Active Control Functions...
Global Alarms...
Master Alarm Status...
Enable Alarm Messages...
Disable Alarm Messages...

Tools
Site Database...
Edit EZ.INI...
Backup Data to A&C
Restore Data from A
Restore Data from C
Damper Override ->
Normal
Minimum
Maximum

Access
Log Out

Help
About Energy Zone...

Pop-up Menus - Pop-up Menus are available to all Access Levels. They can be accessed by clicking the right mouse button from anywhere within the Zone List Box.

Access Level 0

Access

Access Level 1

Setpoints...
Override...

List Options...

Log Out

Access Level 2

Setpoints...
Override...

Trend Logs...
Alarm Logs...
List Options...

Log Out

Access Levels 3 & 4

Troubleshoot...
History...
Status...

Setpoints...
Configure...
Override...

Trend Logs...
Alarm Logs...
List Options...

Log Out

Setpoints Dialog - Using the left mouse button to double click on any Zone while at Access Level 1 or higher will bring up the Setpoints Dialog box.

In Case of Failure at the Command Center

The integrity of the Windows operating system can be affected by a poorly designed Windows application. These events can hinder and possibly even disable the Command Center. These failures can generally be eliminated by using only applications that are provided by **BAS** with the Command Center (Windows standard components and all **Energy Zone®** applications) and those developed by major software vendors. It is also possible for an inexperienced User to inadvertently close Windows or one of the necessary **Energy Zone®** software components.

The System will continue to provide control of the Zones if a problem occurs at the Command Center. If three minutes has passed since the last communication between any RSC and the Command Center, that RSC will assume control of the attached equipment using default control sequences and setpoints.

The following procedure should be used to restore the System to normal operation following any event that is known or suspected to have had an affect on either the Windows operating system or **Energy Zone®**. The steps should be performed in order until the System is restored to normal operation or the Command Center is disabled.

1. Close the problem application or otherwise take steps to correct or eliminate the source of the error. This does not always restore Windows to full normal operation and should only be attempted by Users with experience using the Windows environment.
2. Use the Ctrl-Alt-Del key sequence to re-boot the Command Center.
3. Use the Reset button on the face of the Command Center case to re-boot.
4. Turn off power to all Command Center components (CPU, monitor, modem, etc.). Wait for 10 seconds and re-energize.
5. Turn off and leave off power to all Command Center components (CPU, monitor, modem, etc.). After three minutes all RSCs will enter default mode. Contact your Dealer or **BAS** for additional assistance.

Note: The Command Center and other System components can not be hurt by following these steps. All configuration information is stored on the System hard disk. Upon re-starting, Windows will automatically load all necessary **Energy Zone®**. applications. The System will then load all configuration data and resume normal operation.

Chapter 2

Miscellaneous Equipment

Overview

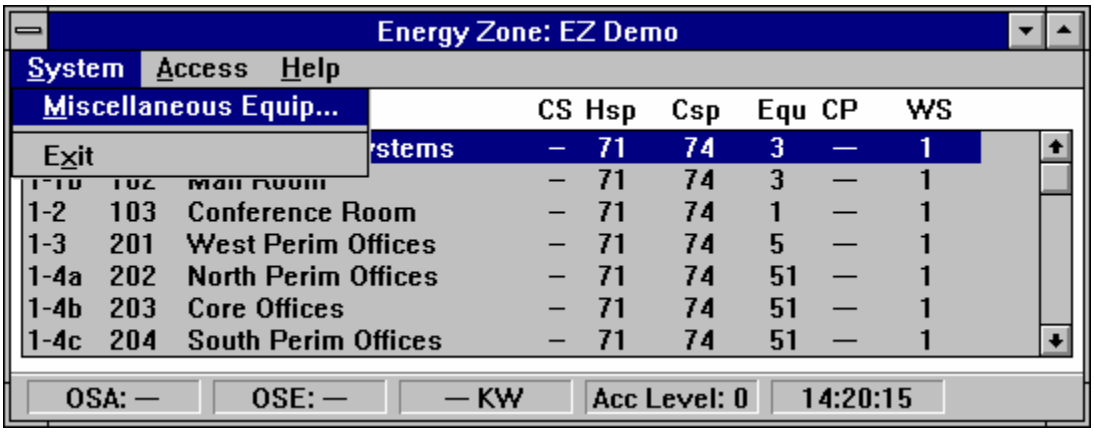
Energy Zone® (**EZ**) has the ability to control Miscellaneous Equipment at any RSC address, independent from any control functions based on the Equipment Schedule. This feature can be used for anything requiring simple on/off control such as lighting, exhaust fans and hot water tanks. An output programmed for Miscellaneous Equipment control will override any Equipment Schedule function attempting to set the state of the output. Miscellaneous Equipment control will not override an Alarm or Control Function.

Features

- Occupied State - On or Off
- Can be Assigned to any Weekly Time Schedule
- Location of Equipment can be any Digital Output on any RSC
- Configurable KW Load Shed Priority Levels
- Setback Override Input Location and Override Time

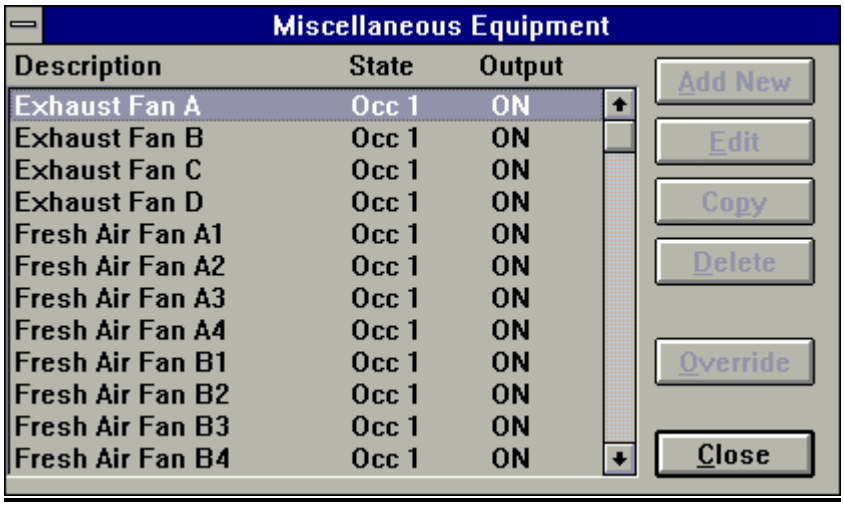
Miscellaneous Equipment Status

The Miscellaneous Equipment Status Screen is accessible from the Main List Box System Menu.



System Menu

This screen is used for display of Miscellaneous Equipment status. The valid States are Occ, Unocc, SZ Occ, SZ Unocc, AZ Occ, AZ Unocc, Setbck Ovr, or Offline. The valid Outputs are either ON, OFF, or -- (Offline).

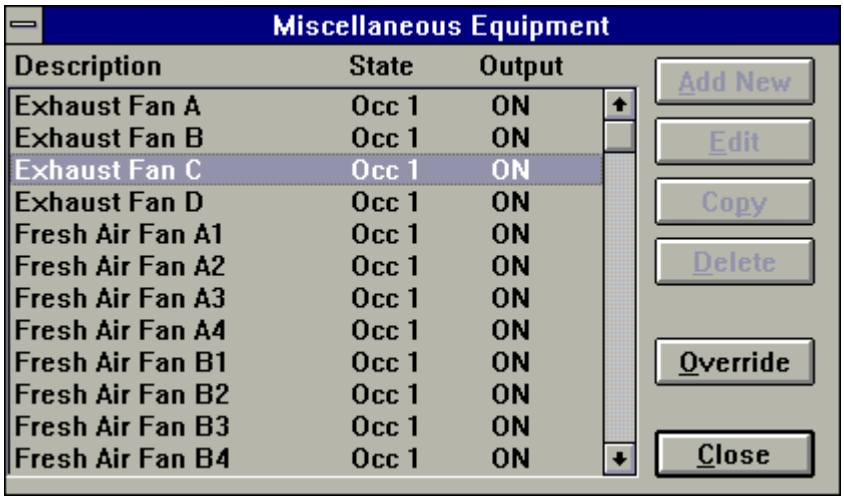


Miscellaneous Equipment Status Screen

Note: The Miscellaneous Equipment Status Screen can be viewed at Access Level 0.

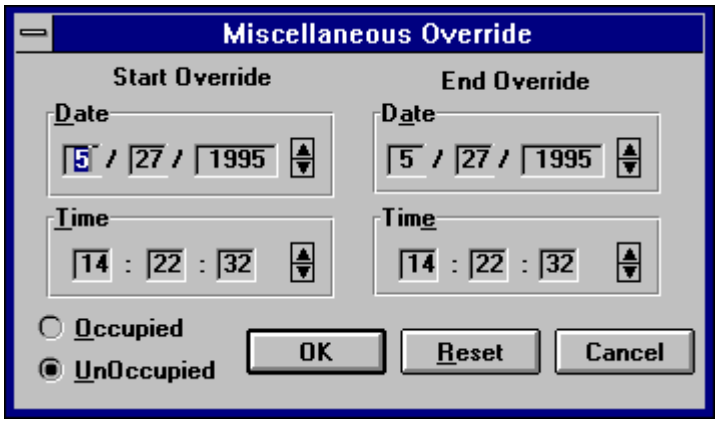
Miscellaneous Equipment Override

To program a one time Setback Override for a single piece of Miscellaneous Equipment, first select the Equipment from the Miscellaneous Equipment list box using the left mouse button. Then select the Override button.



Miscellaneous Equipment List Box

Enter a desired Start time and End time and the mode to be used during the Override period.

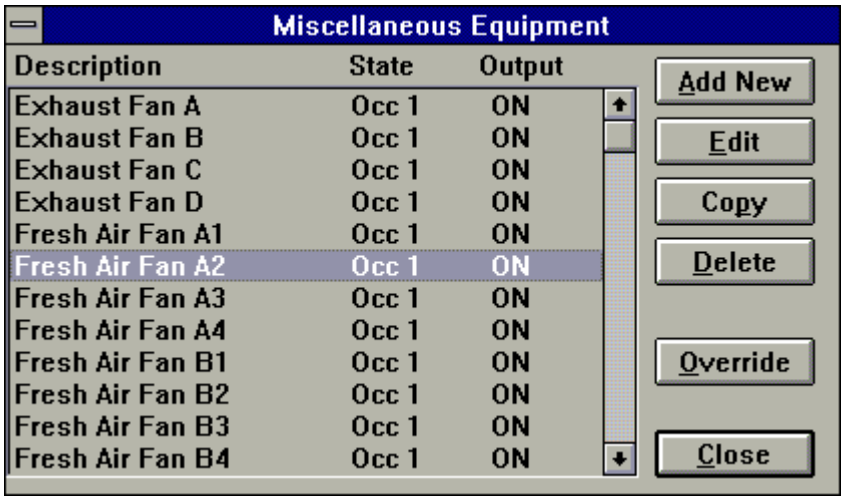


Miscellaneous Equipment Override Screen

Note: The User must be logged onto the System at Access Level 1 to program a Miscellaneous Equipment Override.

Miscellaneous Equipment Configuration

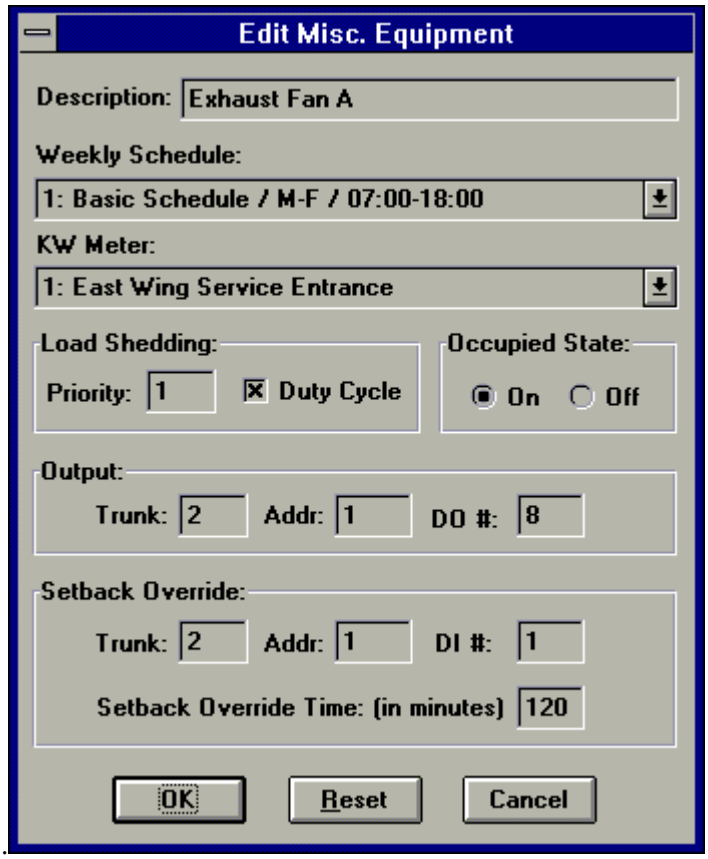
To modify an existing configuration, select the Equipment from the Miscellaneous Equipment list box using the left mouse button. To add a new item, it is not necessary to first make a selection.



Miscellaneous Equipment List Box

Add New - Select the Add New button to configure a new Miscellaneous Equipment item.
Edit - Select the Edit button to modify an existing item.
Copy - Select the Copy button to create a new item and copy all configuration information from the selected Equipment to the new item. The system will create a new item and enter the Edit screen for the new item. Modify configuration as necessary for the new Equipment.
Delete - Select the Delete button in order to remove an item from the System. The Delete function will ask the User for confirmation and then delete the configuration information.

Note: The User must be logged onto the System at Access Level 3 to edit Miscellaneous Equipment configuration.



Edit Miscellaneous Equipment Screen

Description - The description of the Equipment being controlled.

Weekly Schedule - The Weekly Time Schedule used for this equipment. The list box may be dropped down for a complete list of all available weekly schedules.

KW Meter - The KW Meter to be used for KW load shedding of this equipment. The list box may be dropped down for a complete list of all available KW Meters.

Load Shedding - The priority level determines which equipment is Load Shed first. Set a priority level from 1-32. Lower numbers are shed first. Any number of different pieces of equipment may be set to the same priority level. Check the Duty Cycle check box to duty cycle the equipment at the same priority level as this item.

Occupied State - The State of the output in the Occupied mode. In order to ensure fail-safe operation of critical equipment, use a relay to interface the digital output of the RSC to the miscellaneous equipment. Connect the control circuit of the miscellaneous equipment to the normally closed contacts of the interface relay. Configure the miscellaneous equipment to be Off in the Occupied State. A failure in the System will de-energize the interface relay that will then activate the miscellaneous equipment.

Output - The RSC address and output location of the equipment being controlled. This can be any Digital Output (1-8) at any RSC address. Miscellaneous Equipment output locations must be identified by the physical RSC address and Digital Output, not the logical Zone address and output. If an RSC is used for a dual Equipment Schedule, then the physical outputs DO1-8 are setup as logical outputs DO1-4 on Zone A and DO1-4 on Zone B.

Example

RSC 1-1	Zone 1-1a	Zone 1-1b
Physical Output	Logical Output	Logical Output
DO1	DO1	N/A
DO2	DO2	N/A
DO3	DO3	N/A
DO4	DO4	N/A
DO5	N/A	DO1
DO6	N/A	DO2
DO7	N/A	DO3
DO8	N/A	DO4

In order to use DO2 at Zone 1-1b for Miscellaneous Equipment, the output should be configured for RSC Trunk 1, Address 1, DO# 6.

Note: - Any output assigned to an Equipment Schedule should not be used for Miscellaneous Equipment even if it is not actually needed in that Zone. Miscellaneous Equipment will override the output to the correct state when on-line, but the RSC will cycle the output based on the default sequence of operation. It is also not possible to use any output configured for a 3 point floating actuator to control Miscellaneous Equipment. The RSC controls these outputs based strictly on timing and ignores any commands to turn the output on or off.

Setback Override - This configuration will Override the Weekly Time Schedule when the equipment is in the Unoccupied mode. Any Digital Input at any RSC address can be used as an Override input. It is not necessary to use an input at the same RSC as that being used to control the output. The same rules that apply to identification of the output location also apply to input location.

Chapter 3

Time-of-Day Scheduling

Overview

Energy Zone® scheduling provides the User with all of the tools necessary to meet even the most demanding scheduling needs of tenants.

Features

- Standard 7 Day Schedule with 2 Occupied and 2 Unoccupied Periods per Day
- Separate Holiday Schedule with 2 Occupied and 2 Unoccupied Periods per Day
- Monthly Calendars with Programmable Holidays
- Pre-programmed Overrides for Each Individual Zone
- Pre-programmed Override for All Zones in the System
- Occupant Initiated Setback Override Control for Each Individual Zone
- Parent/Child - Links Many Child Zones to the Time-of-Day Mode of one Parent Zone
- Time-of-Day Overrides Available from Alarm or Control Functions
- All Override Events Automatically Stored in the Trend Log

Specifications

Scheduling Priority - The System sets the time-of-day mode of the Zone based on the following order of priority. The priorities are listed in order of least to most important.

1. Standard weekly schedule
2. Holiday Schedule
3. Programmed Building override
4. Programmed Zone override
5. Zone Setback Override
6. Parent/Child Control

Standard Weekly Schedule - The System has the capacity for 32 different time-of-day schedules. Any Zone or piece of Miscellaneous Equipment can be assigned to any one of the 32 schedules. Each schedule has two Occupied and two Unoccupied times per day. Weekly Schedule 32 is dedicated to Zones or Miscellaneous Equipment requiring 24 hour operation and can not be changed by the User.

Holiday Schedule - Each weekly schedule has an eighth day that is used for the time-of-day schedule during holidays. Each holiday has two Occupied and two Unoccupied times per day.

Programmable Holidays - Ten standard holidays through the year 2010 are programmed in the System. Anytime the holiday falls on a Saturday, it is observed on the Friday before. If the holiday falls on a Sunday, it is observed on the following Monday. Any holiday can be easily added or deleted from the System. The programmed holidays are:

1. New Years Day (January 1)
2. Martin Luther King's Birthday (3rd Monday in January)
3. Presidents Day (3rd Monday in February)
4. Memorial Day (Last Monday in May)
5. 4th of July (July 4)
6. Labor Day (First Monday in September)
7. Veteran's Day (November 11)
8. Thanksgiving Day (4th Thursday in November)
9. Friday after Thanksgiving Day
10. Christmas Day (December 25)

Programmable Building Override - The System can have one System-wide, pre-programmed time-of-day schedule override. The override will place all Zones into either Occupied or Unoccupied mode. The override is programmed with a starting date, hour, and minute and an ending date, hour, and minute. The override can be initiated from the System/Building Override menu item or from a programmed Alarm/Control Function.

Programmable Zone Overrides - Each Zone can have one pre-programmed time-of-day schedule override. The override can place the Zone into either Occupied or Unoccupied mode. The override is programmed with a starting date, hour, and minute and an ending date, hour, and minute. The override can be initiated from the Zone/Override menu item or from a programmed Alarm/Control Function.

Setback Override - Each Zone can enter Occupied mode for a pre-programmed length of time. The tenant enters setback override by pressing the button on the top of the wall sensor in the Zone. The button must be pressed for about 2 seconds to initiate an override. Each Zone can be individually programmed for the length of override time allowed, from 0-32,768 minutes. The Zone will return to the standard weekly schedule time-of-day mode at the completion of the setback override. Setback Overrides can also be initiated from a programmed Alarm/Control Function.

Parent/Child - The Parent/Child feature is used to link the time-of-day mode (State) of one Zone (Parent) to the time-of-day mode of one or more other Zones (Child). The Child zones will always use the State of the Parent. There is no limit to the number of Parents, or the number of Children at each Parent. The valid States that will be passed from Parent to Child are:

Az Occ	All Zones Override into Occupied mode.
Az UnOcc	All Zones Override into Unoccupied mode.
CoolDwn	Smart Recovery Cool Down mode.
EarlyOcc	Completion of Smart Recovery prior to Occ 1.
SetbkOvr	Local Setback Override to Occupied mode.
ShedOvr	Zone has been placed in KW Load Shed mode.
Sz Occ	Single Zone Override into Occupied mode.
Sz UnOcc	Single Zone Override into Unoccupied mode.
Occ 1	First programmed occupied time of the day.
Occ 2	Second programmed occupied time of the day.
UnOcc 1	First programmed unoccupied time of day, from midnight to Occ 1.
UnOcc 2	Second programmed unoccupied time of day, between Occ 1 and Occ 2.
UnOcc 3	Last programmed unoccupied time of day, from Occ 2 to midnight.
WarmUp	Smart Recovery Warm Up mode.

The Zone List Box will indicate the Parent and Children under the Weekly Schedule column. If a Parent, the Weekly Schedule ## will be followed by a 'p' (i.e. 13p). If a Child, the Weekly Schedule ## will be followed by a 'c' (i.e. 13c). The Weekly Schedule ## of the Children will match that of the Parent.

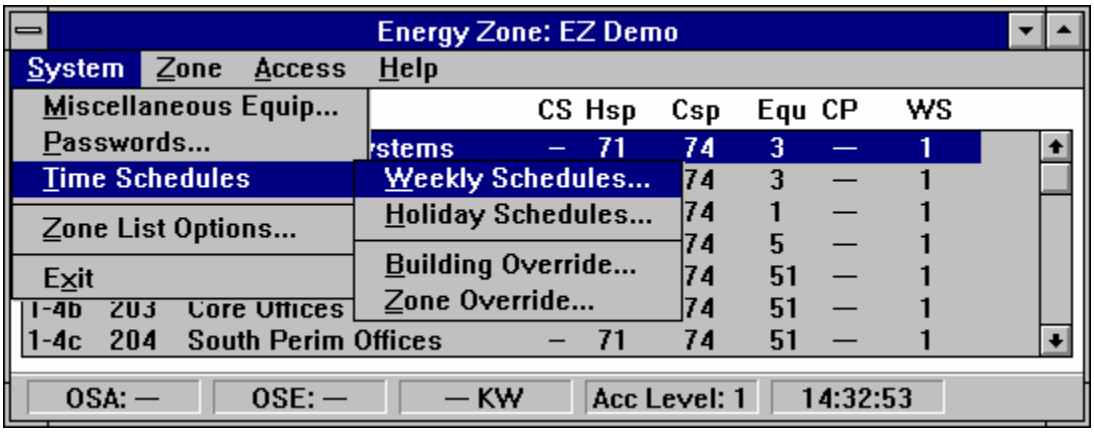
Any Zone configured as a VAV or a VariZone Server can not be configured as a Child Zone.

Overrides Logged - All overrides to the standard weekly schedule are logged to the Trend Log, storing both the begin and end times. This feature allows landlords to bill individual tenants for off-hours usage. See the chapter on Trend Log Viewing for details on this feature. Setback Overrides to a VAV Server are not logged. This would be a duplication of entries, since the override must be initiated from one or more Client zones and are logged at that time.

Alarm/Control Functions - Two time-of-day override conditions can be initiated by either an Alarm or a Control Function. A Building Override can be activated for a period from 1-999 hours. When the Alarm or Control Function is activated, the system will program a Building Override to the Occupied mode for the number of hours specified. This is identical to manually programming a Building Override. When an Alarm or Control Function has been configured for a Setback Override, the system will initiate a Setback Override at that Zone the same as if a Setback Override had been initiated from the Wall Sensor. See the chapter on Alarms and Control Functions for details on configuration.

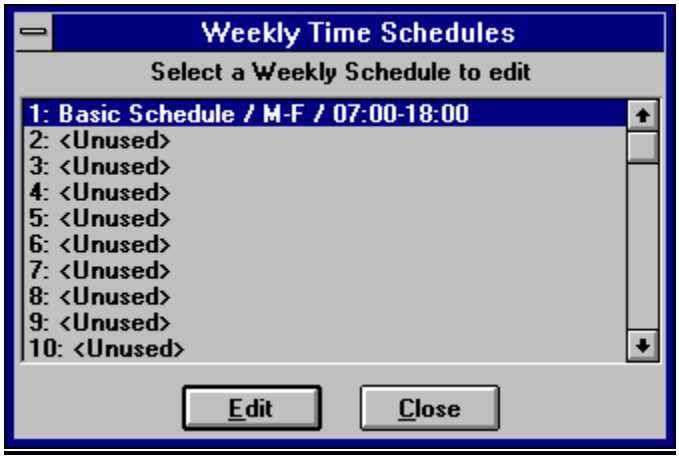
Weekly Schedule Configuration

Weekly Schedule configuration is accessible from the Time Schedules sub-menu of the System menu.



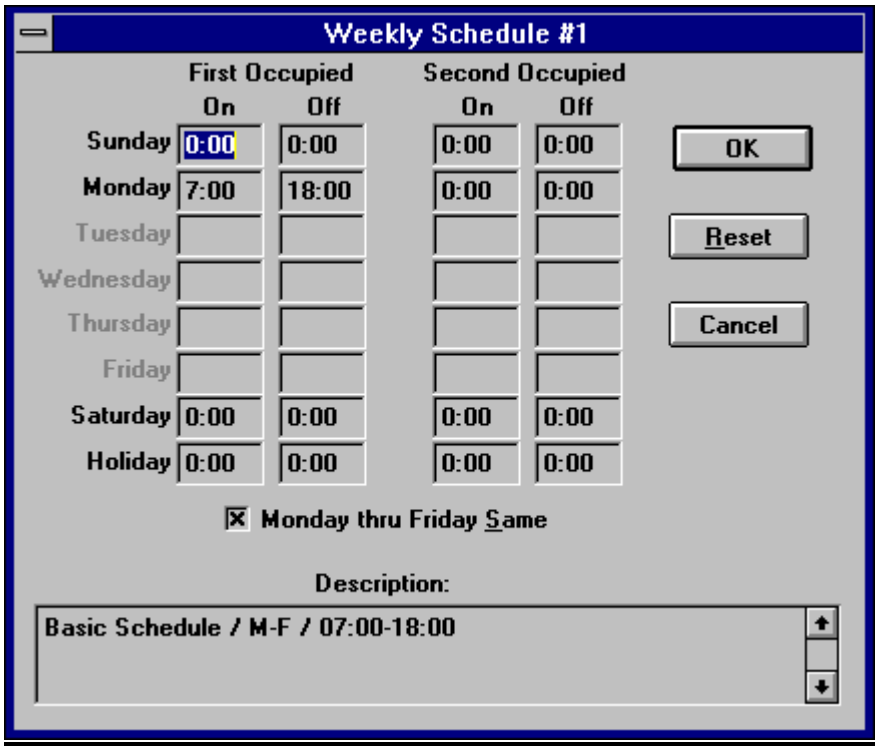
System Menu

The User is then asked to select the Weekly Schedule to edit.



Weekly Schedule Selection Screen

Note: The User must be logged onto the System at Access Level 2 to edit Weekly Schedules.



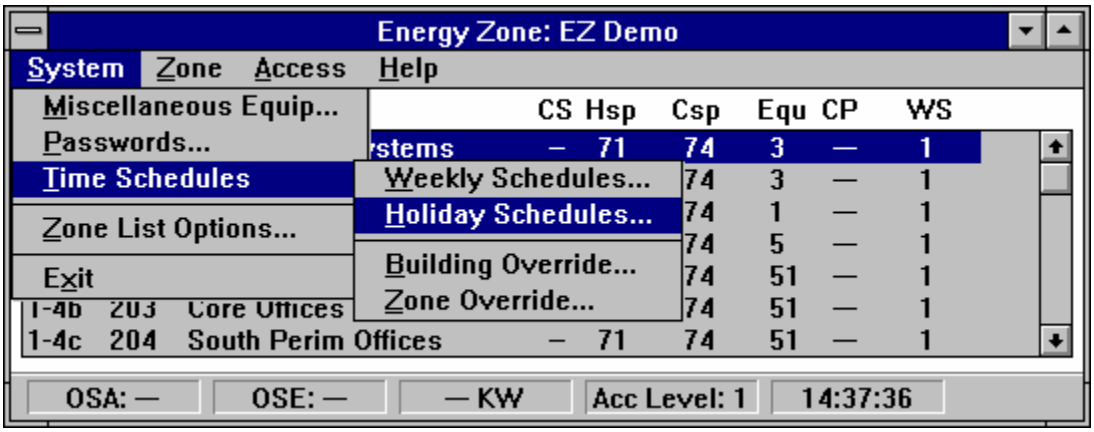
Weekly Schedule Edit Screen

Note: - All time entries must be in 24 hour format.

First Occupied On - Must be between 00:00 and First Occupied Off time.
First Occupied Off - Must be later than First Occupied On time and before 24:00.
Second Occupied On - Must be later than First Occupied Off time and before 24:00.
Second Occupied Off - Must be later than Second Occupied On time and before 24:00.
Monday thru Friday Same - This box should be checked if the same schedule is used for all days of the workweek. If Monday thru Friday Same is checked, then time entries need only be made for Monday.
Description - The first line of the description is used to describe the schedule in the list box. The remainder of the description is a reminder to the User as to the use of this schedule. Entry is optional. For Weekly Schedules assigned to Parent Zones, the description is set by the System and can not be edited.

Holiday Configuration

Holiday dates are accessible from the Time Schedules sub-menu of the System menu.

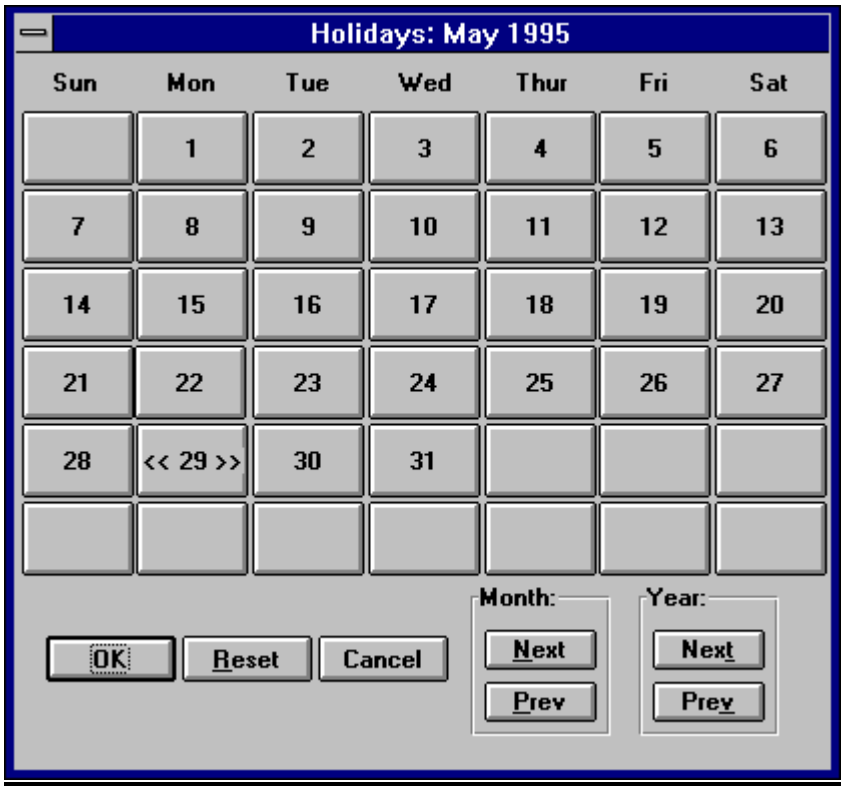


System Menu

The User is then asked to enter the Year and Month to edit.

Holiday Selection Screen

Note: The User must be logged onto the System at Access Level 2 to edit Holidays.

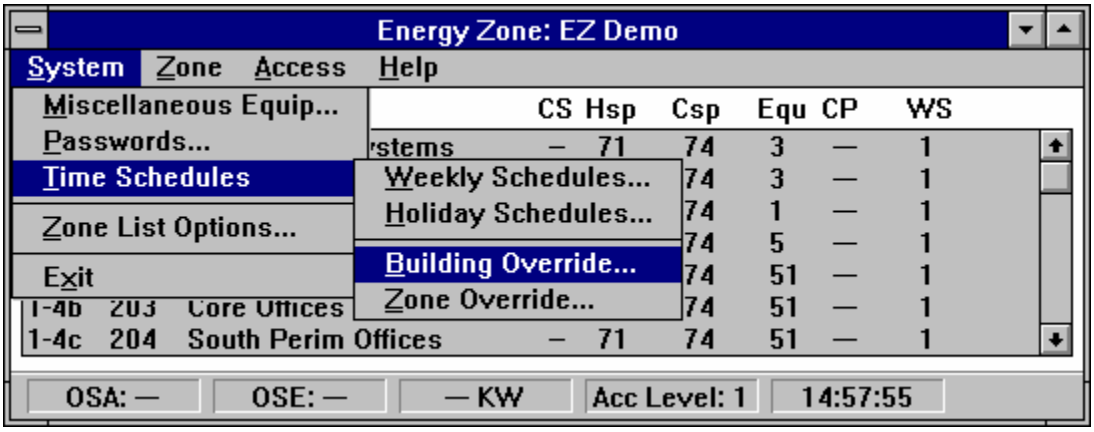


Holiday Edit Screen

Edit Holidays - Any date surrounded by << >> will be treated as a holiday by the System. To either create or delete any holiday, point and click with the mouse on the desired date. The holiday designation will toggle on and off.

All Zones Pre-programmed Override

Select Building Override... from the Time Schedules sub-menu of the System menu.



Main List Box

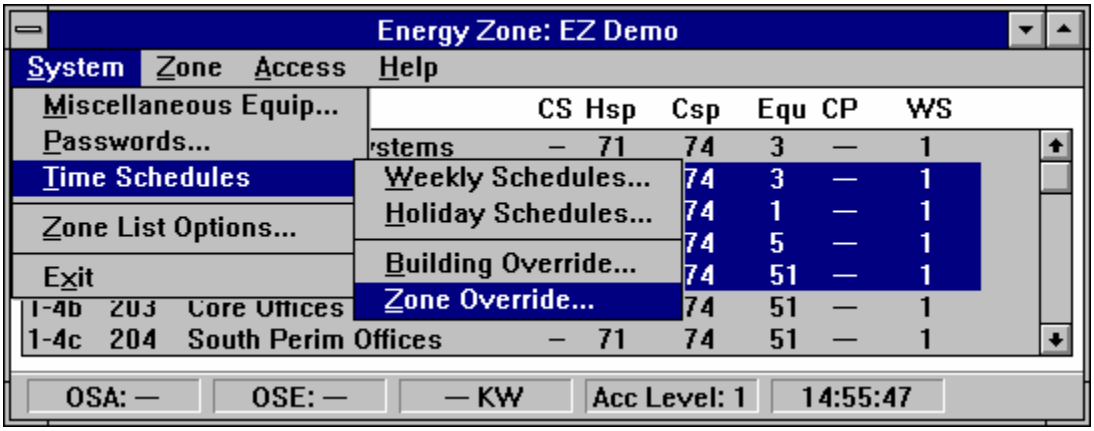
Next enter the desired Start and End times and the desired mode for the Override. All times must be entered in a 24 hour format.

All Zones Override Screen

Note: The User must be logged onto the System at Access Level 1 to enter an All Zones Override.

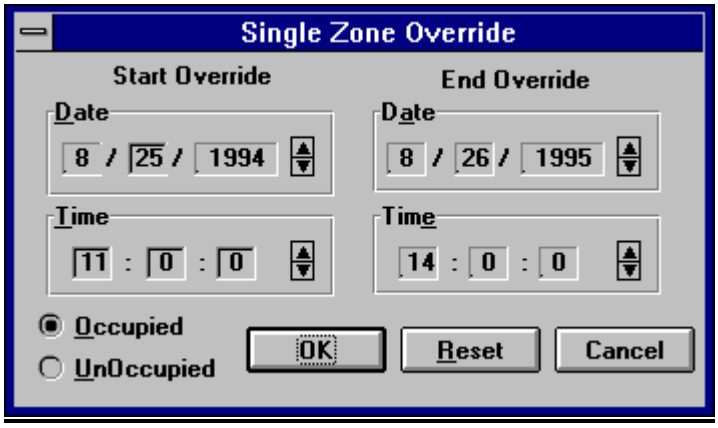
Single Zone Pre-programmed Override

First select a single Zone or multiple Zones from the Zone List Box. Then select Zone Override... from the Time Schedules sub-menu of the System menu.



Zone List Box

Next enter the desired Start and End times and the desired mode for the Override. All times must be entered in a 24 hour format.

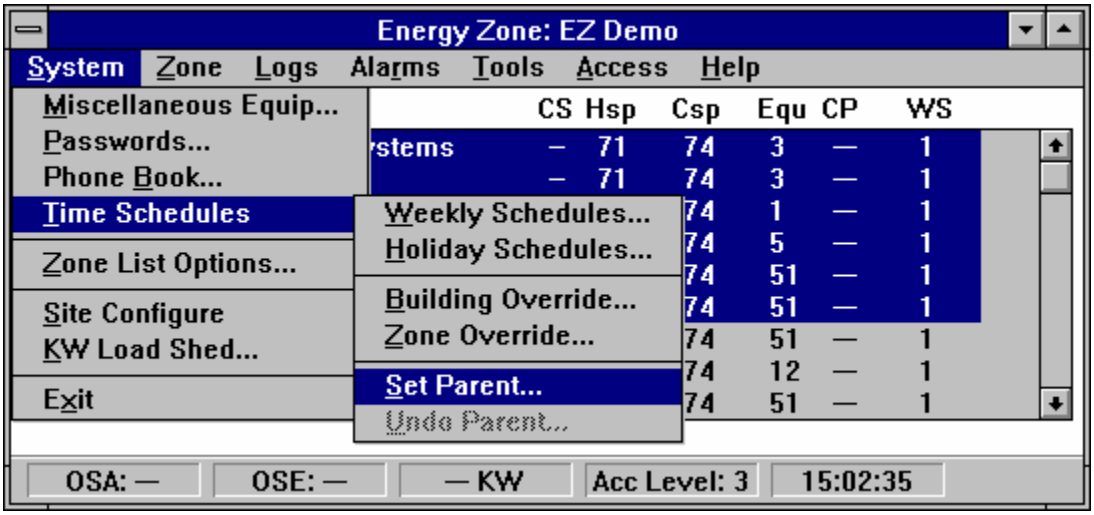


Single Zone Override Screen

Note: The User must be logged onto the System at Access Level 1 to enter a Single Zone Override.

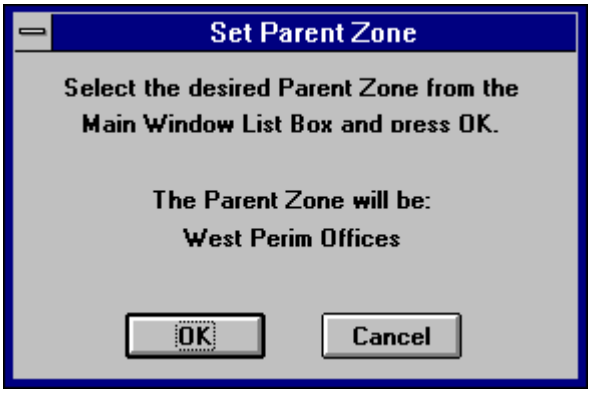
Parent/Child Configuration

Creating a Parent/Child - To setup a Parent/Child relationship, first select one or more Zones that will be the Children. Then select Set Parent... from the Time Schedules sub-menu of the System menu.



Zone List Box

Next select the desired Parent Zone and OK.



Set Parent Message Box

Note: The User must be logged onto the System at Access Level 3 to configure Parent/Child.

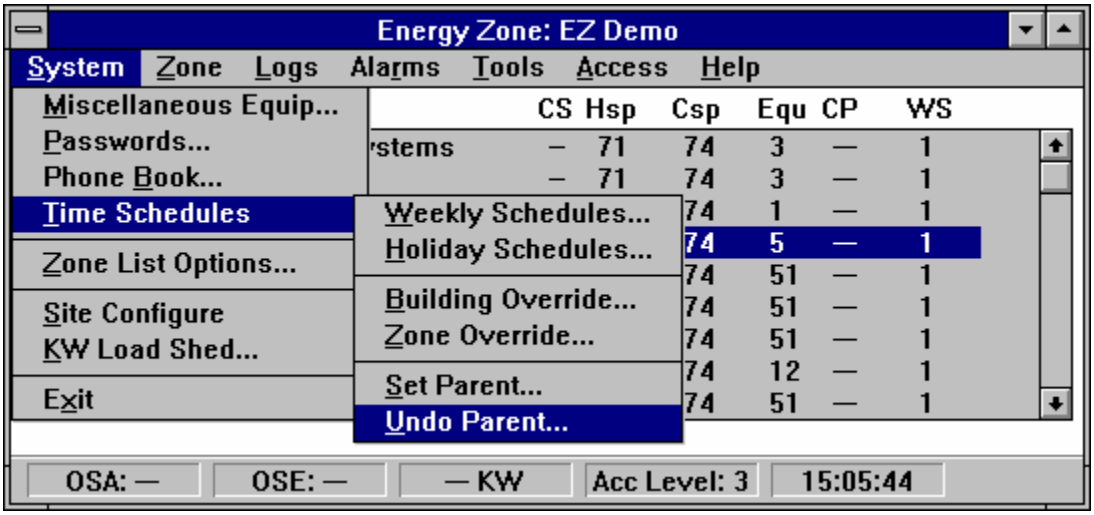
This will create a new Weekly Schedule. This Schedule uses the first unused Weekly Schedule number. The description of the Weekly Schedule will read [Parent {*Trunk-Address*}] {*Zone Description*}. The description from the example would read [Parent 1-3] West Perim Offices. The programmed times used in this new Weekly Schedule are the times from the previous Weekly Schedule of the Parent Zone.

The new Weekly Schedule times can be edited but not the description. The description is what identifies this Schedule as a Parent. The Weekly Schedule number used by the Parent can also not be changed. It must first be Unlocked.

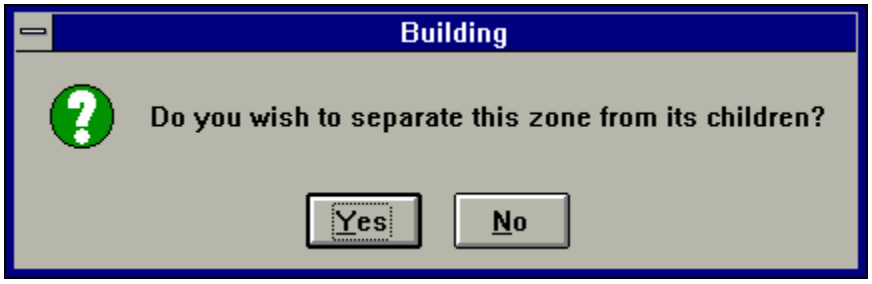
Adding a Child - To add a new Zone to an existing Parent, select the new Child and use the procedure as described above (Set Parent). Any previously configured Children will not be affected. It is not possible to add a Child by simply selecting a Weekly Schedule identified as a Parent. The only way to create the Link is by using the Set Parent function.

Removing a Child - To remove a Child, change the Weekly Schedule used by that Child in the RSC Configuration by using Zone / Configuration.

Removing a Parent - The only way to remove a Parent is to select Undo Parent... from the Time Schedules sub-menu of the System menu after selecting the Parent from the Zone List Box.



Zone List Box



Undo Parent Dialog Box

Answer yes to this dialog and the Parent and Child Zones will separate. The Weekly Schedule used by the Parent will change the description to Schedule ##. The Schedule description can now be edited. All Children will still be assigned to the same Weekly Schedule # but will no longer be locked to the other time-of-day modes of the Parent.

Chapter 4

Trend Log Viewer

Overview

Energy Zone® provides automated Trend Logging services. The Trend Log can be used for troubleshooting, System fine tuning, and investigation of tenant temperature complaints. In addition, the data can be copied via the Windows Clipboard to any other Windows application for documentation or analysis.

Features

- Logging for all 1024 Zones
- Log Files are Organized by Calendar Month
- Automatic Logging of All Time-of-Day Overrides
- Monthly Setback Override Report Included to Track Off-Hours Usage
- Convenient Printing and Data Copying Services

Specifications

Simple selection - Any Zone can be configured for Trend Logging by selecting the Data Log checkbox from the Zone Configuration screen. Data Log is checked on the Zone Configuration screen as the default setting. See the chapter on Zone Configuration to change the Data Log option. Once selected, all input data, output status, and operating conditions from that Zone are automatically logged to the Trend Log once every 10 minutes.

File Size - One hour of Trend Logging for one Zone is equal to about 170 bytes of data. If the System logs all possible 1024 Zones for a full month, the Trend Log will use about 121M bytes of hard disk space. This is a great deal of data and may fill the hard disk on Systems with standard disk capacity. On Systems with more than 500 Zones consideration should be given to either not Trend Logging all Zones or installing a hard disk with more capacity.

Automatic Deletion - The System organizes data in the Trend Log by calendar month. The Trend Logs for the current and the previous month are always available. The Trend Logs for prior months are automatically deleted at the beginning of a new month. For example, the month of February will be available until midnight on the last day of the following month, March 31. February Trend Logs will be deleted automatically at midnight on March 31. The User may backup the pervious months Trend Log prior to the automatic deletion time for long term storage if desired.

Alernate Trend Log - An alternate data storage location can be configurrd for the Site. If configured, the System will maintain a full copy of the Trend Log at the alternate location. This copy will not be automatically deleted.

Automatic Logging of System Parameters - Outside Air Temperature, Outside Air Enthalpy, and Building KW are automatically logged with each time stamp in the Trend Log.

Override Logging - All time-of-day override conditions are automatically logged for all Zones.

Monthly Override Report - An Override Summary Report is available for all Zones in any selected month. The System will print the start, end, and net time for each override as well as an accumulated override time. The reports are organized and printed by Zone.

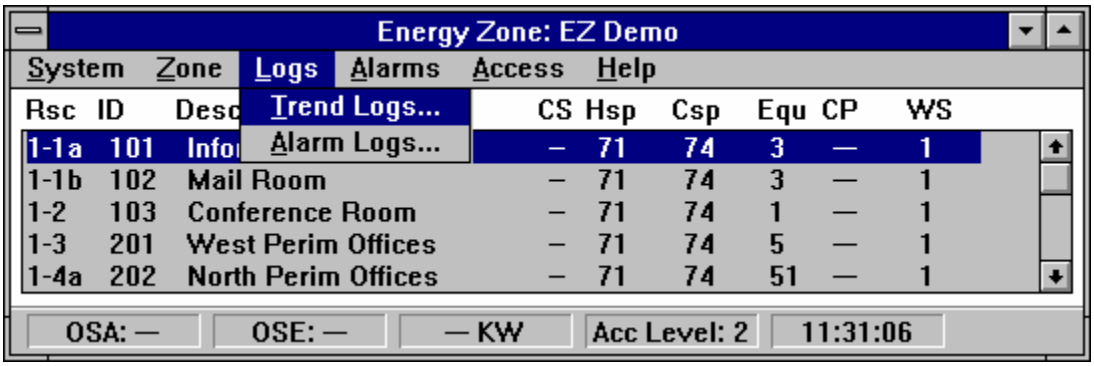
Printing Services - Any portion of the Trend Log may be selected for printing. The currently selected display options will print for all selected entries.

Copy Data - Any portion of the Trend Log may be selected and copied to the Windows Clipboard. The currently selected display options will be copied for all selected entries. From the Clipboard, the data may be pasted into any Windows application.

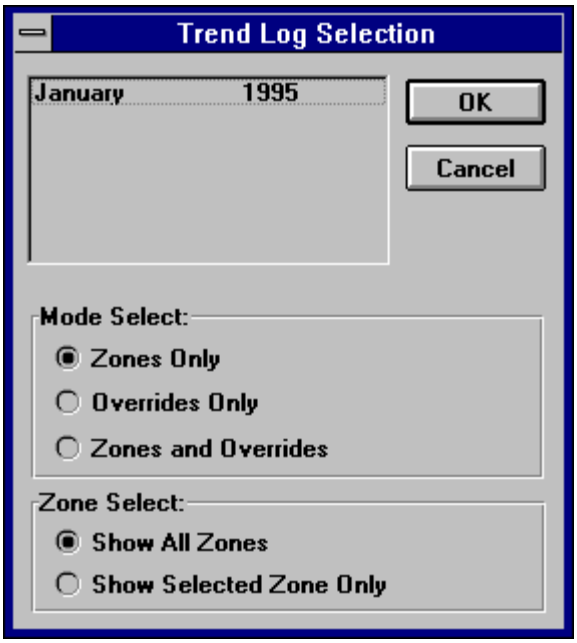
Note: The Trend Log Viewer is an Access Level 2 feature. Level 3 access is necessary to change the Data Log option at a Zone or to setup an alternate data directory.

Log File Selection

The Log File Selection screen is activated by selecting Logs, Trend Logs... form the Menu Bar.



Trend Log Access

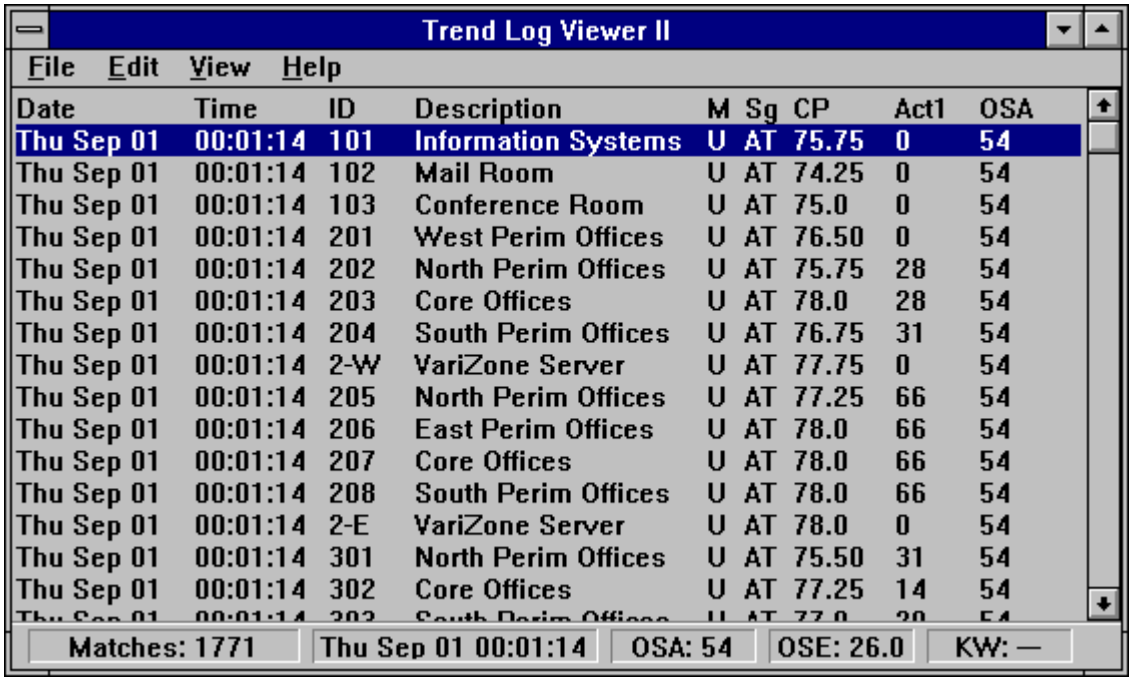


Log File Selection Screen

Select Log - Select the desired month and year for the data to be viewed.
Display Mode - Select Zones Only (Zone point data and status), Overrides Only (time-of-day override events), or Zones and Overrides.
Zone Selection - Choose to Show All Zones or Show Selected Zone Only (this will show data from the Zone that is currently selected in the Zone List Box).

Trend Log Viewer

After the month and Zone selection options are chosen, the Trend Log is displayed. Depending on the selections and the number of entries, the System may take several seconds to retrieve and display the data.



Trend Log Viewer

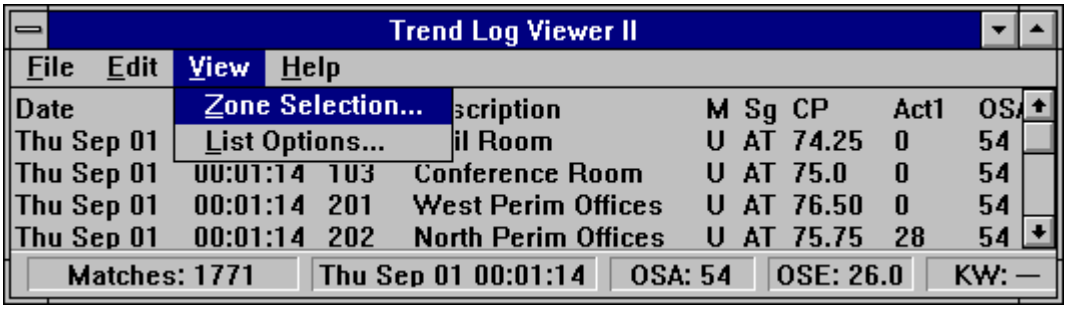
Data Display - The data displayed in the Trend Log Viewer is based on the View selection options made by the User.

Status Line - The Status Line is located at the bottom of the display. The Status Line corresponds to either the first line of data in the current display or, if a line is highlighted, the data from that Zone:

- Matches - This the total number of data lines that meet the search criteria. This number will give an indication of the size of the Trend Log being displayed.
- Date/Time - The date and time of the entry.
- OSA: - The outside air temperature.
- OSE: - The outside air enthalpy.
- KW: - The building KW from the meter assigned to that Zone.

Trend Log Viewer Display Options

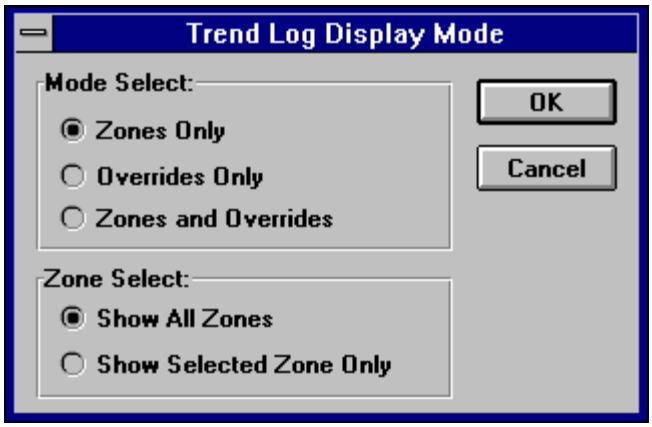
Two display options are available from the View menu of Trend Log Viewer, Zone Selection and List Options.



View Menu

Zone Selection... - Allows the User to change the Zone for which data is displayed.
List Options... - Allows the User to select which input and outputs are to be displayed for the selected Zones.

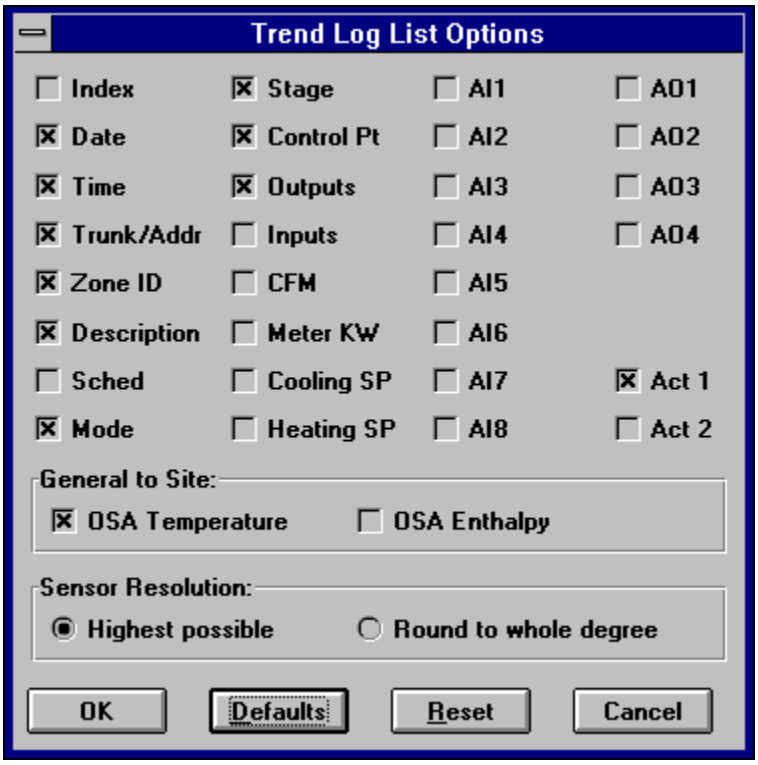
To change Zones for which data is displayed, choose Zone Selection...:



Trend Log Display Options

Select the desired Zone options.

To change the data being displayed for each Zone, select List Options...:



Trend Log List Options

Configuring Trend List Options - To select information for display, simply click on the desired information box with the mouse. Those items checked will be displayed on each line of data.

- **Index** - This represents the line number, starting at line #1 for the first displayed entry of the month in the current log.
- **Date** - The day of the week, month, and date.
- **Time** - The time in 24 hour format including hour, minute, and seconds.
- **Trunk/Addr** - Trunk (1-8), Address (1-32), and if applicable SubZone (a-d).
- **Zone ID** - The Zone ID configured for that Zone.
- **Description** - The Zone Description configured for that Zone.
- **Sched** - The number of the Equipment Schedule.
- **Mode** - This is the current state of the Zone. The valid states are:
  - O Occupied.
  - U Unoccupied.
  - W Warmup.
  - C Cooldown.
  - D Default (off-line).
  - E Early Occupied (The Occupied setpoints were reached early when in Cooldown or Warmup).

- **Stage** - The current stage. The valid stages are:
  C1 - C4 Cooling stage 1 through cooling stage 4.
  H1 - H4 Heating stage 1 through heating stage 4.
  AT Zone is at setpoint.
- **Control Pt.** - The value of the Control Point. This is normally the same as AI1, but could be a calculated value as configured for that Zone.
- **Outputs** - The current state of all digital outputs for the Zone. A display of 0 indicates the output is off, and 1 indicates the output is on. All 8 outputs are listed in order from 1 to 8.
- **Inputs** - The current state of all digital inputs for the Zone. A display of 0 indicates the input is off, and 1 indicates the input is on. All 8 inputs are listed in order from 1 to 8.
- **CFM** - The CFM airflow reading.
- **Meter KW** - The KW as read at the building KW meter assigned to that Zone.
- **Cooling SP** - The current cooling setpoint.
- **Heating SP** - The current heating setpoint.
- **AI1** thru **AI8** - The value of the Analog Input, scaled correctly based on the Zone configuration.
- **AO1** thru **AO4** - The percentage open position the Analog Output.
- **Act 1** - The percentage open position of the first 3 point floating actuator.
- **Act 2** - The percentage open position of the second 3 point floating actuator.

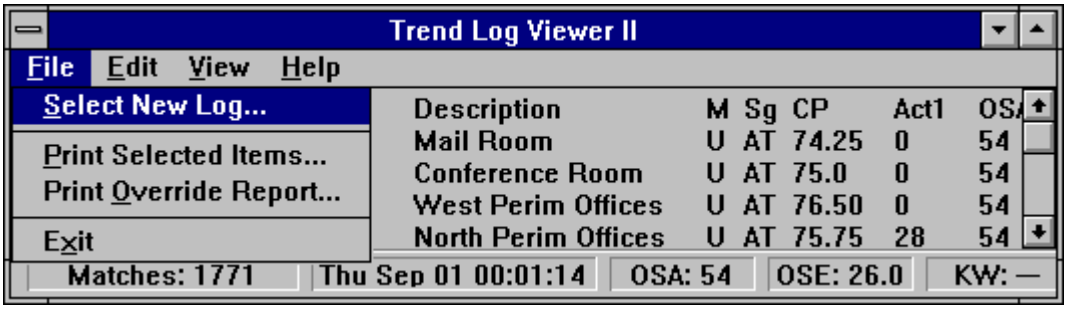
General to Site:
- **OSA Temperature** - The outside air temperature.
- **OSA Enthalpy** - The outside air enthalpy.

Sensor Resolution:
- **Highest Possible** - Displays analog inputs at the maximum resolution for that input (i.e. Nearest 0.25° F for room temperature).
- **Round to Whole Degree** - Display analog inputs rounded to the nearest whole number.

Note: For Zones that are part of a quad or dual Equipment Schedule, the data that is not applicable will record a 0 in the Trend Log. For example, a dual Zone (which uses digital outputs 1-4) will always display 0 for digital outputs 5-8.

Selecting New Data

To select a new data file for the Trend Log Viewer, choose File, Select New Log...



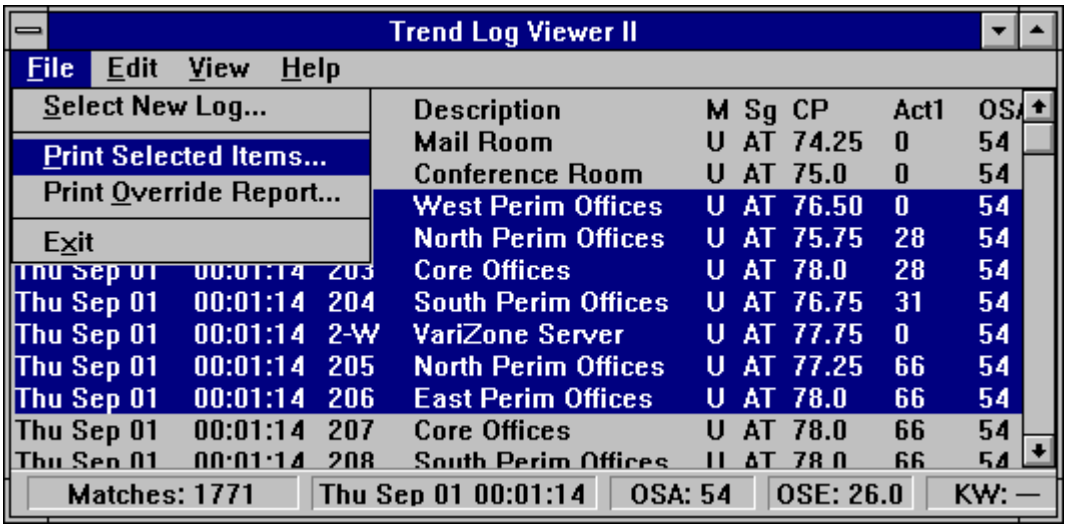
Trend Log Viewer Main Screen

Then select the desired new data.

Log File Selection Screen

Printing Data from the Trend Log Viewer

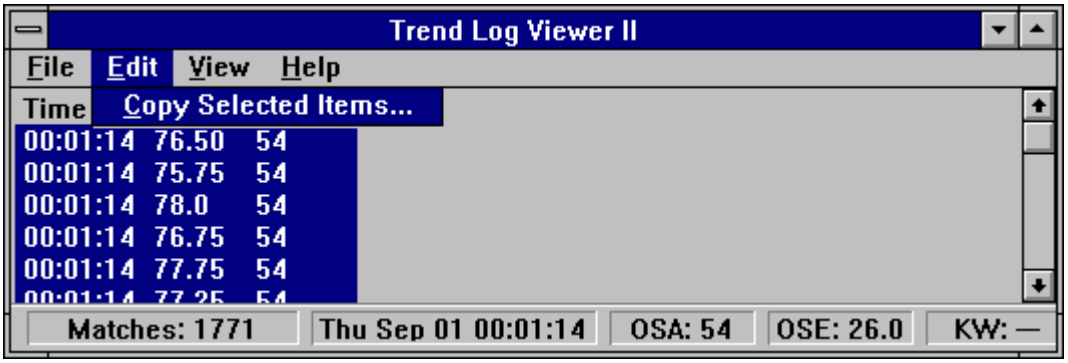
To print data from the Trend Log Viewer, first select the data to be printed with the mouse. Then select File, Print Selected... to send all selected data to the printer.



Trend Log Viewer Main Screen

Copying Data to the Windows Clipboard

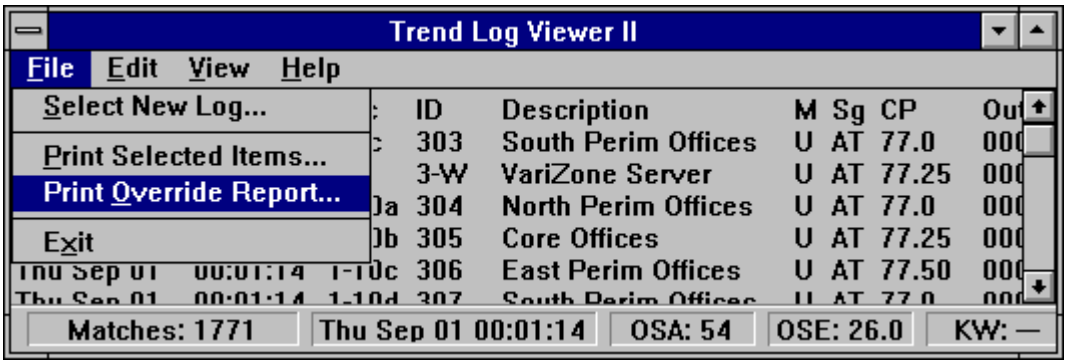
To copy data from the Trend Log Viewer to the Windows Clipboard, first select the data to be copied with the mouse. Then select Edit, Copy Selected Items... to copy all selected data to the Windows Clipboard.



Trend Log Viewer Main Screen

Printing the Override Summary Report

To print the Override Summary Report, select File and then Print Override Report... The report will then automatically print.



Trend Log Viewer Main Screen

```
Dept of Transportation: Override Summary Report - September 1994      1/27/95

1-1a  101  3rd Fl, W HP, S Zone

Date         Time       Override Event                  Net Time
Fri Sep  2   19:43:14   Enter Setback Override
Fri Sep  2   22:43:14   Setback Override Timeout        3.0 Hrs
Tue Sep  6   18:00:00   Enter All Zones Override OCC
Tue Sep  6   22:00:00   End of All Zones Override       4.0 Hrs
Thu Sep  8   06:42:22   Enter Setback Override
Thu Sep  8   07:00:00   Setback Override Timeout        0.3 Hrs
Sat Sep 10   08:00:00   Enter Single Zone Override OCC
Tue Sep 10   16:30:00   End of Single Zone Override     8.5 Hrs

                        Total:                         15.8 Hrs
```

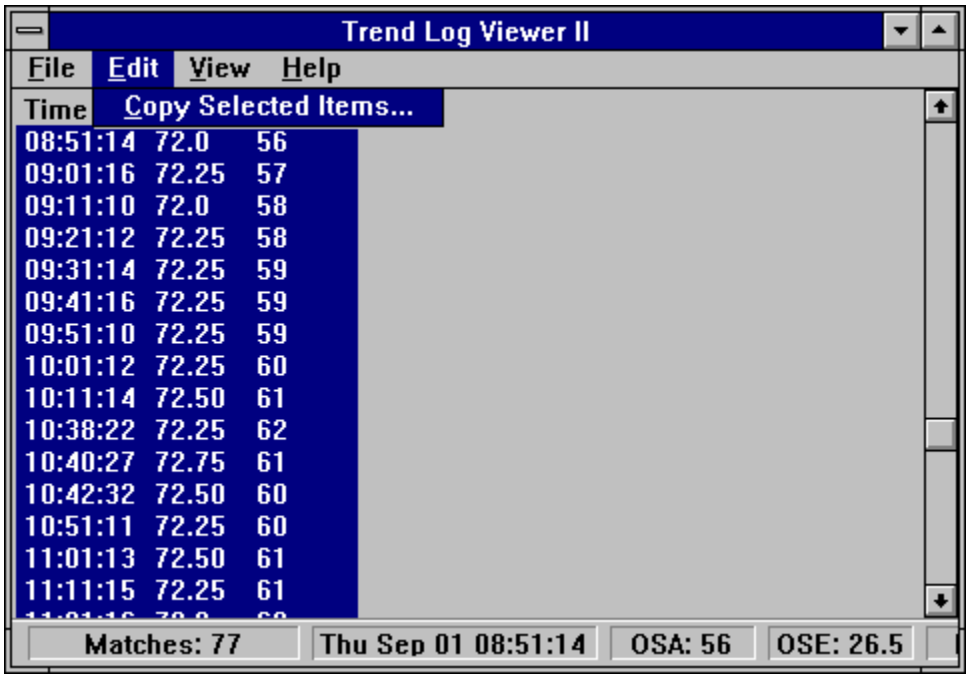
Sample Override Summary Report

A Practical Use Example of Trend Log Viewer

In this example, we will assume that the building engineer has received a complaint from the manager of a group within the building. Some of the employees within this group complained about being too warm yesterday. We must investigate the complaint and respond to the manager by memo.

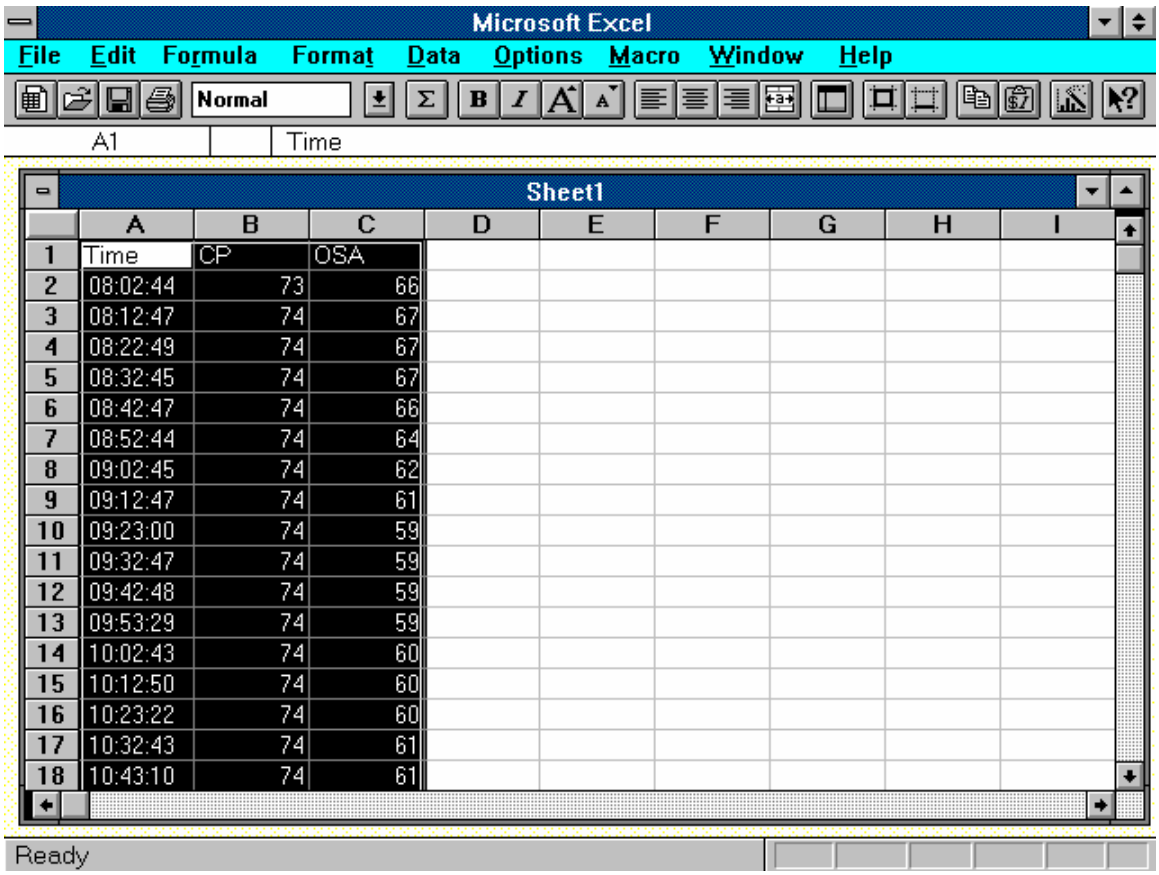
Note: This example assumes that the User has access to Microsoft Excel and a Windows based word processor program. Any questions as how to use either of those two applications should be referred to the documentation supplied with those applications.

First, select the desired month and year, Zone, and list options.
Then highlight the data for the desired time frame and copy to the Windows Clipboard.



Selecting Data to Copy to Clipboard

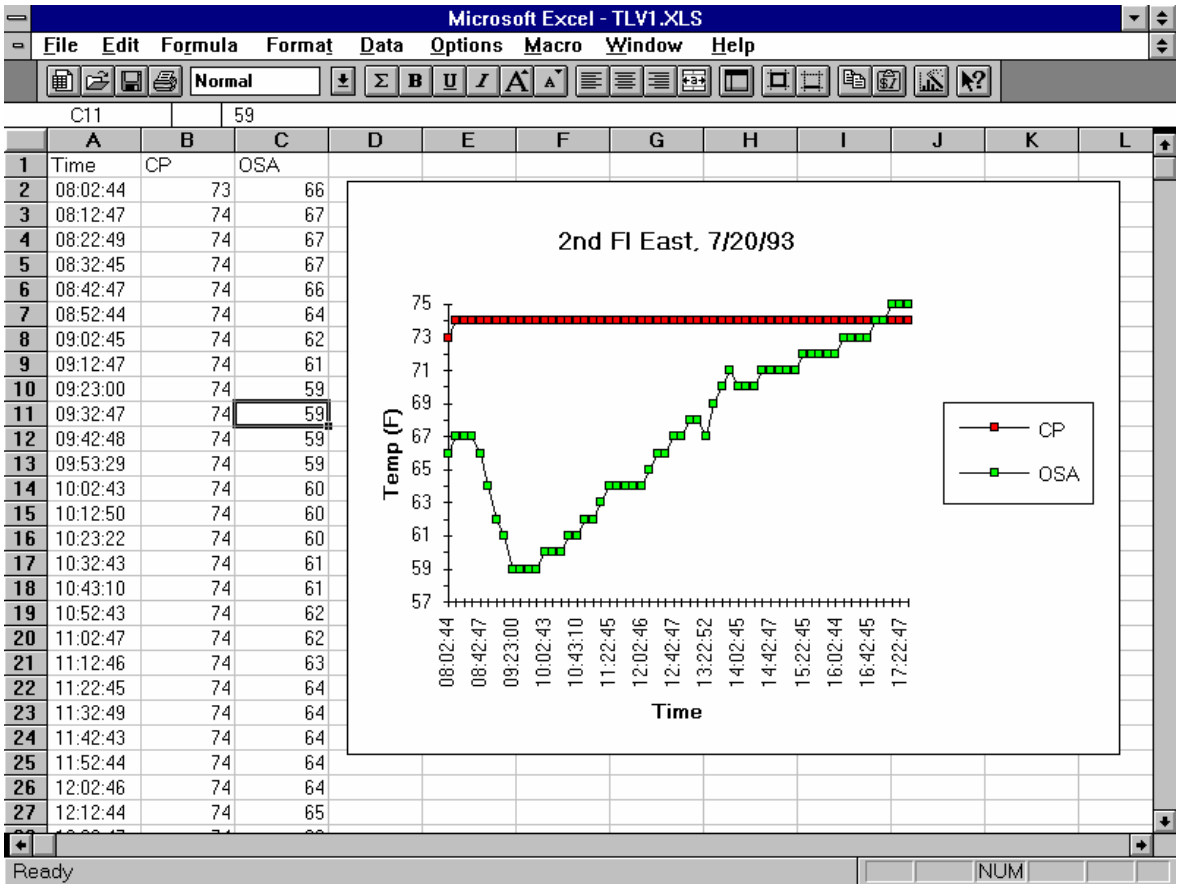
Once copied to the Clipboard, the data can be pasted to any other Windows application. Microsoft Excel is a very easy to use and yet powerful application for manipulating Trend Log Data. To use Excel, start the application and paste the data into a spreadsheet.



	A	B	C	D	E	F	G	H	I
1	Time	CP	OSA						
2	08:02:44	73	66						
3	08:12:47	74	67						
4	08:22:49	74	67						
5	08:32:45	74	67						
6	08:42:47	74	66						
7	08:52:44	74	64						
8	09:02:45	74	62						
9	09:12:47	74	61						
10	09:23:00	74	59						
11	09:32:47	74	59						
12	09:42:48	74	59						
13	09:53:29	74	59						
14	10:02:43	74	60						
15	10:12:50	74	60						
16	10:23:22	74	60						
17	10:32:43	74	61						
18	10:43:10	74	61						

Excel with Trend Log Data Inserted

Next use the Chart Wizard feature of Excel to create a graph of the data.



	A	B	C
1	Time	CP	OSA
2	08:02:44	73	66
3	08:12:47	74	67
4	08:22:49	74	67
5	08:32:45	74	67
6	08:42:47	74	66
7	08:52:44	74	64
8	09:02:45	74	62
9	09:12:47	74	61
10	09:23:00	74	59
11	09:32:47	74	59
12	09:42:48	74	59
13	09:53:29	74	59
14	10:02:43	74	60
15	10:12:50	74	60
16	10:23:22	74	60
17	10:32:43	74	61
18	10:43:10	74	61
19	10:52:43	74	62
20	11:02:47	74	62
21	11:12:46	74	63
22	11:22:45	74	64
23	11:32:49	74	64
24	11:42:43	74	64
25	11:52:44	74	64
26	12:02:46	74	64
27	12:12:44	74	65

Creating an Excel Chart

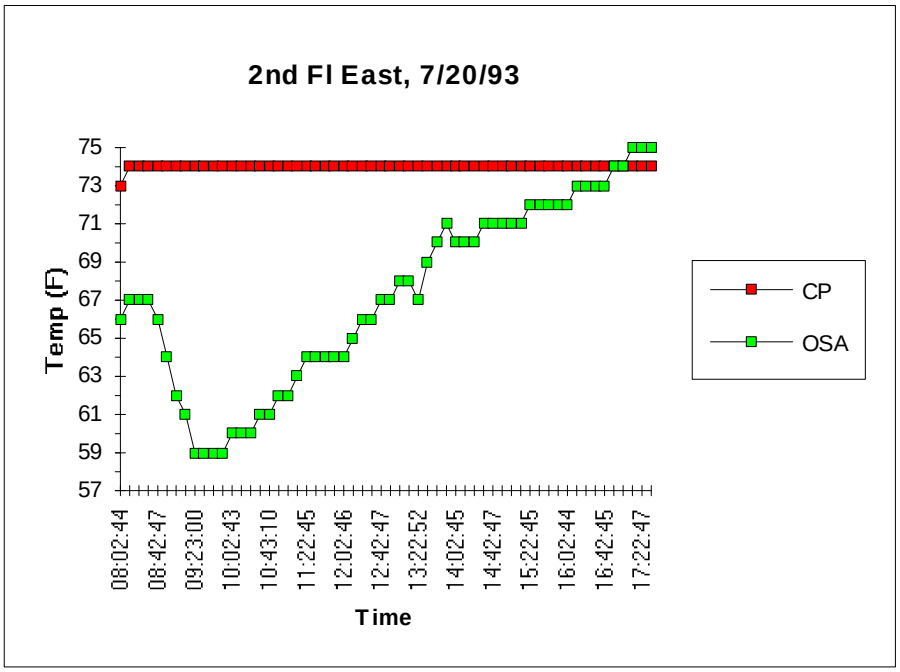
Once a chart is created, it can be selected and then pasted to the Clipboard.

Finally use a word processor, such as Word for Windows, to write a memo to accompany the chart. The chart can be pasted directly into the memo.

To: Mr. Manager
From: Mr. Building Engineer
Subject: Temperature Control Complaints

After receiving complaints from employees on the East perimeter of the 2nd Floor about yesterday's temperatures, I reviewed the Trend Log for that Zone. The Energy Management System we installed last year records the temperatures in all Zones once every 10 minutes. I have charted the space temperatures for yesterday and have also included the outside air temperatures. As the chart indicates, the outside air temperature ranged from 59° F to 75° F while the space temperature did not vary outside a range of 73° F to 74° F. The setpoints for that Zone are 72° F to 74° F.

As you can see, the HVAC System is performing perfectly. If the employees in that Zone desire a different temperature setpoint, please let me know so that I may make the necessary changes.



Let me know if I can be any further assistance.

Chapter 5

Remote Communication

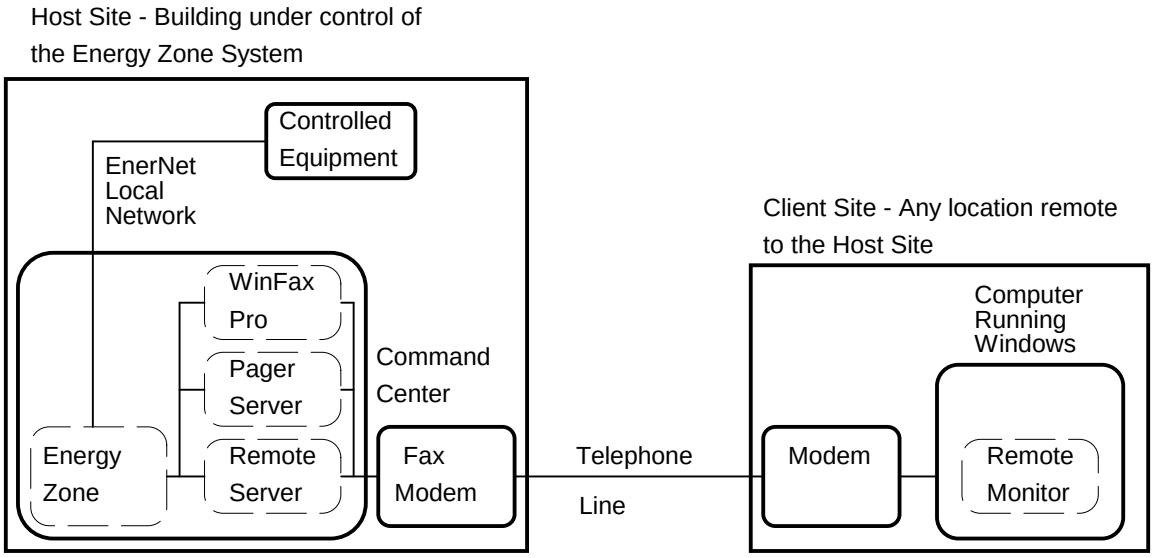
Overview

The **Energy Zone®** Remote Monitoring package provides the User with a very easy to use method of monitoring and controlling an **Energy Zone®** site from a remote location. All **Energy Zone®** Systems are provided with the hardware and software necessary to receive incoming calls from the optional Remote Monitoring version of Building. The standard on-site package also includes the capability for Alarm callout.

Features

- Full Remote Control of any Building Site
- Alarm Callout to Digital Pager
- Alarm Callout to Fax Machine

Specifications



Remote Communication Block Diagram

Remote Server - The on-site communication package runs in the Command Center at an **Energy Zone®** site and monitors the incoming phone line. When called from an Energy Zone Remote Monitoring station, Remote Server will connect the remote User to the Command Center. The User then has access to all System functions and capabilities the same as if at the Command Center. This side of remote communications, which contains the Command Center, is referred to as the Host Site.

Remote Monitor - The Remote Monitor (also referred to as Remote Building) is a software package that allows the User to connect to any **Energy Zone®** Host Site. The Remote Monitor can operate on any platform with a minimum configuration of Microsoft Windows 3.1 and one of the supported modems. This side of remote communications is referred to as the Client Site. If Remote Server is not running at a Host Site, the modem can be used as a Client Site to call into another Host Site. A second modem can be installed at a Host site and dedicated to Remote Monitoring while the primary modem functions as a Remote Server.

The Remote Monitor screen is identical to the screen at the Host Site, except for the title and the addition of the Communication menu item. When connected to a Host Site, all data displayed is current data from the Host Site. This includes the Site Name in the Window Frame and all data in the Status Bar. The time of day displayed in the Status Bar is also transmitted from the Host site.

Pager Server - Pager Server is available to the Command Center for alarm callout to a digital pager. If an alarm occurs which is configured for Pager, Pager Server will use the modem to call the first number in the Phone Book configured for Pager. Pager Server will then transmit the Host Number that has been configured for that Site. The Host Number is a four digit number configured for the Site. If the modem is in use, Pager Server will continue to try to make the call once a minute until successful. A second modem can be dedicated to Pager Alarm callout to prevent delays in alarm callout if the primary modem is in use.

Fax Services - Fax services are provided by Delrina Win Fax Pro. Win Fax is installed by **BAS** on Systems ordered with this capability. For details on the operation of Win Fax, see the provided manuals. Win Fax is available to the Command Center for alarm callout to a fax machine. If an alarm occurs which is configured for Fax, Win Fax will call the first number in the Phone Book configured for Fax. Win Fax will then transmit one page of information, including details on the alarm and a snapshot taken of the Troubleshooting Screen at the time of the Alarm. If the modem is in use or Win Fax can not connect to a remote fax for some reason, Win Fax will continue to try to make the call once a minute until successful. A second fax-modem can be dedicated to Fax Alarm callout to prevent delays in alarm callout if the primary modem is in use.

Telephone Lines - A standard voice grade telephone line is all that is necessary for remote communications. It is always preferable to have a telephone line dedicated to the Command Center, but it is not required.

Hardware - It is important that a 16550AFN UART (Universal Asynchronous Receiver Transmitter) is installed on the COM port used for remote communications. Many computer manufacturers do not provide this UART and it must be field installed. High speed communications are unreliable in Windows without the buffer provided by this chip. Contact **BAS** for technical assistance in determining the correct hardware configuration. A 14,400 baud modem is recommended for remote monitoring. Both a 14,400 baud modem and a 16550AFN UART are included by **BAS** on all **Energy Zone®** Systems. See the list below for supported modems.

Manufacturer	Model	Line Speed	Description	Suggested Computer to Modem Speed
Any Hayes Compatible		2,400	Int or Ext Modem	9,600
Gateway	Telepath II	14,400	Int Fax/Modem	38,400
US Robotics	Sportster 14400	14,400	Int Fax/Modem	38,400
MegaHertz	XJ144 II	14,400	PCMCIA Fax/Mdm	38,400
Hayes	Optima 288 II	28,800	Ext Fax/Modem	38,400
Supra	144LC II	14,400	Ext Fax/Modem	38,400
Zoom	FC9624V II	2,400	Ext Fax/Modem	9,600
Zoom	V.42 bis II	2,400	Ext Modem	9,600

Dialing Script - Remote Building uses a dialing script to configure the modem and place the call to the Host Site. Several dialing scripts are included in the \EZ\DATA directory. The System will use the correct script for the modem selected in Communication Settings. All commands in the dialing scripts are from the Hayes standard AT command set. These scripts can be modified for modems not included in the modem list. The scripts should only be edited by Users with advanced modem experience. The changes can be made with a standard text editor such as Windows Notepad. Contact **BAS** for assistance with script modifications.

CheckSum Errors - All data received by the Remote Monitor is checked for integrity by use of a check sum added to the end of each data packet. Any data that does not pass the check sum test is rejected and reported as a check sum error. The errors provide a relative indication of the quality of the phone connection. The CheckSum Errors can be selected for display on the Status Line of the Remote Monitoring version of Building. This value is the total of all errors accumulated during current session. The fewer the number of errors, the better the connection. If errors are frequent (more than about 10 per minute) then try re-dialing the site for a new line connection. It may be necessary in some cases to lower the baud rate in order to improve communication reliability.

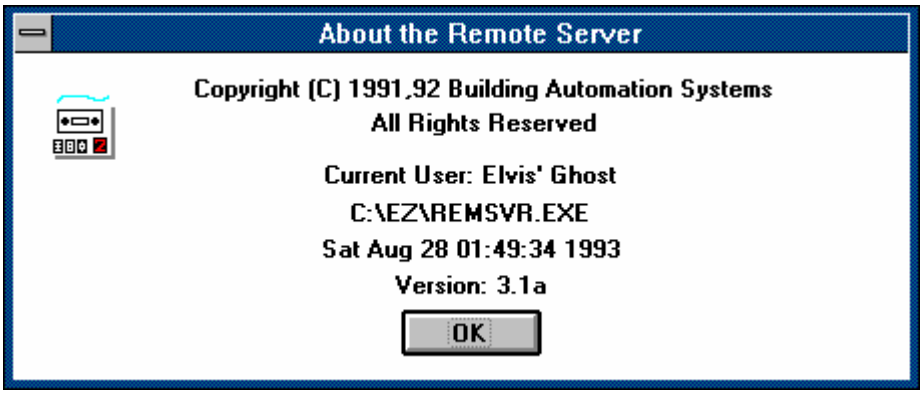
Remote Server

There is no User interface to the Remote Server program. It is started automatically on initial startup by being located in the Windows Start Up group. The Remote Server icon will indicate the current status of the modem. The messages are:

OK - The modem is waiting for an incoming call.
Connect 9600 - A Client Site is connected to the Command Center at 9600 baud.
Resetting - A Client Site has disconnected and Remote Server is preparing for another call.

Configuration of Remote Server is done by **BAS** when a System is shipped. All settings are stored in EZ.INI and are described in Remote Monitoring Configuration.

If About... is selected from the Remote Server System menu, a message box will appear showing the name of the User who is currently logged into the System. The name comes from the Password configuration of the Host Site. If the User is at Access Level 0, no name will appear.



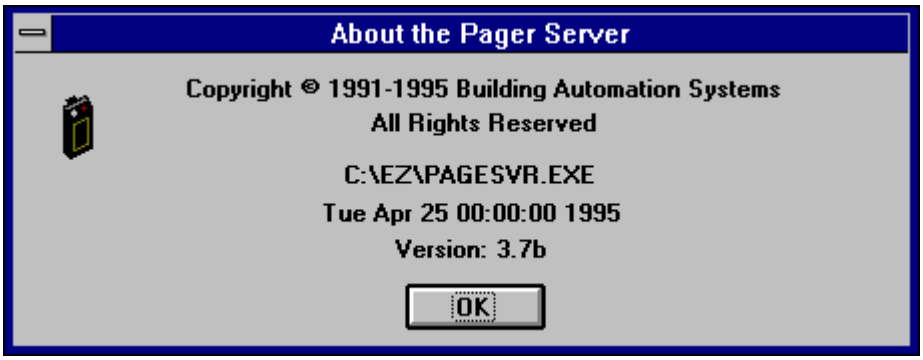
Remote Server About Screen

Disconnecting a Client Site - If a User wants to disconnect a Client Site from the Host Site, use the Remote Server System menu to Close Remote Server and then cycle power to the modem. Remote Server can then be re-started to be available for the next incoming call.

Pager Server

The About Box is the only User interface to the Pager Server program. Pager Server is started automatically on initial startup by being located in the Windows Start Up group. It can be closed by selecting Close from the Pager Server System menu.

Configuration of Pager Server is done by **BAS** when a System is shipped. All settings are stored in EZ.INI and are described in Remote Monitoring Configuration.



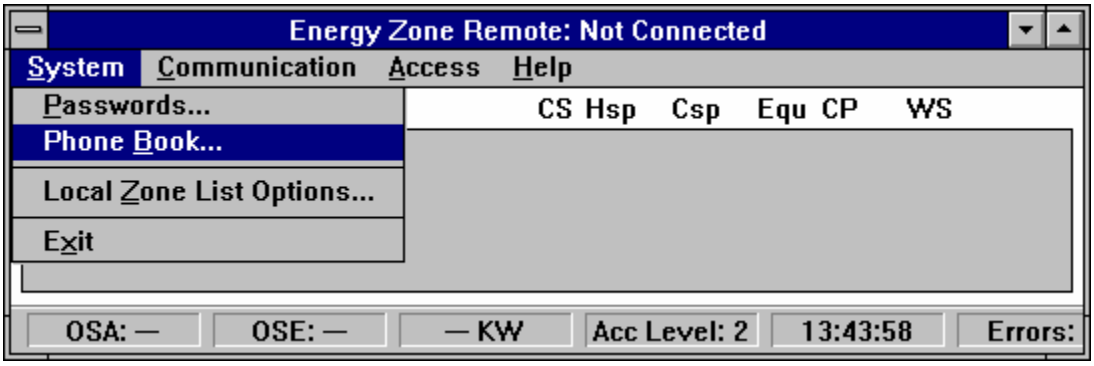
Pager Server About Screen

Win Fax

Win Fax is normally started automatically on initial startup by being located in the Windows Start Up group. For additional details on the operation of Win Fax, see the Win Fax manual. It can be closed by selecting Close from the Win Fax System menu.

Remote Monitoring Configuration

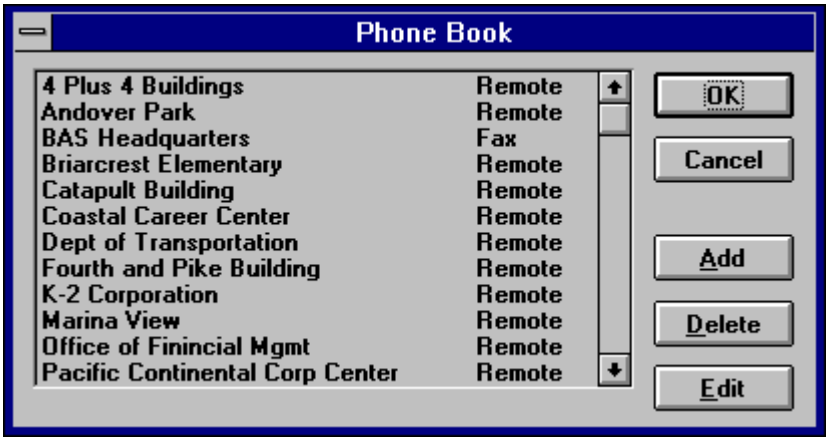
Phone Book - The Phone Book must be configured before connection can be made to a Host Site. The Phone Book is accessed from the System menu in Building.



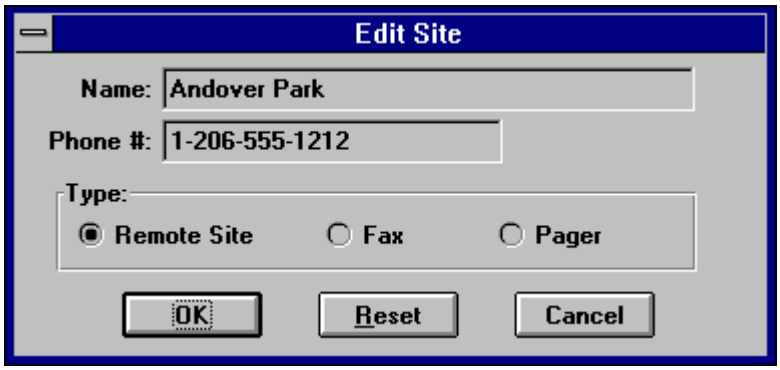
Energy Zone Remote Main Window

Note: The Phone Book is available at Access Level 2.

The Phone Book list box is then displayed. Select an item to Edit, Delete, or Add.



Phone Book Selection Screen



Phone Book Entry Screen

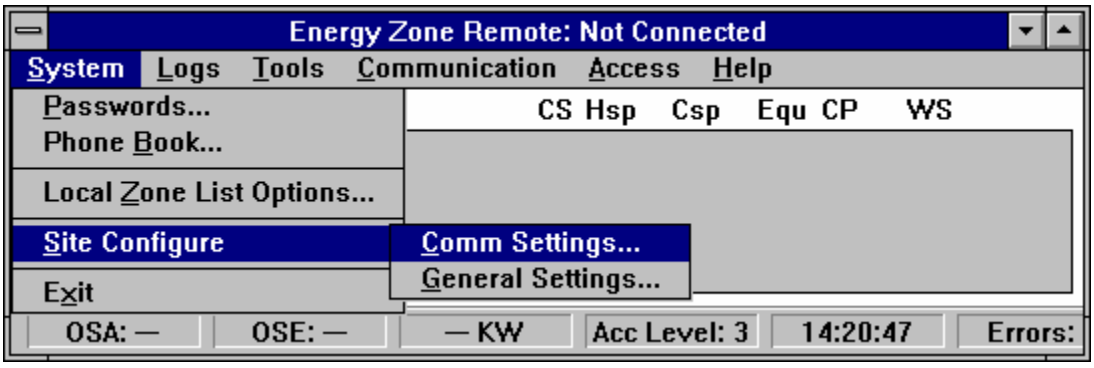
Name: A text description up to 30 characters in length.

Phone #: The phone number can be up to 19 characters in length and can include dashes or spaces. If calling out from an internal phone system, it is sometimes necessary to include a 9 to acquire an outside line and time delays between calling sequences. To cause a time delay, add a comma to the phone number. Each comma adds a 2 second delay. For example; 9,,1-206-555-1212 would dial 9 to acquire an outside line, wait 4 seconds, and then dial the number of the remote site.

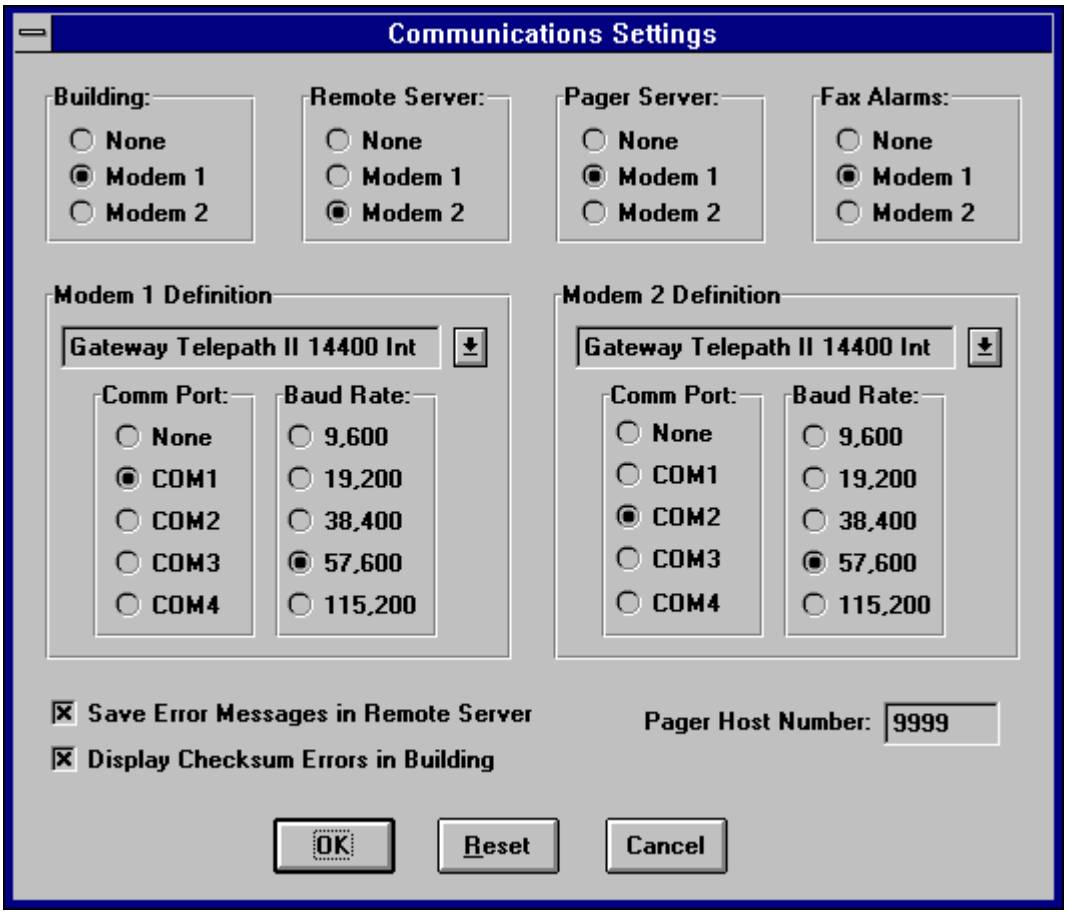
Type: Select correct option.

Note: The System will always use the first Pager number and the first Fax number found in the list when calling out alarms. No problems will occur if additional numbers are entered, but they will be ignored.

Communication Settings Dialog - Select Comm Settings... from the Site Configure item in the System menu.



Energy Zone Remote Main Window



Communications Settings Screen

Building, Remote Server, Pager Server, Fax Alarms - Select the modem to use, or none if this feature is not used.

Modem 1 Definition - Select the model, COM Port connection, and computer to modem baud rate for Modem #1.

Modem 2 Definition - Select the model, COM Port connection, and computer to modem baud rate for Modem #2.

Save Error Messages in Remote Server - If selected, communication errors are recorded in COMMLOG.TXT in the \EZ\DATA directory.

Display Checksum Errors in Building - If selected, the System will display the total number of checksum errors accumulated during any Remote Communication session. The errors are displayed in the status line of Building Remote.

Pager Host Number - This number is sent to a digital pager on alarm. This can be any four digit number.

Note: The Communication Settings Screen is available at Access Level 3.

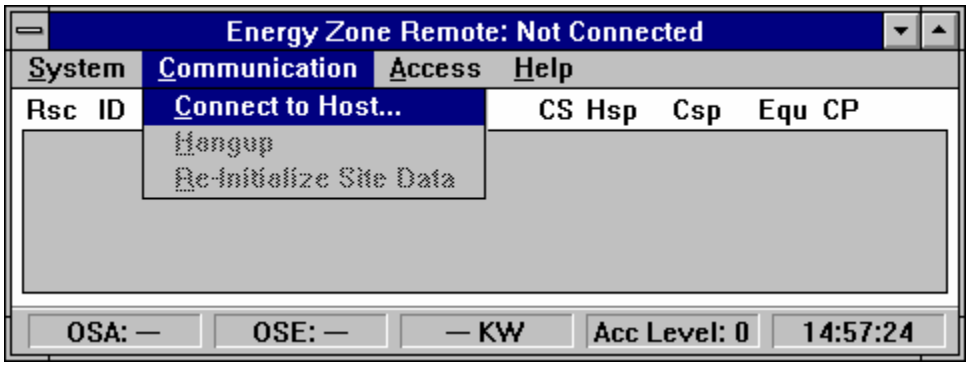
Additional Configuration - Two additional settings are accessed from General Settings... under the Site Configure item in the System menu.

Screen Update Time: This is the number of seconds between requests for an update of the data displayed in the Zone List box. If the screen update speed is configured for less than 10 seconds, an update time of 10 seconds will be used.

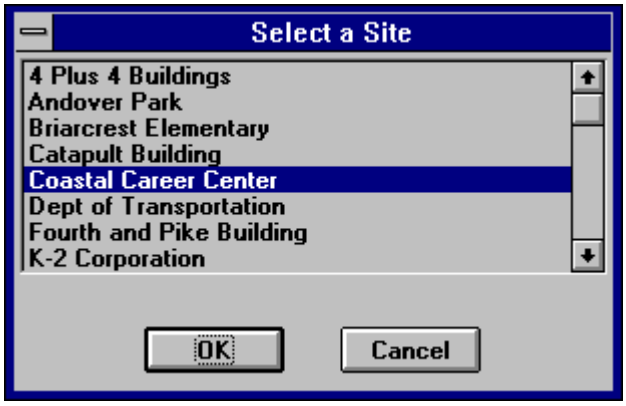
Access Timeout: This is the number of minutes with no keyboard or mouse activity before Remote Building will automatically disconnect the modem.

Remote Monitoring

Connecting to a Remote Host Site -The Remote Building program is started by clicking on the Remote Building icon in the **Energy Zone®** group. To access a Host Site, select Connect to Host... from the Communication menu**.** This will bring up the Site selection dialog.



Energy Zone Remote Main Window



Site Selection Screen

Select the Host Site from this list. Once the site has been selected, the System will attempt to call and connect to the Command Center at that site.

The Connection Status Screen will appear and remain displayed until successful connection or until 60 seconds has elapsed.

Connection Status Screen

Once connected to a Host Site, general Site data will begin to be transmitted to the Client. After completion, the System will operate as if the User is at the Host Site.

Disconnecting from a Host Site - Select Hangup from the Communication menu**.** The System will then terminate the connection. The request to Hangup must wait for an opportunity to be transmitted to the Host Site. If this occurs during a period of high data transmission, it is possible that it may take several seconds to disconnect. Choosing Exit from the System menu will close Remote Building and the System will immediately disconnect.

Note: It can take up to 30 seconds for Remote Server to reset after a hang-up. Because of this, do not attempt to re-connect to any site until at least 30 seconds have passed since the last connection.

Note: In order to call from one Host Site to another Host Site, it is necessary to first close Remote Server and the on-site version of Building at the originating, or Client Site. Only one version of Building may be run on any given computer at any given time. Remote Server can remain active at the Host Site if two modems are installed and both applications are configured for a different modem.

Differences Between Local and Remote Operation

All menu selections initiate a request for data from the Host Site. Remote Server will receive and process the request, sending the requested data to the Client Site. Any time that data is requested which requires more than a couple of seconds to transmit, the Progress screen is displayed.

Progress Screen

The Progress screen indicates the status of a data transfer from the Host to the Client Site. Any time a Progress Screen is displayed, no other actions may be initiated. If the requested data is not received in the expected length of time, a message box will display “Timed Out”. The User may make a new menu selection at that time. It is possible to close the Progress screen and regain access to the System by pressing the Escape key.

The “Timed Out” message can result from either the request not reaching the Host or the Client not receiving the expected data packet from the Host. Any request or data packet that can not be verified is rejected. This is usually caused by a poor quality phone line.

Re-Initialize Site Data - Several important data items from the Host are transmitted only once on initial connection. If an error is encountered during transmission of the initial packet of Site data (the ”Timed Out” message is displayed), it is necessary to manually request a new transmission. This is done by selecting Re-Initialize Site Data from the Communication menu.

Trend Log Viewing - Significant delays may be experienced (up to 1 minute) when initially retrieving Trend Log data from a remote Site. This is due the amount of data in the Trend Log that must be sorted prior to transfer. After the initial setup, Remote Server will transmit the first 100 lines of data. Remote Server will only transmit additional data, 100 lines at a time, when requested by Trend Log Viewer at the Client Site.

Config.sys - The Config.sys file from the Host Site may be viewed. This can be helpful in diagnosing operating problems at the Host Site. Requests for Config.sys are made from the Tools menu.

Autoexec.bat - The Autoexec.bat file from the Host Site may be viewed. This can be helpful in diagnosing operating problems at the Host Site. Requests for Autoexec.bat are made from the Tools menu.

Communication Errors Log - All communication errors recorded by Remote Server at the Host Site may be viewed. Requests for the Comm Error Log are made from the Logs menu.

EZ.ini - The EZ.ini file from the Host Site may be viewed only and not edited.

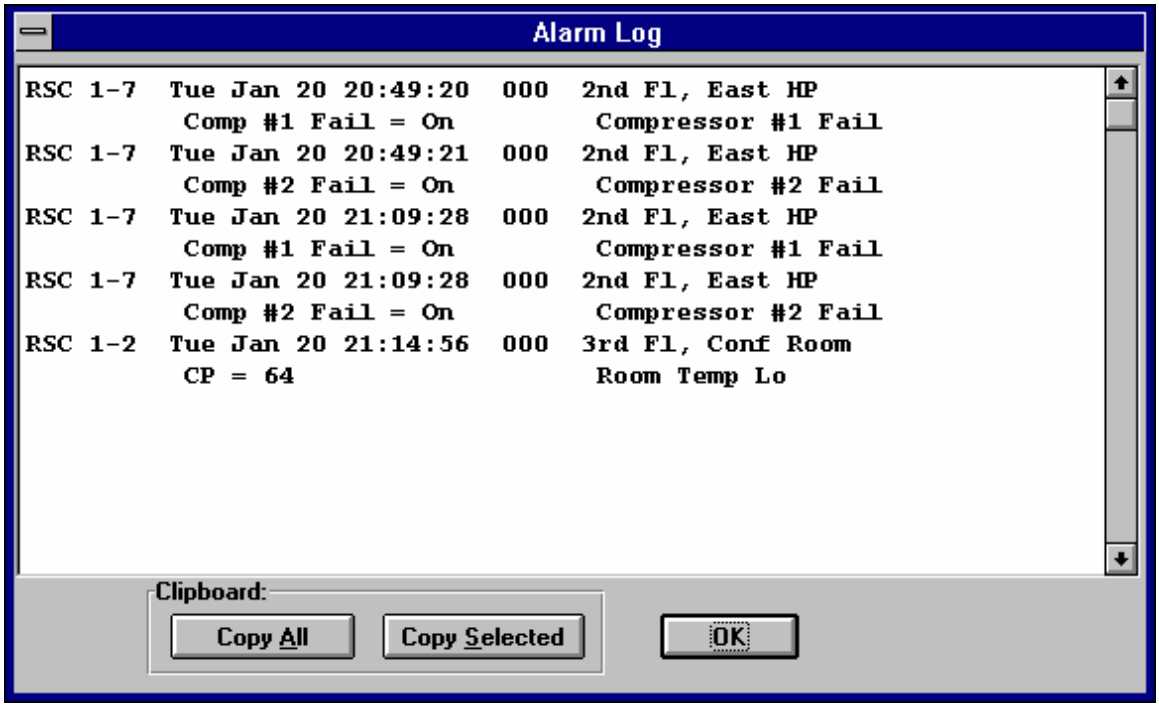
Data Backup Tools - The Backup and Restore Tools are not available when connected remotely. The Host data files can only be backed up or restored from the Host Site.

General Site Settings - The General Settings of the Host Site are not available when connected remotely.

Communication Settings - The Comm Settings of the Host Site are not available when connected remotely.

About Box - Selecting About... from the Help menu while connected to Host will display the version of the software in operation at the Host Site.

Alarm Log Viewing - When viewing the Alarm Log remotely, a different method is used than when at the Host Site. A special Alarm Log screen is displayed. This screen allows for viewing and copying selected portions of the Alarm Log.



Alarm Log Remote Viewing Screen

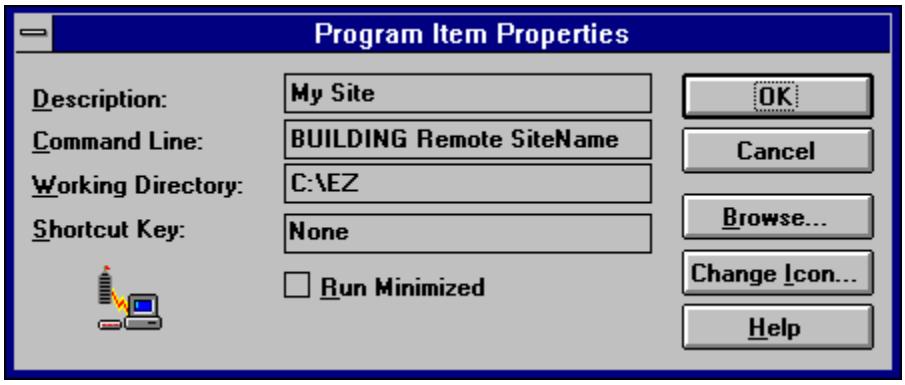
If the Alarm Log is to be printed or saved at the Client Site, then it must first be copied to the Windows Clipboard. The User may either Copy All of the Alarm Log to the Clipboard or select portions and then Copy Selected. It is then possible to Paste the data into any other Windows application, such as Notepad, for off-line viewing, printing, or storage.

Note: The maximum amount of Alarm data that can be transmitted to the Alarm Log Viewer is 8,000 bytes. This corresponds to somewhere between 50-80 Alarms. If more Alarms than this are recorded in the Alarm Log, then only the most recent 8,000 bytes of Alarm data is transmitted.

Creating Custom Site Icons

A custom icon may be created for each site in the phone book. The System will automatically call and connect to that site when the icon is selected in the **Energy Zone®** group. Create site icons using the following procedure:

1. If not already done, create an entry in the Phone Book for the Site.
2. Click once to highlight the Remote Building icon in the **Energy Zone®** group. The Remote Building icon is created during installation of the Remote Monitor package.
3. Select File and then Copy from the Windows Program Manager.
4. Select the **Energy Zone®** group, or other group as desired, and then Ok to create the new icon.
5. Click once to highlight the newly created Remote Building icon.
6. Select File and then Properties from the Windows Program Manager. The Program Item Properties dialog box will appear.
7. Enter a name for the Site in the Description box. This description will be displayed beneath the icon in the **Energy Zone®** group.
8. The Command Line should include the words “Building.exe Remote SiteName.” Substitute an actual SiteName from the Phone Book. The SiteName must be spelled exactly the same as in the Phone Book, including capitalization. It is not necessary to include the full name. Any portion of the name as listed in the Phone Book may be used.
9. Select Change Icon and choose the Remote Monitoring icon from the available Building icons.
10. Repeat this process for each additional Site.



Program Manager Properties Edit Dialog

When the new icon is double-clicked, the Remote Building program will start and automatically call the phone number for the Site.

Chapter 6

Graphics Viewer

Overview

The **Energy Zone®** Graphics Viewer is an optional alternative to the standard Building User interface. A separate application, the Graphics Builder, is used to create the displays used by Viewer. Viewer allows even the largest projects to be quickly scanned to determine System performance. No modification of System configuration (temperature setpoints, time-of-day schedules, etc.) is allowed from Graphics Viewer.

Features

- Unlimited Number of Graphical Displays
- Simple Point-and-Click Mouse Interface

Specifications

The Viewer application is a container used to display graphics created with Graphics Builder. There are few limitations on the number and complexity of displays for a Site. The quality and ease-of-use of any given Viewer site is highly dependent on the care given when creating the displays with Builder. The designer of the displays for a Site should provide either written or clear on-screen instructions for operation of the graphics at that Site.

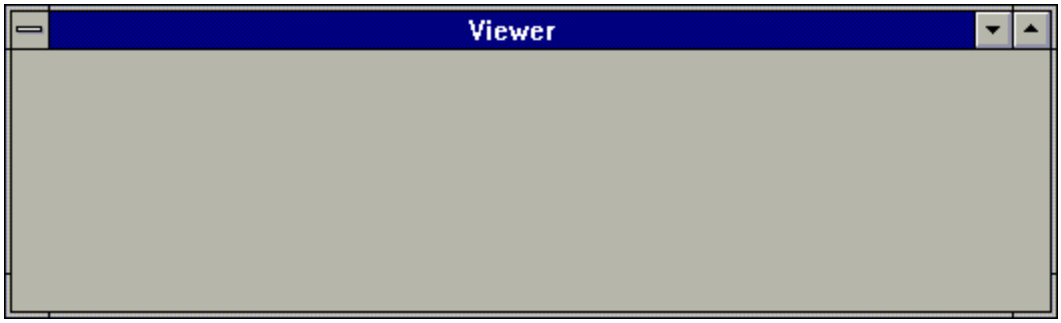
Floorview - Each graphic screen capable of being displayed by Viewer is referred to as a Floorview. A Floorview will generally include a floor plan with Zone data overlaid, but is not restricted to floor plans. Anything that can be saved in a Windows Bitmap format can be the background for a Floorview. Dynamic data, dynamic equipment displays, labels, and links to other Floorviews are overlaid on the background using Builder.

Note: Since no configuration information can be changed from Viewer, there are no Password or security provisions.

Note: RSCPC must be running at the Command Center prior to starting Viewer.

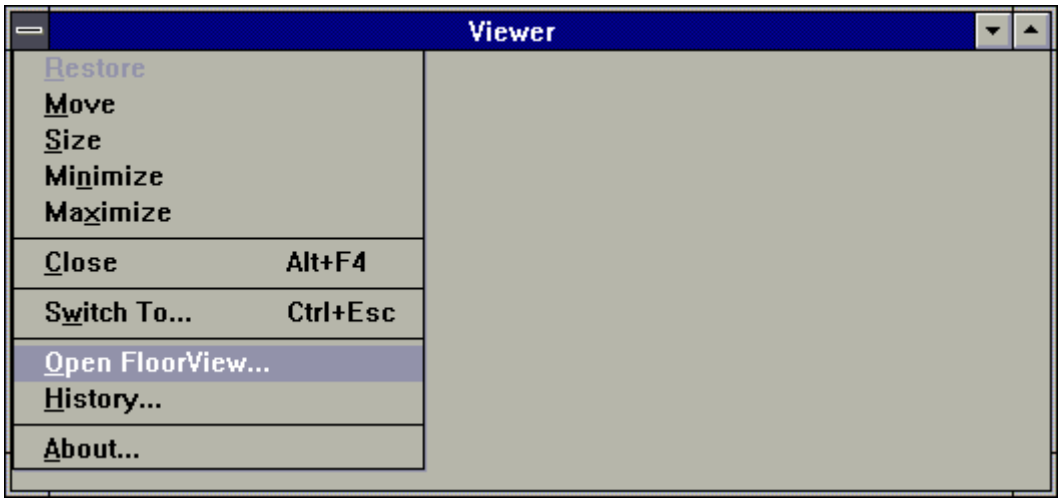
Opening a Floorview

There are four different methods of opening a Floorview. First, the Viewer application is started by selecting the Viewer icon in the **Energy Zone®** group. When the Viewer application begins the following screen will appear:



Graphics Viewer Application Window

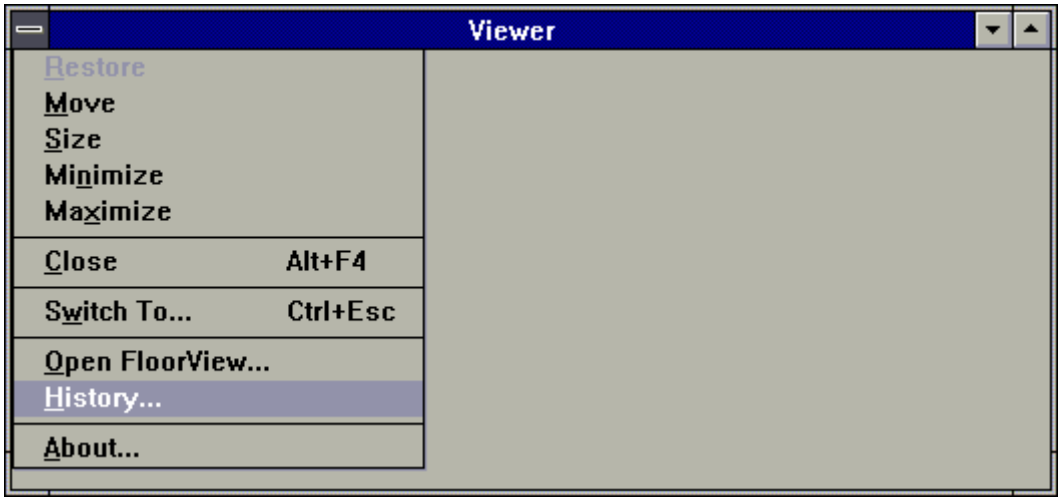
Method 1. From the Viewer System menu choose Open Floorview...



Graphics Viewer Menu

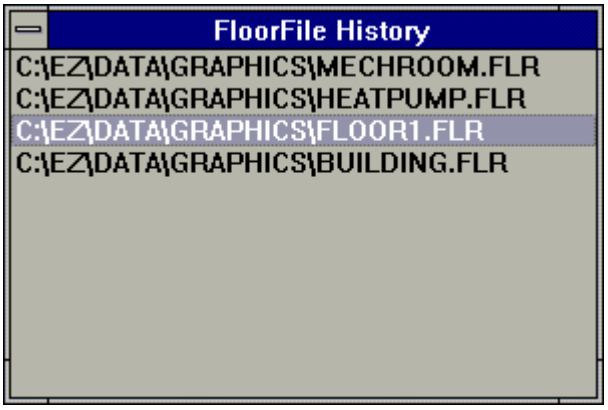
A file open dialog box will appear. Choose the file you would like to load and select OK. The Floorview will load in, updating all System readings as it is loading.

Method 2. This method will work if the User wishes to display a Floorview that was previously displayed during the current session. From the System menu choose History...



Graphics Viewer Menu

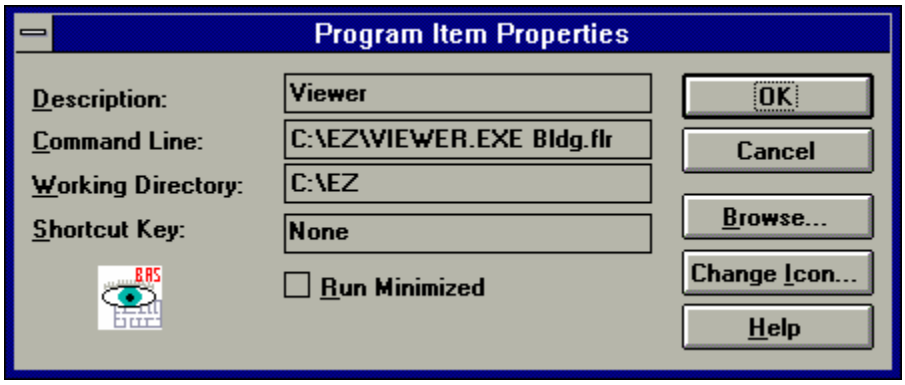
A FloorFile History is then displayed.



FloorFile History Screen

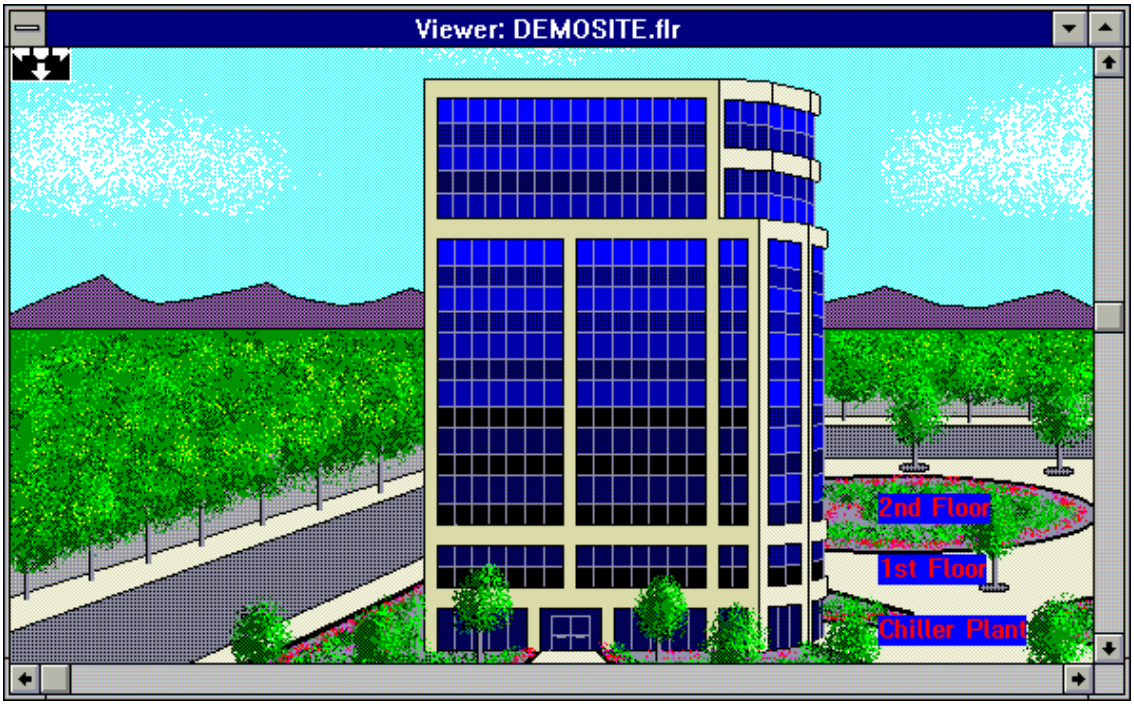
The FloorFile History Screen includes all Floor Files opened during the current session. Point and double-click on the desired Floorview in order to re-open it.

Method 3. Automatically open a Floorview when starting Viewer. This is done by editing the properties of the Viewer icon with Program Manager. Select Viewer by clicking once on the Viewer icon in the **Energy Zone®** group. Select File Properties from Program Manager and edit the Command Line. The Command Line should read "C:\EZ\VIEWER.EXE Bldg.flr". Substitute the name of the desired Floorview for Bldg.flr. Be sure to include the full file path if the file is not in the \EZ directory.



Program Manager File Properties Screen

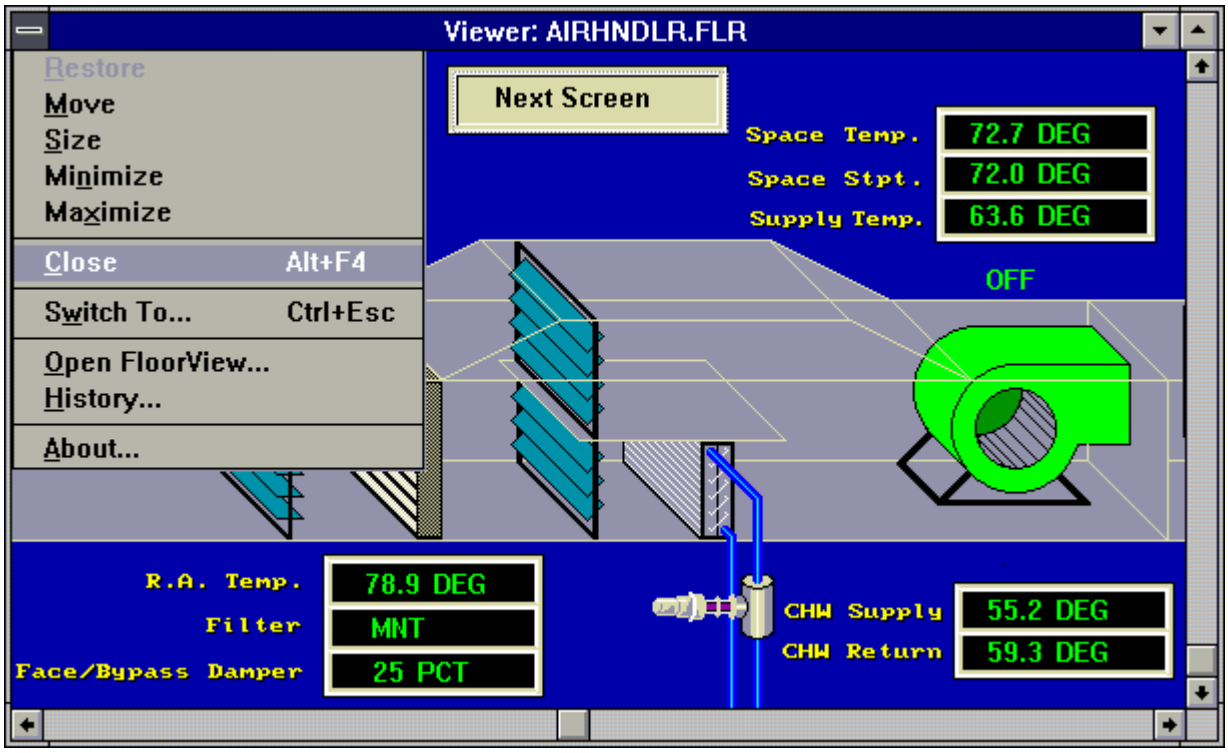
Method 4. Hit Links are used to automatically activate a new Floorview by double-clicking on a designated area of the current Floorview. Hit Links can be located anywhere on a Floorview and must have been created with Builder. The Floorview should provide some indication of where the Hit Link is located.



Viewer Display with Hit Links

Closing Viewer

The Viewer application is closed by selecting Close from the Viewer system menu:



Graphics Viewer Menu

Chapter 7

Graphics Builder

Overview

The Graphics Builder is used to design and build graphic displays that present data to the User at **Energy Zone®** Sites. Any standard Windows Bitmap can be used as a backdrop for the display. Controls are then overlaid on the background that link System data to the display.

Features

- Unlimited Number of Interlinked Graphical Displays
- Pre-defined Dynamic Graphic Displays
- Indicates Zone Alarm Conditions
- Display any System Analog or Digital Values
- Display Zone Configuration Values
- Use any Windows Fonts for Data Display

Specifications

Floorview - Each graphic screen created by Builder is referred to as a Floorview. A Floorview will generally include a floor plan with Zone data overlaid, but is not restricted to floor plans. Anything that can be saved in a Windows Bitmap format can be the background for a Floorview. Dynamic data, dynamic equipment displays, labels, and links to other Floorviews are then overlaid on the background using Builder.

Controls - Those items that can be overlaid on a background bitmap are called Controls. Controls can be static or dynamic, linked to RSCPC through Dynamic Data Exchange (DDE). Any Windows installed font can be used at any Control. The Controls that are available include:

- **On/Off Text** is used to display the status of a Digital Input or Output. Different text can be configured for both the On and the Off states.
- **Text** is static and is only used for labels.
- **DDE Readings** are dynamic and can be linked to most System data values that can change including Digital, Analog, and Zone Configuration values. The available items for a DDE reading are:

  AI - Scaled Analog Input 1-8
  AlarmOn - Configured Alarms 1-16. The Item # corresponds to the number assigned to the Alarm in the Zone Configuration Alarm Edit list Box of the Building application. The displayed value will be Yes or No.
  AO - Percentage open of Analog Output 1-5
  CFM - CFM airflow reading on Pressure Independent VAV Zones
  CP - Scaled Control Point
  Description - Zone Description from the Zone Configuration
  DI - Digital Input 1-8. The displayed value will be On or Off
  DO - Digital Output 1-8. The displayed value will be On or Off
  ID - Zone ID from the Zone Configuration
  InAlarm - Indicates if any Alarms are active at the Zone. The displayed value will be Yes or No.
  Mode - Current Mode of the Zone (Occupied, Unoccupied, or Offline)
  OCSP - Occupied Cooling Setpoint
  OHSP - Occupied Heating Setpoint
  RAI - Raw (unscaled) Analog Input 1-8. The displayed value will be 0-255.
  RAO - Raw (unscaled) Analog Output 1-8. The displayed value will be 0-255.
  ROMVer - Version of the EPROM at the RSC
  SchedNum - Equipment Schedule # configured for the Zone
  SCSP - Load Shed Cooling Setpoint
  Setback Time - Number of minutes of Setback Override allowed
  SHSP - Load Shed Heating Setpoint
  Stage - Current Stage for the Zone (H1, AT, C1, etc.)
  State - Current State of the Zone (Occ 1, Occ 2, UnOcc 1, SBOVR, etc.)
  UCSP - Unoccupied Cooling Setpoint
  UHSP - Unoccupied Heating Setpoint
  WeeklySched - Weekly Schedule # assigned to the Zone

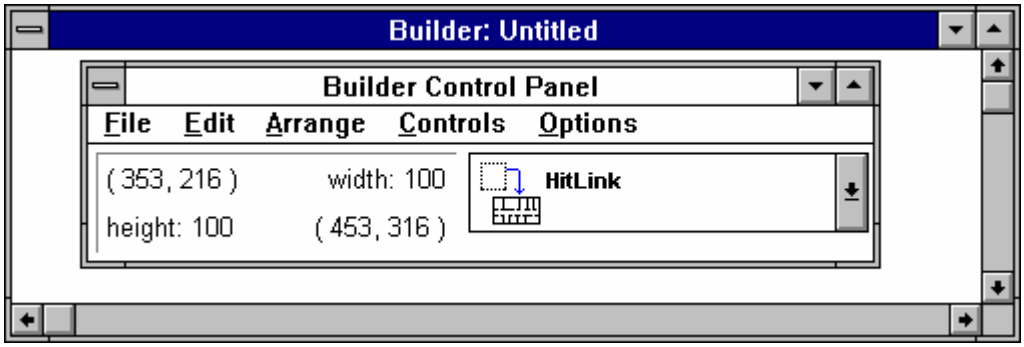
- **HitLinks** provide a means to jump from one Floorview to another. This will allow navigation of the data for a building that can not be easily displayed on one screen. HitLinks can be placed anywhere on a Floorview and can link to any desired Floorview. HitLinks are activated by double-clicking with a mouse on the designated area. The link will connect to the other Floorview only while in Viewer.
- **Override Link** will link data from any number of System addresses to a single Floorview. Override Links can be placed anywhere on a Floorview. This allows the User to create one typical graphic for equipment used throughout the project, such as a heat pump. Override Links can then be placed over the floor plan at each Zone. Double-clicking with a mouse on the designated area will activate the heat pump graphic and read in data from the selected Zone.

  Note: Whenever a HitLink or Override Link is used to activate a new Floorview, the only way to automatically return to the original Floorview is with another HitLink. The designer of a Floorview must ensure the User of Viewer has a means to move to another a Floorview. The User will not be stranded, as it is always possible to manually activated a new Floorview with Viewer.

- **Animated Bitmaps** are linked to any Digital Input or Output and will display an animated bitmap controlled by the state of the linked point. Animated Bitmaps are pre-defined and included with the System. Animated Bitmaps will indicate movement when in the On state, such as rotating blades of a fan.
- **On/Off Bitmaps** are linked to any Digital Input or Output and will change the bitmap displayed based on the state of the monitored point. On/Off Bitmaps are pre-defined and included with the System. On/Off Bitmaps are essentially two separate Static Bitmaps, one displayed in the On state and one displayed in the Off state.
- **Static Bitmaps** are not linked to any System data and do not change. They are provided to assist in creating equipment graphic displays. Static Bitmaps are pre-defined and included with the System.
- **Exclamation Alarms** will display an exclamation point when an alarm condition occurs at the selected Zone. This function can be configured for a specific Alarm or to display when any Alarm occurs. Alarm information can also be displayed using a DDE Reading.

Using Builder

The Builder application is started by selecting the Builder icon in the **Energy Zone®** group. When the Builder application begins the following screen will appear

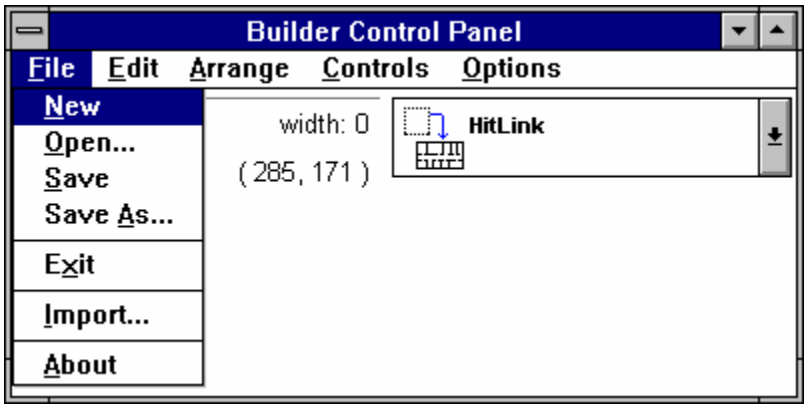


The Builder Application Window

The **Builder Control Panel** overlays the Builder Application window. The Control Panel can be dragged to any position on the desktop. The Builder Control Panel contains the tools that are used to place and edit Controls on the Floorview. The drop down list box in the upper left corner will show the currently selected Control. The left side of the Control Panel displays the coordinates of the currently selected Control.

Opening and Saving a New or Existing Floorview

Floorviews are opened and saved from the File menu of the Builder Control Panel.



The Builder Control Panel

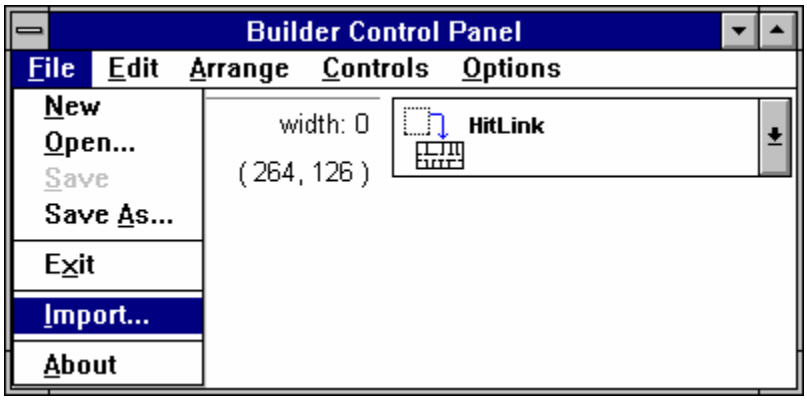
Starting a New Floorview File - Select New... to start a new Floorview

Opening an Existing Floorview File - Select Open... to edit an existing Floorview.

Saving a Floorview File - To save a Floorview file select Save As... Enter an 8 character file name with the extension *.flr*. Once the Floorview file has been saved, further changes to the Floorview can be saved by choosing Save rather than Save As. When Save or Save As is chosen, the Floorview is saved at the current size of the window.

Setting a Background Bitmap

To import a background bitmap, select Import... from the File menu.

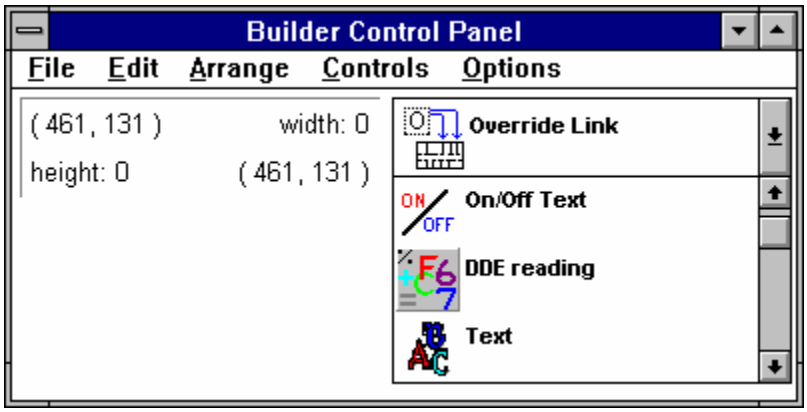


The Builder Control Panel

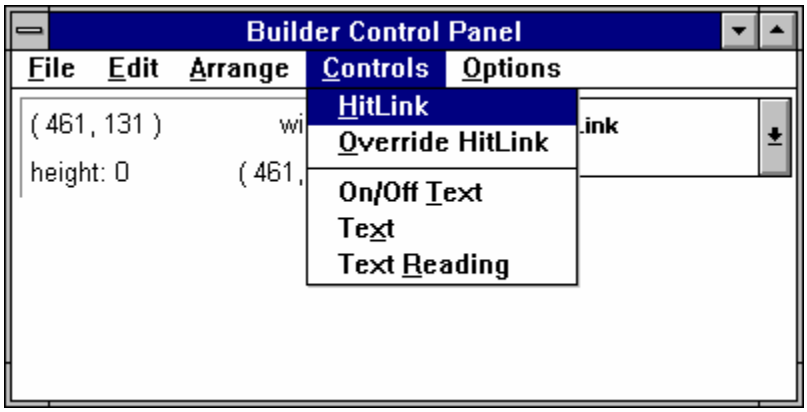
This will bring up a dialog box that allows the User to choose a bitmap file. Any file that conforms to the standard Windows bitmap specification can be imported as a background. Once a bitmap is selected, the bitmap will be painted as the backdrop on the Builder application window. The background can be changed to a different bitmap at any time by simply choosing the Import option. Any Controls that have been placed on the background will be painted in their exact positions and sizes on the new backdrop. Only one background bitmap may be placed within any given Floorview. Once the bitmap has been placed in Builder, it can not be scaled or edited.

Working with Controls

A list box is available in the Builder Control Panel containing all Controls. Several Controls can also be accessed from the Controls menu.



The Control List Box



The Controls Menu

Note: If many of the Controls will be using the same trunk, address, and/or font style, set all desired characteristics with the first Control. The Controls created afterward will automatically contain these characteristics.

Placing a Control - Several types of Controls are available, including On/Off Text, Text (static), DDE Reading, HitLink, Override Link, Animated Bitmap, On/Off Bitmap, Static Bitmap, and Alarms. Follow these steps to insert a Control to the Floorview:

1. Select the Control to insert from either the Controls menu or the list box.
2. When the mouse is moved over the Floorview, an arrow symbol (⇑) will appear:
3. Move the arrow to the approximate area on the Floorview where the Control should be placed and click the left mouse button. The Control is now placed.
4. To move the Control, click once and hold down the left mouse button within the area of the Control. Move the Control to the new location and release the mouse button to release.
5. For Controls that allow configuration options (On/Off Text, DDE Reading, HitLink, Override Link, Animated Bitmap, On/Off Bitmap, and Alarms), double-click within the area of the Control and a dialog box will appear. This dialog box contains the configuration for that Control. There is no dialog box or data associated with a static bitmap Control.

Sizing a Control - To change the size of a Control, first select the Control by clicking on it. Eight small squares will appear around the perimeter of the object. Move the mouse over one of the squares. The pointer should change to a double sided arrow (⇔). The Control can now be stretched or shrunk by dragging the mouse.

Note: If an Animated Bitmap is stretched or shrunk, it will run much more slowly than if it is left at its original size.

Text Font, Size, and Color - When a Control containing text is first created, the font, size, and color of the text matches the settings of the last Control created. Changing these settings is done by selecting the Set Font button from the dialog box for the Control.

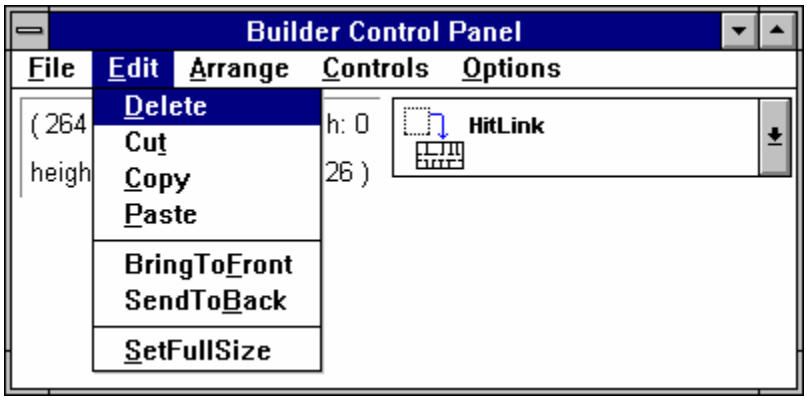
Text Alignment - There are three choices for text alignment: Left, Center, and Right. The default is set as Center, until a Control is edited and the alignment changed. Then, as with the font information, any text Controls created afterward will contain the new alignment. The text alignment aligns the text within the Control's bounding rectangle, not the overall Floorview. Whether the text is aligned to the left, center or right, if the text wraps around within the bounding rectangle, it will break between words rather than in the middle of a word.

Trunk-Address - Those Controls that are linked to System data require entry of the location of the RSC to be monitored. The format to be used is *X-YYZ* where *X* is the Trunk (1-8), *YY* is the Address (1-32), and Z is the sub-zone (a-d).

Manually Aligning Controls - When manually aligning two or more Controls, the coordinate box in the upper left corner of the Builder Control Panel can be helpful. The coordinate box displays the height and width of the Control's bounding rectangle (in pixels) as well as the pixel coordinates of the upper left and lower right corners. The Controls can be easily aligned by matching the coordinates.

Changing a Control's Data - When a Control is first created, it will contain default information. To change the information specific to the Control, first select the Control, then double click on it. A dialog box will appear allowing modification of the Control's settings.

Editing a Floorview



The Builder Edit Menu

Editing Floor Files - Multiple select is supported for all the Control editing commands as well as moving Controls. Multiple Controls can be selected by drawing a rectangle around the objects while holding down the left mouse button down and then releasing. They can also be selected by clicking with the mouse on successive Controls while holding down the Ctrl key. Editing commands follow standard Windows conventions.

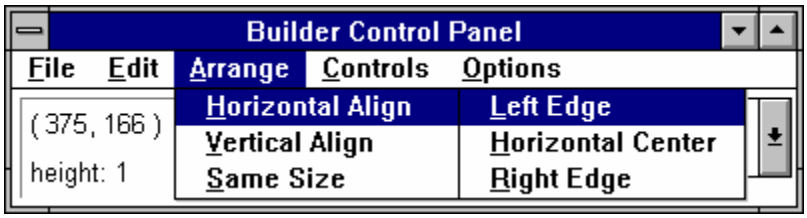
Delete, Cut, Copy, Paste - These tools work on Builder Controls the same as standard Windows edit commands. Builder will not paste to or from other applications.

Bring To Front, Send to Back - This tool is used for overlapping Controls. The selected Control will either move to the front or the back of the overlapping group of Controls.

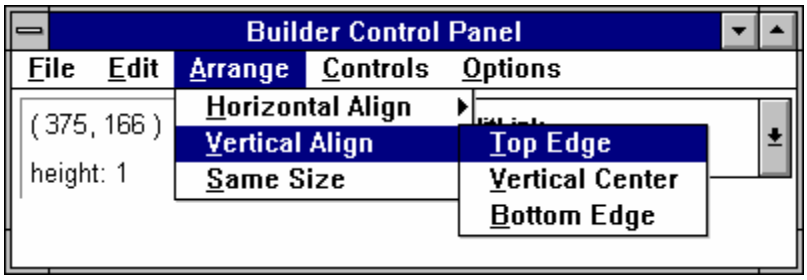
Set Full Size - The Set Full Size option is used to set the size at which the scroll bars become active for the Floorview window. This is used when creating a Floorview that is larger or smaller than the default size. To change the stored window size, first size the window as desired then choose Set Full Size. The window size is now set.

Automatic Alignment of Controls

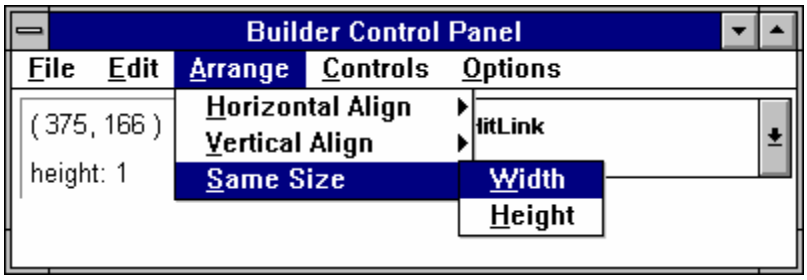
These tools will assist the User in aligning and sizing Controls.



Horizontal Align Menu



Vertical Align Menu



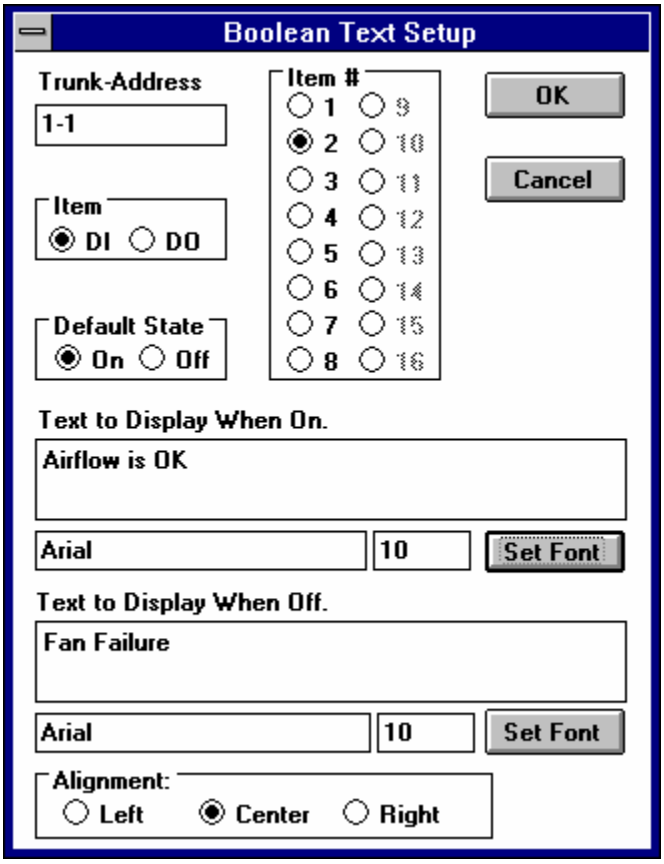
Controls Re-size Menu

To use these features, first select any number of multiple Controls on the existing Floorview. This is done selected by drawing a rectangle around the objects while holding down the left mouse button down and then releasing or by holding down the Ctrl key while clicking on the Controls with the left mouse button. All selected Controls will display the bounding rectangle. The most recently selected Control will have the sizing handles of the bounding rectangle filled solid. This is the Control that will be used as the master for moving or sizing all other selected Controls. Once the controls are selected, pick the desired function from the Arrange menu. After selection, all Controls will be automatically moved or sized.

Note: There is no Undo facility for this function. If unsure of the action, save the Floorview prior to selecting the function.

On/Off Text

The On/Off Text Control is used to relay information about Digital Inputs and Outputs. When the Control is first created, it will display the text “On/Off TEXT”.

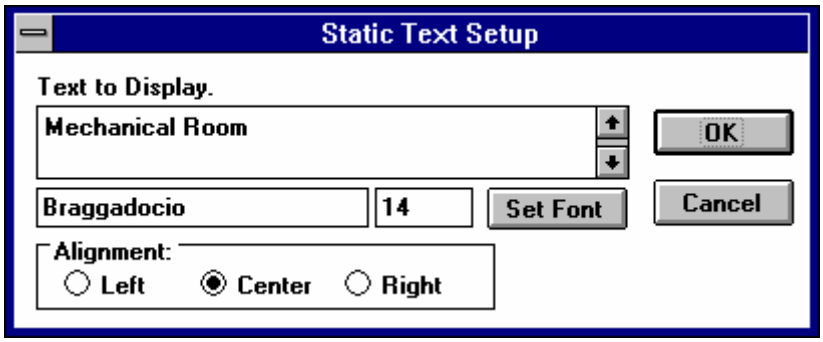


On/Off Text Dialog Box

Trunk-Address: - This is the location of the RSC containing the data.
Item - This is either a DI (Digital Input) or DO (Digital Output).
Item # - This is the number of the DI or DO to be monitored.
Default State - The Default State option button selects whether to display the On text or the Off text prior to linking to System data.
Text to Display When On - Text to be displayed when the DI/DO is in the On state.
Text to Display When Off - Text to be displayed when the DI/DO is in the Off state.

Text (Static)

The Text Control is used to convey information that is not dependent on the state of the actual building controls. For example, this Control can be used to label a Floorview, zone or bitmap. When the Control is first created, it will display the text “Text”.

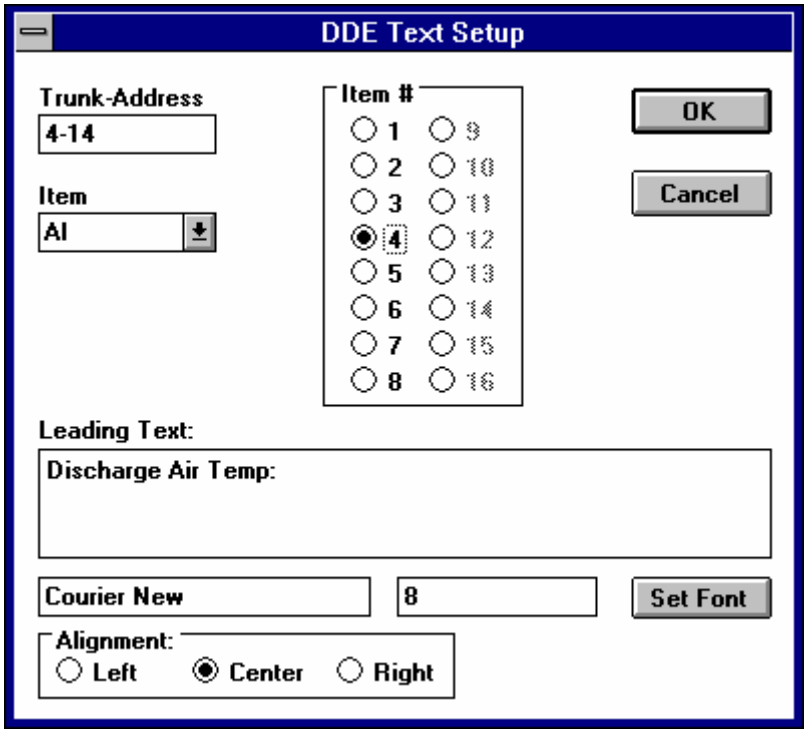


Text Setup Dialog Box

Text to Display - Enter the desired text in this box.

DDE Reading

The DDE Reading Control is used to display an Analog Input or other text readings from the System. When the Control is first created, it will display the text “Reading”.



DDE Text Reading Setup Dialog Box

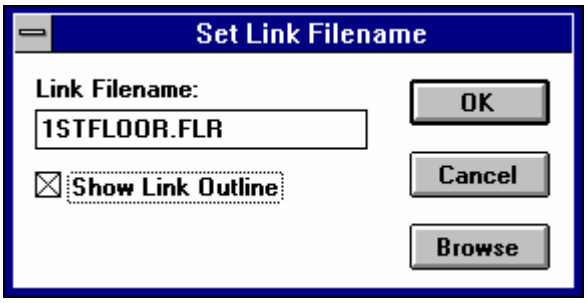
Trunk-Address: - This is the location of the RSC containing the data.

Item - When in Builder the item name and number will appear after the leading text, or by itself if there is no leading text (i.e. Discharge Air Temp: AI4). This is to help keep track of what the item is for each text reading while building the Floorview. The item name and number will be replaced with the reading when the Floorview is loaded in the Viewer application.

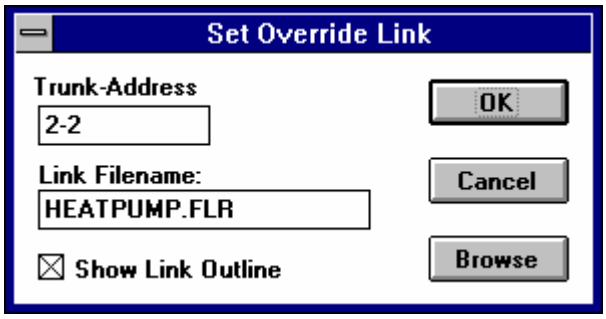
Item # - This is the number of the Item to be monitored.

Leading Text - Text to be displayed in front of the displayed value. A space is automatically added between the leading text and the reading that will be displayed.

HitLinks and Override Links



Hit Link Dialog Box

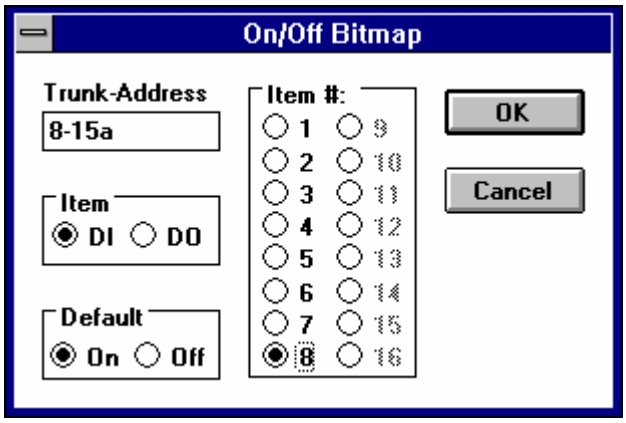


Override Link Dialog Box

Trunk-Address: - This is the location of the RSC data to be read into an Override Link.
Link Filename: - This is the Floorview to display when the Link is selected.
Show Link Outline - This will determine whether or not a dashed line is drawn around the location of the Link in both Builder and Viewer. If the Show Link Outline check box is clear, the location of the Link will not be shown.

Displaying Hidden Links - To display invisible links visible, select Options / Show Link Outlines from the Builder Control Panel. The links will then be visible for the duration of the session or until Show Link Outlines is selected again. This option only has an affect on those Controls that do not have the Show Link Outline box checked and only works in Builder.

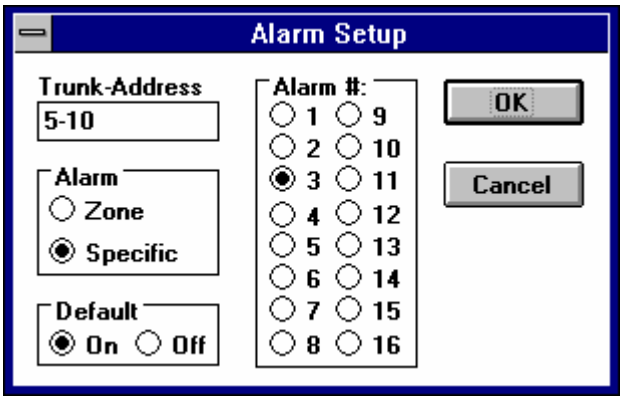
On/Off and Animated Bitmap



On/Off and Animated Bitmap Setup Dialog Box

Trunk-Address: - This is the location of the RSC containing the data.
Item - This is either a DI (Digital Input) or DO (Digital Output).
Item # - This is the number of the DI or DO to be monitored.
Default State - The Default State option button selects whether to display the On state or the Off state of the bitmap prior to linking to System data.

Exclamation Alarms



Alarm Setup Dialog Box

Trunk-Address: - This is the location of the RSC containing the Alarm to be monitored.

Alarm - Select either Zone, indicating any Alarm that has occurred at the Zone, or Specific, requiring the User to select a specific Alarm #.

Alarm # - The Alarm # corresponds to the number assigned to the Alarm in the Zone Configuration Alarm Edit list Box of the Building application.

Default State - The Default State option button selects whether to display the On state or the Off state of the bitmap prior to linking to System data.

Part III

Hardware

1. Remote System Controller
2. Analog Input Devices
3. Analog Outputs
4. EnerNet®

Chapter 1

Remote System Controller

Overview

The microprocessor based Remote System Controller (RSC) can be programmed with control sequences for 128 different types of HVAC equipment, serving the needs of virtually all equipment found in use today. The RSC, when connected to Command Center with a 2 conductor trunk line, provides the basis for an extremely powerful and versatile Building Automation and Energy Management System.

Features

- 8 Analog Inputs
- 4 Analog Outputs
- 8 Digital Inputs
- 8 Digital Outputs
- Up to 4 HVAC Zones connected to a single RSC
- Communicates with the Command Center using reliable RS-485 communication network
- Dip switch selectable default mode allows operation without Command Center interface
- Advanced microprocessor control algorithms provide highly accurate temperature control
- Test plug allows connection of portable handheld terminal

Specifications

General Description - The RSC is a microprocessor based controller. The design of the RSC circuit board is based on the NEC 78C10 microcomputer. Each RSC has a total capacity of thirty I/O points including eight Digital Outputs, eight Digital Inputs, eight Analog Inputs, four Analog Outputs, and two remote LCD display modules. The Analog Outputs (AO) are controlled by the RSC but require the use of a separate AO board.

Memory Configurations - The RSC contains 256 bytes of on-board RAM. The operating instructions and default Equipment Schedules are provided in one of four possible configurations; 1) 32K EPROM (the most common configuration), 2) 128K EPROM, 3) 32K battery backed SRAM, and 4) 128K battery backed SRAM. Jumpers are used to configure the RSCs for the different memory configurations. These are set at the factory and will not need to be modified in the field.

Default Mode - Equipment Schedules are the control sequences for a given type of HVAC equipment. Equipment Schedules are stored on an EPROM that resides on the RSC. The default mode for all supported Equipment Schedules is programmed into the EPROM (or SRAM) shipped with every RSC. Positioning a dip switch on the RSC will determine which Equipment Schedule is used for RSC default control. The dip switch selectable default mode provides for sophisticated control algorithms without connection to a Command Center, allowing for rapid and trouble free initial building startup. This also ensures continuation of excellent temperature control even after loss of the System Command Center or a communication trunk failure.

Multiple Zone Control - One RSC can control up to 4 HVAC control zones. Each Equipment Schedule is divided into 1, 2, or 4 control Zones depending on the output requirements of the equipment being controlled. When using the Handheld Tester to troubleshoot the RSC, the Zones are identified as follows; 1) Zone A for a single Zone schedule, 2) Zone A and Zone C for a dual Zone schedule, and 3) Zone A, Zone B, Zone C, and Zone D for a quad Zone schedule.

RSC Address - Each RSC on a given trunk line must be assigned a unique address between 1-32. The address does not have to correspond to the physical location or position on the trunk line. One of the two dip switch banks on the RSC is used to set the address.

Communication -Two communication interfaces are available at each RSC. Communication between each RSC and the Command Center follows the RS-485 specification. Up to 32 RSCs can be placed on each of eight trunk lines. Communication is on a standard 2-conductor, 18 AWG, twisted shielded pair (tsp), with all RSCs on a trunk line wired in parallel. Maximum length of the trunk line is 5000'. The trunk line is protected from voltage spikes at each RSC by surge suppressers. Automatic resetting solid state fuses prevent damage to the surge suppressers by sustained faults.

An RS-232 interface is also available at each RSC and is the communication standard used to communicate with the Handheld Tester (HTD). The HTD can be plugged directly into the RSC or into an external RJ-11 jack up to 250’ from the RSC. The presence of the HTD is sensed by the RSC, which will then automatically enter HTD troubleshooting mode.

Externally Provided Power Supply - The RSC requires 10 VA @ 24 Vac from a NEC Class 2 UL Listed transformer. When power reaches the RSC it is first passed through a pair of automatic resetting solid state fuses and an isolation transformer. This combination provides the RSC with almost complete immunity to fluctuations and noise in the 24 VAC power supply. It also protects vital components against faults that could affect RSC operation and reliability.

The power supply must be able to maintain a minimum of 20 Vac under all load conditions. If a Digital Output is switching a large inductive load, such as the coil of a large contactor, the supply voltage is very important. The triac will begin to malfunction if trying to switch an inductive load with a pull-in current of 1 A or more and a supply voltage of 18 Vac or less.

Internally Generated Power Supplies - All DC voltages necessary for system operation are generated by two onboard regulated power supplies, 18 VDC for external components and 5 VDC for onboard digital logic circuits.

Status LEDs - Several status LEDs are provided on the RSC. Most common problems can be isolated by simply checking the status of these LEDs. A Heartbeat LED monitor is located on the RSC and will indicate the operational status and mode of the RSC. Two LEDs indicate the status of communication, one for incoming and one for outgoing transmissions. Eight additional LEDs are provided, one at each Digital Output, to indicate the commanded state of the output.

The Heartbeat LED will start a new flash sequence once every 3 seconds. The number of flashes that occur at the beginning of the sequence indicate the mode of the RSC. The indicated modes are:

1 Flash	On-line with Command Center, normal operation
2 Flashes	Offline, controlling in default mode from the EPROM
3 Flashes	Test Mode, under control of the Handheld Tester
4 Flashes	Init, initializing a new connection with the Command Center
5 Flashes	Reboot, the RSC is in a power-up sequence

LCD Display Modules - Terminals are provided for connection of up to two externally mounted LCD display modules. Support for these modules is limited at this time. They will display the scaled value of a standard range temperature sensor connected to AI1. Additional uses are planned for a future EPROM release.

Analog Inputs - The RSC has the capacity for 8 Analog Inputs. All Analog Inputs are jumper selectable as 0-5 Vdc or 4-20 mA. All 8 AI locations are provided with a separate 18 VDC power supply terminal and a DC common terminal.

Analog Outputs - All modulating Analog Outputs are provided by an AO card. AO cards receive digital control data from the RSC and use the data to generate 4 individual modulating outputs. Each output is jumper selectable as either 4-20 mA or 0-10 VDC. The AO card connects to the RSC by means of a factory provided 16 pin ribbon cable and connector.

Digital Inputs - The RSC has the capacity for 8 Digital Inputs. Digital Inputs are activated by routing 18 Vdc from the RSC power supply to the appropriate RSC input terminal through a field device. This field device could be anything with a set of dry contacts.

Digital Outputs - The RSC has the capacity for 8 Digital Outputs. Control of loads connected to Digital Outputs is provided by triacs mounted on the RSC. Each output can directly switch loads up to 1 A @ 24 Vac. Loads that exceed these ratings should be provided with a pilot duty relay for interface to the RSC. Each DO is accompanied by an LED that indicates the state of the DO.

Digital Output Bank Isolation - The 8 DOs are divided into two banks of 4 DOs each, Bank A (DO1-4) and Bank B (DO5-8). The power supply common to each bank can be shared with the RSC or each bank can use an individual common, isolated from the rest of the RSC. This allows for control of up to two different pieces of HVAC equipment having a factory transformer from one RSC without the use of field installed isolation relays.

Installation - RSCs are sometimes grouped in a central location, but are usually distributed throughout the facility and mounted near the equipment they serve. The RSC is 5 1/2”w x 7”h and is mounted in a 7 1/2”w x 9”h NEMA 1 metal enclosure. Electrical conduit knockouts are provided in both 1/2” and 3/4” sizes. The RSC must be either mounted in a dry location or installed inside a field supplied enclosure. RSCs are available from BAS without an enclosure and can be mounted directly to any flat surface using plastic standoffs.

The RSC and all devices supplied by BAS, except the Command Center, are rated as Class 2 limited energy electrical devices. UL does not require UL certification of any component manufactured and sold by BAS as long as the installation conforms to the NEC for a Class 2 circuit installation. All field wiring connects to the RSC with de-pluggable compression type screw terminal strips. These de-pluggable terminals allow for rapid changeout of damaged RSCs.

RSC Operation

Startup

1. Upon supplying 24 Vac to the RSC, the RSC begins an initialization and self test procedure. The RSC requires an initialization period of 16 seconds. This time is used primarily to ensure a stabilized average for all Analog Input readings.
2. The Heartbeat LED will indicate Reboot (5 flashes).

Normal Operation - On-line with the Command Center

1. If a Command Center is connected to the trunk line, the RSC will establish a communication link with it. During normal operation, the RSC is on-line with the computer. When in this mode, all control functions are handled by the computer. The RSC is a slave to the Command Center.
2. On establishing initial communication with the Command Center, the Heartbeat LED will indicate Init (4 flashes). The initialization process is completed after several seconds. After beginning normal operation at the RSC, the Heartbeat LED will indicate On-line (1 flash).
3. The Command Center communicates with every RSC once every eight seconds. Between updates, the RSC collects data as to the status of all inputs. All Analog Inputs are sampled once every two seconds and the results are averaged over a total of eight samples. Any Digital Input that is activated during this period is reported as on. When requested by the Command Center, the RSC reports the status of all its inputs. At the same time the Command Center directs the RSC as to the state of all of its outputs based on the last reported input state. This cycle repeats continuously.
4. Two LEDs indicate status of communications. The green LED will indicate any traffic on the trunk, both from the Command Center and from all other connected RSCs. The yellow LED will indicate the outgoing data from the RSC.
5. If the RSC loses the link with the Command Center (noisy data, Command Center off-line, broken trunk line, etc.), it will maintain the state of all of the outputs for three minutes while trying to reestablish a link with the Command Center. After the end of three minutes without a link, the RSC will enter default mode. The Heartbeat LED will indicate Offline (2 flashes).

Default Mode

1. Prior to connection to a Command Center, or following a failure of the communication link to the Command Center, the RSC is in default mode. Default operation is indicated at the RSC by the Heartbeat LED flashing the Offline sequence (2 flashes). When in this mode, all control functions are handled by the RSC as a stand-alone controller. The Equipment Schedule to be used is determined by the dip switch settings on the RSC.
2. The RSC uses proportional control when in default mode.

Test Mode

1. The Heartbeat LED will indicate Test (3 flashes).
2. All outputs will maintain their last state unless commanded to change with a Handheld Tester.
3. Any output whose state is changed when in Test mode will maintain that state while in Test mode.
4. All Analog Inputs will update immediately on the Handheld Tester display following a change.
5. When returned to normal operation, the RSC will first enter default mode and then attempt to establish communication with a Command Center.

RSC Inputs and Outputs

1. A certain number of inputs and outputs are necessary for the proper operation of each equipment schedule. See the sequence of operation for a detailed description of the inputs and outputs used on each schedule.
2. Any input or output not dedicated to the operation of a piece of equipment can be used for auxiliary control. An example would be: Digital Output - exhaust fan, lights; Digital Input - air flow switch, pressure switch; Analog Input - discharge air temperature, space humidity.
3. Equipment Schedule #64 is defined as a null schedule with no pre-defined control sequence. All inputs and outputs can be programmed as desired.

Setback Override Button

1. The button on top of the wall sensor is used to send a setback override signal to the Command Center. This button actually shorts the analog temperature signal from the wall sensor to ground. When this happens, the RSC holds Analog Input 1 (space temperature) at the previous value and reports to the Command Center that Digital Input 1 = ON.
2. A switch can be wired from the +18 Vdc power supply to Digital Input 1 and used as an alternative method of signaling a setback override. This would allow for installation of multiple setback override switches.

Economizer Operation

1. All units using an Equipment Schedule with economizer control must have a return air enthalpy sensor installed and wired to Analog Input 2.
2. If the equipment uses an economizer directly modulated by the RSC, a duct sensor must be wired to Analog Input 6 for economizer low limit control. This would normally be mounted in the mixed air plenum but would also work in the discharge air plenum. This is not necessary if the RSC is interfacing to a factory economizer package using Digital Outputs.
3. When on-line with the Command Center, outside air enthalpy is input in one location and passed to all RSCs. The RSC will then make a decision on using the economizer based on differential enthalpy.
4. When in default, the RSC will ignore the economizer and use mechanical cooling only.

VariZone Servers

1. All units configured as a VariZone Server must have a duct sensor installed in the discharge plenum and wired to Analog Input 4. This sensor is used for protection of the equipment during periods of high bypass.

Installation

Note: A label is attached to the back of each RSC enclosure. This label includes the information necessary to answer most of the common installation questions.

Location and Mounting

1. The RSC is provided in a 7 1/2”w x 9”h NEMA 1 metal enclosure. Choose a location that is not exposed to the weather and where controls, connections, and the Test socket are accessible. The RSC enclosure must be connected to earth ground for proper trunk-line surge protection. Attaching the RSC enclosure to a metal structure is generally adequate.
2. The RSC may be installed in wet or damp environments as long as it is installed in a field supplied enclosure that is rated for the environment.

Wiring (See the Equipment Schedule schematic for detailed wiring instructions)

1. General - All wiring must conform to the NEC requirements for a Class 2 Limited Energy circuit in addition to any special local codes. This equipment is not rated for nor intended to fulfill any Life Safety requirements.

2. Power Supply - Provide the RSC with a 10 VA, 24 Vac power supply. De-energize the power supply before making connections to avoid electrical shock or equipment damage. All wiring must comply with local codes and ordinances.

3. Power Supply Jumpers - The Digital Outputs are divided into 2 banks. DO1-4 are on Bank A and DO5-8 are on Bank B. Each bank can either be provided with an independent 24 Vac hot or the banks can be jumpered together. The banks can also be combined with the same power source used to supply the RSC. There are 4 power supply terminals; 1) 24V VHA is the supply to DO Bank A, 2) 24V VHB is the supply to DO Bank B, 3) 24V ACIP is the isolated power supply to the RSC, and 4) 24V ACN is the neutral or common used for the RSC power supply. If the power supply jumpers are installed on the RSC (factory default), the power only needs to be connected to the 24V ACIP and 24V ACN terminals. The jumpers will send the 24 Vac from the 24V ACIP terminal to both Bank A and Bank B.

4. Trunk Line - The communication trunk must be a minimum 18 AWG, 2 conductor Twisted Shielded Pair (TSP) cable. Smaller gauge wire may be used on short trunk lines, down to a minimum of 24 AWG on runs of 500’ or less. The trunk line must be connected to all RSCs in parallel. The wiring should be done in a daisy chain configuration. Up to 32 RSCs can be installed on a trunk line, with up to 8 trunk lines per Command Center. The RSCs can be addressed in any order. The polarity of all RSC on the trunk line must be maintained. The RSC terminals are marked plus (+) and minus (-).

   The last RSC (the end of the wiring run) on each trunk should have its termination jumper installed. The jumper will place a 120 ohm termination resistor across the trunk line. The jumper is not installed by default.

   Caution: Do not connect the trunk wires to any device other than the trunk terminals at the RSC or the Command Center. Other voltages on the trunk line can damage all RSCs connected to the trunk line.

   Note: Do not route the trunk line directly adjacent to power wiring or other noise producing devices such as fluorescent lights or computer networks.

5. Digital Outputs (DO) - Connect DO as necessary, following the Equipment Schedule drawing.

6. Analog Inputs (AI) - Provide wiring to all accessory devices in accordance with instructions included with those devices. If an input device from other than BAS is used, it must be able to operate from a 18 Vdc supply and use no more than 0.7 VA. If the device uses a 4-20 mA dc signal, install the 4-20 mA jumper for that AI position (located above the EPROM).

   Caution: The AI terminals on the RSC should not be connected to any voltage higher than 5 Vdc or less than 0 Vdc. **Voltages outside this range will affect operation of the RSC and may cause damage to the RSC processor.**

7. Digital Inputs (DI) - Route a wire from the PWR terminal, through a field device with a set of dry contacts, back to the desired DI position.

8. Analog Outputs (AO) - All AOs are provided by an optional AO board. This board is attached to the RSC with a 16 pin connector and ribbon cable. Once connected, the AO will operate with no additional setup.

Setup

Equipment Schedule Dip Switch Settings - Each RSC must have the switch positions on Dip Switch Bank #1 (the upper bank) set for the Equipment Schedule that provides the desired default control.

Address Dip Switch Settings - Each RSC on a trunk line must have a unique address from 1-32. RSC address settings are made on Dip Switch Bank #2 (the lower bank). Switch Positions 1 through 5 are used to determine the address.

ES # or	Switch Position							Switch Position						
Address #	1	2	3	4	5	6	ES #	1	2	3	4	5	6
1	0	0	0	0	0	0	33	0	0	0	0	0	1
2	1	0	0	0	0	0	34	1	0	0	0	0	1
3	0	1	0	0	0	0	35	0	1	0	0	0	1
4	1	1	0	0	0	0	36	1	1	0	0	0	1
5	0	0	1	0	0	0	37	0	0	1	0	0	1
6	1	0	1	0	0	0	38	1	0	1	0	0	1
7	0	1	1	0	0	0	39	0	1	1	0	0	1
8	1	1	1	0	0	0	40	1	1	1	0	0	1
9	0	0	0	1	0	0	41	0	0	0	1	0	1
10	1	0	0	1	0	0	42	1	0	0	1	0	1
11	0	1	0	1	0	0	43	0	1	0	1	0	1
12	1	1	0	1	0	0	44	1	1	0	1	0	1
13	0	0	1	1	0	0	45	0	0	1	1	0	1
14	1	0	1	1	0	0	46	1	0	1	1	0	1
15	0	1	1	1	0	0	47	0	1	1	1	0	1
16	1	1	1	1	0	0	48	1	1	1	1	0	1
17	0	0	0	0	1	0	49	0	0	0	0	1	1
18	1	0	0	0	1	0	50	1	0	0	0	1	1
19	0	1	0	0	1	0	51	0	1	0	0	1	1
20	1	1	0	0	1	0	52	1	1	0	0	1	1
21	0	0	1	0	1	0	53	0	0	1	0	1	1
22	1	0	1	0	1	0	54	1	0	1	0	1	1
23	0	1	1	0	1	0	55	0	1	1	0	1	1
24	1	1	1	0	1	0	56	1	1	1	0	1	1
25	0	0	0	1	1	0	57	0	0	0	1	1	1
26	1	0	0	1	1	0	58	1	0	0	1	1	1
27	0	1	0	1	1	0	59	0	1	0	1	1	1
28	1	1	0	1	1	0	60	1	1	0	1	1	1
29	0	0	1	1	1	0	61	0	0	1	1	1	1
30	1	0	1	1	1	0	62	1	0	1	1	1	1
31	0	1	1	1	1	0	63	0	1	1	1	1	1
32	1	1	1	1	1	0	64	1	1	1	1	1	1

1 indicates switch in the ON position.
0 indicates switch in the OFF position

System Startup/Checkout

1. Place the RSC in Test Mode by plugging in the Handheld Tester.
2. Energize the RSC.
3. The RSC Heartbeat LED should indicate Test (3 flashes). If not, verify 24 Vac is supplied to the RSC. If power is OK, then the RSC must be replaced.
4. Check calibration of the wall sensor. Verify reading at the Handheld tester.
5. Check the status of all Analog Inputs and Digital Inputs. Analog inputs should read the correct value if an input is connected, or either 1 or 0 if no device is connected. Digital inputs should read the correct value if an input is connected, or 0 if no device is connected.
6. Test the operation of all Digital Outputs. Use caution to energize the outputs in the correct sequence for the attached equipment.
7. Test the operation of any Analog Outputs, if used.
8. If the RSC tests satisfactorily, unplug the Handheld Tester. If the Command Center is on-line, the RSC Heartbeat LED will indicate Init (4 flashes). After several seconds, the initialization should be complete and the Heartbeat LED will indicate On-line (1 flash). If the Command Center is not yet on-line, the RSC will begin operation in default mode, indicates by 2 flashes of the Heartbeat LED.

Handheld Tester Operation

Note: There are differences between the Handheld Tester (HTD) used for Version 3.x and later RSCs and those used for earlier versions of the RSC. Adapters are available to allow use of either HTD on either RSC style. A label affixed to the back of each HTD will show the proper connection procedures for both RSC versions. Attempting to make connection with incompatible versions may damage either the RSC or the HTD.

1. The RSC will automatically enter Test mode when the Handheld Tester (HTD) is plugged into the RSC. The RSC can be locked into Test mode by setting Dip Switch 8 on Switch Bank #2 to ON. If on-line with the Command Center when entering Test mode, the RSC will transmit its status to the Command Center before allowing Test mode. This will take a maximum of 8 seconds. The RSC will indicate Test mode by the Heartbeat changing to Test mode (3 flashes). Once in Test Mode the following options are available:

   F1 - Read all Analog Input and Analog Output values.
   F2 - Position any Analog Output.
   F3 - Display the status of all Digital Inputs and Digital Outputs.
   F4 - Position any Digital Output.
   F5 - Reads the position of all dip switches.
   T - Display the temperature in deg F in .25 deg resolution, current stage, and information about the first two actuators if used.
   U - Display the temperature in deg F in .25 deg resolution, current stage, and information about the second two actuators if used.
   1 - Display the temperature in deg F in .25 deg resolution and current stage for the first Zone (Zone A) on multiple Zone schedules when in T or U modes.
   2 - Display the temperature in deg F in .25 deg resolution and current stage for the second Zone (Zone B) on multiple Zone schedules when in T or U modes.
   3 - Display the temperature in deg F in .25 deg resolution and current stage for the third Zone (Zone C) on multiple Zone schedules when in T or U modes.
   4 - Display the temperature in deg F in .25 deg resolution and current stage for the fourth Zone (Zone D) on multiple Zone schedules when in T or U modes.
   S - Display the current Equipment Schedule # and Address #.
   H - Will increase the current stage one step in the heating direction.
   C - Will increase the current stage one step in the cooling direction.
   A - Forces the RSC to the At Set position.

2. Pressing Enter from any screen will bring up the menu.

```
RSC TEST  S SYS INFO
F1 AI/AO  F2 SET AO
F3 DI/DO  F4 SET DO
F5 DSW    T/U ZONE
```

3. F1 - Read all Analog Input and Analog Output values. This mode displays the current raw value of all Analog Inputs and Analog Outputs in the range of 0-255. The display of the conditioned value on the Temperature screen is more usable in most cases.

```
AI 1-8  000 000 000
000 000 000 000 000

AO 1-4  000 000 000
000
```

4. F2 - Position any Analog Output. This mode allows for the override of any Analog Output to the desired position. The output will remain positioned until Test mode is exited by removing the HTD.

```
  < OVERRIDE AO >

SELECT AO (1-4)?  _
VALUE (000-255)?  _
```

Select the desired output from 1-4. Enter the value for the desired analog position. This number must be in the range of 000-255. (000=0%, 255=100%, etc.)

5. F3 - Display the status of all Digital Inputs and Digital Outputs. This function will display the following:

```
 < DIGITAL VALUES >
POSITION #12345678
   INPUTS 00000000
  OUTPUTS 00000000
```

All Digital Inputs or Outputs indicate either 0 if they are off or 1 if they are on.

6. F4 - Position any Digital Output. This mode allows for the override of any Digital Output to the desired position. The output will remain positioned until Test mode is exited by removing the HTD.

```
  < OVERRIDE DO >

SELECT DO (1-8) ? _
ON(1) OR OFF(0) ? _
```

Select the desired output from 1-8. Enter the value for the desired output position.

7. F5 - Display the status of all Dip Switches. This function will display the following:

```
  < DIP SWITCHES >
POSITION #12345678
 SWITCH 1 00000000
 SWITCH 2 00000000
```

All dip switches indicate either 0 if they are off or 1 if they are on. The number displayed is the binary representation of the Equipment Schedule and Address. It is more convenient to use the Schedule screen to display these values.

8. T - Display several System status items. This function will display the following:

```
Z:A  Stg:INIT   74.25
TIM1:   0   TIM2:   0
SET1: 150   SET2: 150
POS1: 150   POS2: 150
```

Note: The Zones are identified as follows; 1) Zone A for a single Zone schedule, 2) Zone A and Zone C for a dual Zone schedule, and 3) Zone A, Zone B, Zone C, and Zone D for a quad Zone schedule.

Z displays the Zone (A, B, C, or D) for which the first line of data applies.
74.25 is the present temperature in degrees F of the Zone listed.
Stg is the current active stage of the Zone listed. The possible modes are:
INIT - initialization at System startup
AT - RSC is at Setpoint
C1 through C4 - RSC is in cooling, stage 1 through 4
H1 through H4 - RSC is in heating, stage 1 through 4

The next 3 lines provide information for the first two 3 point floating actuators:

TIM1 and TIM2 are the timing in 2 second increments (a display of 150 equals 300 seconds) remaining for the present positioning of actuator 1 and actuator 2.

SET1 and SET2 are the timing in 2 second increments (a display of 150 equals 300 seconds) of the desired position of actuator 1 and actuator 2.

POS1 and POS2 are the timing in 2 second increments (a display of 150 equals 300 seconds) of the actual position of actuator 1 and actuator 2.

9. U - Displays the same information as selecting ‘T’, except that the last 3 lines toggle to display information for the last two 3 point floating actuators. The top line of display will not change. This function will display the following:

```
Z:A  Stg:INIT   74.25
TIM3:   0   TIM4:   0
SET3: 150   SET4: 150
POS3: 150   POS4: 150
```

The last 3 lines provide information for the last two 3 point floating actuators:

TIM3 and TIM4 are the timing in 2 second increments (a display of 150 equals 300 seconds) remaining for the present positioning of actuator 3 and actuator 4.

SET3 and SET4 are the timing in 2 second increments (a display of 150 equals 300 seconds) of the desired position of actuator 3 and actuator 4.

POS3 and POS4 are the timing in 2 second increments (a display of 150 equals 300 seconds) of the actual position of actuator 4 and actuator 4.

10. 1, 2, 3, or 4 - Toggles the Zone for which the top line of data is displayed when in the T or U screen:

```
Z:A  Stg:INIT   74.25
TIM1:   0   TIM2:   0
SET1: 150   SET2: 150
POS1: 150   POS2: 150
```

1 - Will display the current stage and temperature for Zone A.
2 - Will display the current stage and temperature for Zone B.
3 - Will display the current stage and temperature for Zone C.
4 - Will display the current stage and temperature for Zone D.

11. S - Display Equipment Schedule and Address numbers. This function will display the following:

```
ENERTEC/BAS RSC 3.21
 Address:  1
Schedule:  1
 Version:4.0a
```

The first line identifies the hardware model and version.
Address is the Address # from 1-32.
Schedule is the Equipment Schedule # from 1-128.
Version is the Version # of the installed EPROM.

12. H, C, or A - Changes the current stage for the Zone displayed when in the T or U screen. The stages will cycle in the following order: C4 - C3 - C2 - C1 - AT - H1 - H2 - H3 - H4.

H - Will increase the current stage one step in the heating direction.
C - Will increase the current stage one step in the cooling direction.
A - Will force the current stage to At Set.

13. Substituting a PC for a Handheld Tester. The terminal must be configured as a standard RS-232 terminal. If the screen width is configurable, set to 20 characters.

Command Substitutions:

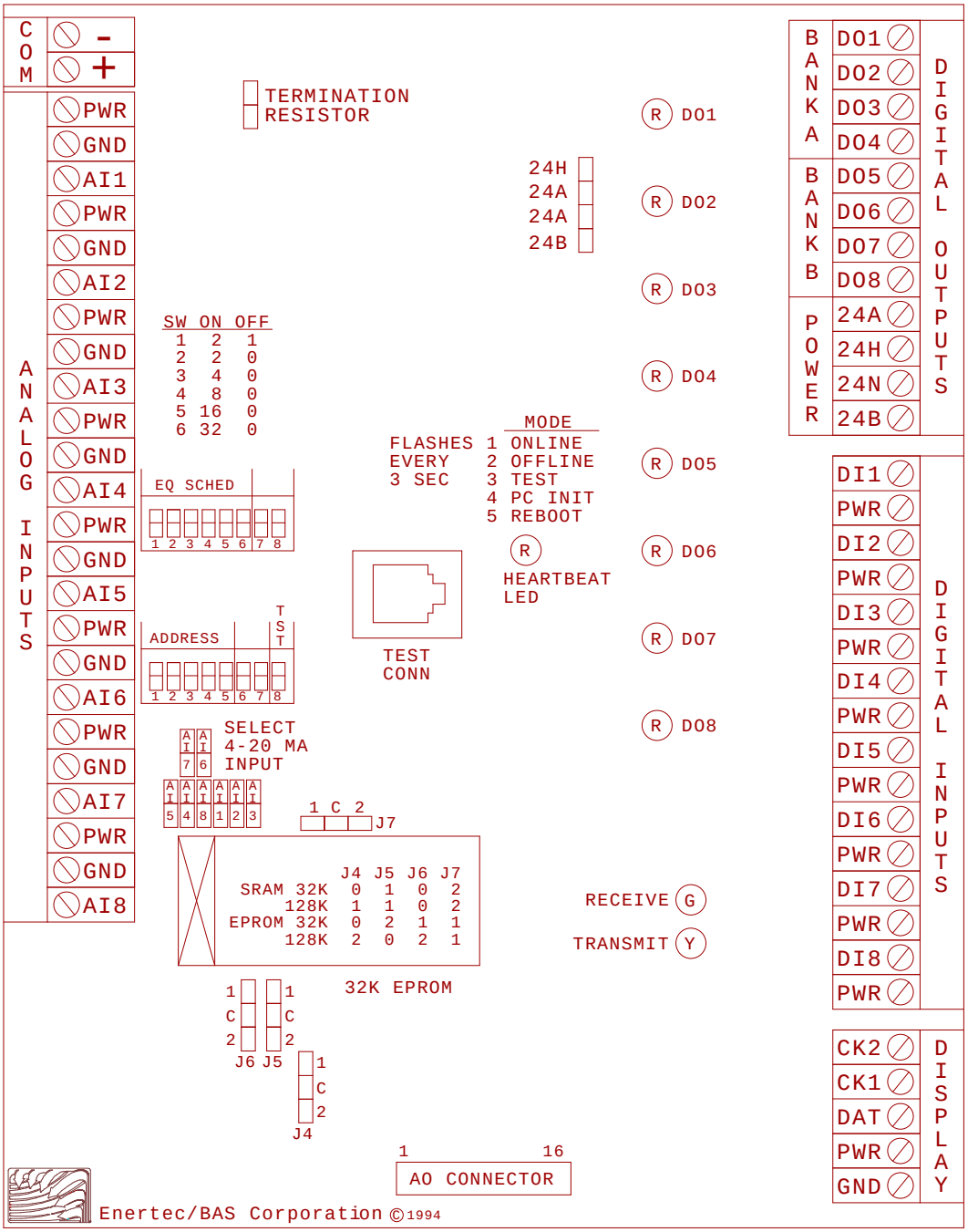
HTD	Terminal
F1	Control Q
F2	Control R
F3	Control S
F4	Control T
F5	Control U

All other command entries same as HTD. All commands must be uppercase.

Terminal settings:

Baud Rate	9600
Data Bits	8
Stop Bits	1
Parity	None
Handshaking	None

RSC Board Layout



Chapter 2

Analog Input Devices

Overview

The **Energy Zone®** System uses the LM-34 integrated circuit precision temperature sensor for all temperature sensing requirements. The LM-34 sensor provides an output voltage that is linearly proportional to temperature. The LM-34 is manufactured with a tolerance of +/- .5° F and is easily calibrated to within +/- 0.1° F. This sensor is very stable and reliable over time. Other sensors for conditions such as humidity, enthalpy, pressure, etc. are supplied by the Dealer from their choice of third party manufacturers.

Features

- Linear +10.0 mV/° F scale factor
- Precalibration accuracy of 1.0° F guaranteed (@ 77° F)
- Rated for full -50° to +300° F range
- Long term stability
- Available in wall, outside, duct, and well configurations
- All Analog Input terminals allow for any standard 0-5 Vdc or 4-20 mA dc analog device

Specifications

General Description - The LM-34 temperature sensor is provided in 4 configurations: wall sensor; outside air sensor; duct sensor; and well sensor. All sensors have a standard output of +10 mV/° F (74.6 ° F would output a voltage at the sensor of 746 mVdc). This output is offset and amplified to a range of 0-5 Vdc at the sensor prior to being sent to the RSC. All sensors are calibrated at the factory and in addition are provided with pots for field calibration when necessary.

Wall Sensor - The standard range of the LM-34 WS is 32.00° to 95.75° F (0.00° to 35.42° C). The resolution of this sensor is +/- .25° F (+/- .14° C). The sensor is enclosed in an attractive 2"w x 2.5"h x 1.5"d, off-white plastic enclosure. Wall sensors are provided with a night setback override button. A calibration pot is located on the circuit board under the sensor cover. This calibration pot can provide a span of +/- 8.5 °F. An optional offset pot can be provided which allows the occupant to raise or lower the occupied Zone setpoints. The wall sensor is also available in a vandal-proof flush mount stainless plate version.

Outside Air Sensor - The standard range of the LM-34 OS is -12.0° to 115.5° F (-24.44° to 46.39° C). The resolution of this sensor is +/- .50° F (+/- .28° C). The sensor is enclosed in a 4.25"w x 0.875" diameter plastic pipe. The pipe is attached to a standard 2"x4" weatherproof aluminum "Bell" box. The output from the sensor is wired to a conditioning card mounted inside the sensor enclosure. A calibration pot and an offset pot are both located on the conditioning card.

Duct Air Sensor - The standard range of the LM-34 DS is 30.0° to 157.5° F (-1.11° to 69.72° C). The resolution of this sensor is +/- .50° F (+/- .28° C). The sensor is enclosed in a 5.5"l x 0.25" diameter metal tube. The tube is attached to a standard 2"x4" electrical box. The output from the sensor is wired to a conditioning card mounted inside the enclosure. A calibration pot and an offset pot are both located on the conditioning card.

Well Sensor - The standard range of the LM-34 LS is 0° to 255° F (-17.78° to 123.89° C). The resolution of this sensor is +/- 1° F (+/- .56° C). The sensor is enclosed in a 5.5"l x 0.5" diameter metal tube, which is then threaded into 4"x.5" NPT stainless steel immersion thermowell. The tube is attached to a standard 2"x4" electrical box. The output from the sensor is wired to a conditioning card mounted inside the enclosure. A calibration pot is located on the conditioning card.

Third Party Analog Input Devices - BAS welcomes the use of sensing devices provided by third party suppliers. Industry standard voltage and current devices are supported without modification. The requirements for an Analog Device to be fully compatible with an RSC are:

1. The device must be able to operate on an 18 Vdc supply
2. The device consumes no more than 0.7 VA
3. The signal delivered to the RSC does not fall outside the limits of 0-5 Vdc for a voltage device or 4-20 mAdc for a current device.

LM-34 Operation

Normal Operation

1. During normal operation the LM-34 will sense temperature, convert this temperature to a voltage, and this voltage will be input to the appropriate analog input terminal on the RSC.
2. The signal input range to the RSC is 0-5.00 Vdc on all temperature sensors. A shorted signal (>=5.00 Vdc) will be reported as HI at the Command Center. An open signal (0 Vdc) will be reported as LO at the Command Center.

Setback Override Button

1. The button on top of the wall sensor is used to send a setback override signal to the Command Center. The button must remain depressed for about 2 seconds to be recognized as a valid override signal. This button actually shorts the analog temperature signal from the wall sensor to ground. This is recognized by the RSC that then holds AI1 (space temperature) at the previous value and reports to the Command Center that DI1 = ON.
2. It is also possible to wire a switch from PWR directly to DI1 on the RSC as an alternate method of signaling a setback override.

Optional Offset Pot

1. The Offset Pot will send a voltage to the RSC that is interpreted by the Command Center as an offset to the occupied temperature setpoints for that Zone. When the pot is centered, the output is 2.5 Vdc and no offset is applied. When the pot is fully counter-clockwise, the output is 0 Vdc and the maximum negative offset is applied (more cooling). When the pot is fully clockwise, the output is 5 Vdc and the maximum positive offset is applied (more heating).
2. Each Zone can be configured for 0-10° F offset. The configured offset is applied in both directions, i.e. an offset configured for 3° F will allow a total range from -3° F to +3° F offset from the configured setpoints. The offset is applied to both the heating and cooling setpoints.

Installation

Location and Mounting

1. Standard Wall Sensor - Choose a location on an interior wall that is not exposed to sunlight, drafts from open doors and windows, or other heat sources such as copiers or coffee pots. The sensor should be located in a spot that is representative of the space and exposed to air movement, preferably near a return air diffuser. Ensure that the air flow from a supply diffuser is not blowing directly on the sensor. The optimum mounting height for sensor performance is 60". Building codes will sometimes require a lower mounting height to allow for handicap access (usually 42”). The wall sensor is designed to be mounted directly on the wall.

2. Optional Back Plate - If the sensor is to be mounted on a standard 2"x4" electrical enclosure, the sensor must first be mounted on the optional 2"x4" back plate. The back plate is designed for horizontal mounting.

3. Flush Mount Wall Sensor - The flush mount wall sensor is designed to be mounted to a standard vertical 2"x4" electrical enclosure. The sensor senses room temperature from the stainless steel plate. Some electrical enclosures inside walls are exposed to drafts from outside air. Since the sensor is located on the backside of the plate, this will cause significant errors in temperature sensing. Use caulking or other method where necessary to prevent drafts from reaching the sensor.

2. Outside Air Sensor - Choose a location on the exterior of the building that is not exposed to sunlight (a northern exposure) or other heat sources such as directly above windows or near attic vents. It is recommended that the sensor be mounted in a position that would allow for easy access for maintenance.

3. Duct Air Sensor - Choose a location in the duct that is representative of the overall duct temperature. It is recommended that the sensor be mounted in a position that would allow for easy access for maintenance.

4. Well Sensor - Choose a location in the pipe that is representative of the overall liquid temperature. The sensor mounts in a standard 1/2" NPT stainless steel well, which is provided. It is best to use a thermally conductive compound between the sensor and the well. It is recommended that the sensor be mounted in a position that would allow for easy access for maintenance.

5. Other Devices - Install as per manufacturer’s instructions. If the device uses a 4-20 mA dc signal, install the 4-20 mA jumper on the RSC for that AI. The jumpers are located above the EPROM. The sensor definition for the Zone in the Command Center configuration must also be selected for 4-20 mA input.

Wiring

1. A three conductor wire is used between all 0-5 Vdc sensors and the RSC. A two conductor wire is used for 4-20 mA dc devices. A 4 conductor wire is required where an offset pot is used. A standard Class 2/24 AWG wire is adequate in most applications of 100' or less. The wire should be routed away from sources of electrical noise such as large electrical equipment. Longer wiring runs should be done with larger gauge wire.

2. If the wire must be run through an electrically noisy environment, shielded cable should be used. The shield must be tied to a solid earth ground on one end only, with no other connections to ground.

System Startup/Checkout

Note: Under normal circumstances, it is not necessary to perform this procedure. These sensors come from the factory pre-calibrated. Checking for a reading at the Command Center is generally all that is required.

The temperature sensors can be checked using the following methods:

Wall Sensors

1. The temperature at the sensor location must first be checked. This can be done two ways:
   a. Measure the output voltage of the LM-34 and convert the reading to ° F. This is done by checking the dc voltage between ground (terminal 2) and R-9 (on the side closest to U-2). See the board layout at the end of this chapter for details. The reading can be converted directly from mV dc to ° F. 10 mV dc = 1.0° F (i.e., 754 mV dc = 75.4° F).

      Note: The LM-34 sensor (U-2 on the circuit board) is very sensitive and can change by body heat alone. Do not place your hands, or breathe, near the sensor. Take the voltage reading quickly in order to minimize the possibility of error from body heat.

   b. Measure the temperature at the sensor with an independent measuring device. Use caution in placement of the sensor to insure an accurate reading.
2. The output can then be checked in two ways:
   a. Place the RSC in Troubleshooting Mode and press T on the Handheld tester. This will provide a reading in ° F.
   b. Measure the output voltage of the wall sensor and compare this to the expected reading on the conversion chart in this chapter. This is done by checking the dc voltage between ground (terminal 2) and signal (terminal 1).
3. If necessary, the output can then be calibrated using the pot located on the wall sensor circuit board. The pot is turned clockwise to decrease output and counterclockwise to increase output.
4. The night setback override button can be tested by pressing the button while monitoring the temperature reading on the handheld tester. The reading should drop to 32.00 ° F on the Handheld Tester or 0 Vdc output from the sensor.

Outside, Duct, and Well Sensors

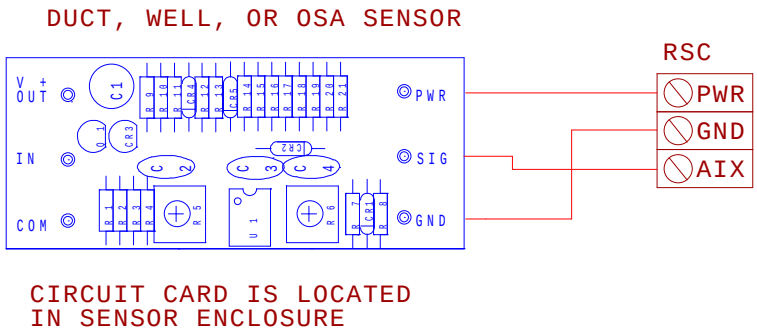
1. The temperature at the sensor location must first be checked. This can be done two ways:
   a. Measure the output voltage of the LM-34 and convert the reading to ° F. This is done by checking the dc voltage between ground and signal at either the sensor terminal strip or the input side of the conditioning card terminal strip. The reading can be converted directly from mV dc to ° F. 10 mV dc = 1.0° F (i.e., 754 mV dc = 75.4° F).
   b. Measure the temperature at the sensor with an independent measuring device. Use caution in placement of the sensor to insure an accurate reading.
2. The output can then be checked in two ways:
   a. Place the RSC in Troubleshooting Mode and press F1 on the handheld tester. This will provide a reading scaled in a range of 0-255. Compare this to the expected reading on the conversion chart in this chapter.
   b. Measure the output voltage of the conditioning card and compare this to the expected reading on the conversion chart in this chapter. This is done by checking the dc voltage between ground and the appropriate AI terminal of the RSC.

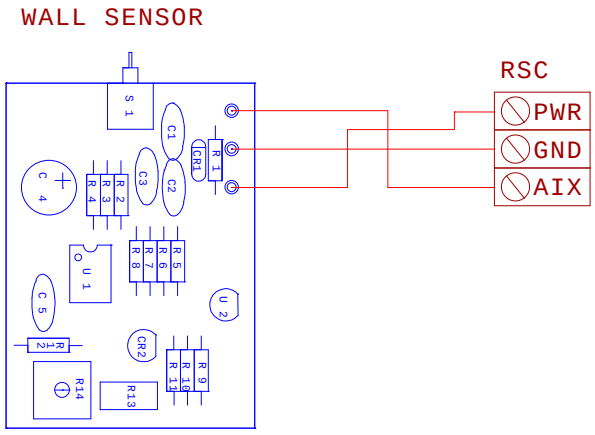
3. If necessary, the output can then be calibrated using the pot located on the conditioning card. The pot is turned clockwise to decrease output and counterclockwise to increase output.

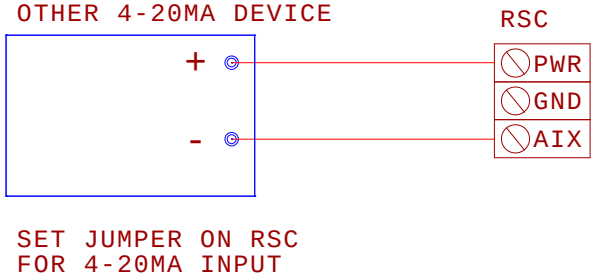
Other Devices

1. Commission as per manufacturer's instructions. Correct interpretation of the sensor's output by the RSC can be verified using charts included in this chapter.

Analog Input Device Connections







Building Automation Systems Analog Input Voltage Conversion Chart Page 1 of 2

32.00° - 95.75° F TEMPERATURE CHART

STANDARD WALL SENSOR RANGE V3.2

	Voltage	Temp	
HTD	Input	Act	Ind
000	0.000	32.00	32.0
001	0.020	32.25	32.3
002	0.039	32.50	32.5
003	0.059	32.75	32.8
004	0.078	33.00	33.0
005	0.098	33.25	33.3
006	0.118	33.50	33.5
007	0.137	33.75	33.8
008	0.157	34.00	34.0
009	0.176	34.25	34.3
010	0.196	34.50	34.5
011	0.216	34.75	34.8
012	0.235	35.00	35.0
013	0.255	35.25	35.3
014	0.275	35.50	35.5
015	0.294	35.75	35.8
016	0.314	36.00	36.0
017	0.333	36.25	36.3
018	0.353	36.50	36.5
019	0.373	36.75	36.8
020	0.392	37.00	37.0
021	0.412	37.25	37.3
022	0.431	37.50	37.5
023	0.451	37.75	37.8
024	0.471	38.00	38.0
025	0.490	38.25	38.3
026	0.510	38.50	38.5
027	0.529	38.75	38.8
028	0.549	39.00	39.0
029	0.569	39.25	39.3
030	0.588	39.50	39.5
031	0.608	39.75	39.8
032	0.627	40.00	40.0
033	0.647	40.25	40.3
034	0.667	40.50	40.5
035	0.686	40.75	40.8
036	0.706	41.00	41.0
037	0.725	41.25	41.3
038	0.745	41.50	41.5
039	0.765	41.75	41.8
040	0.784	42.00	42.0
041	0.804	42.25	42.3
042	0.824	42.50	42.5
043	0.843	42.75	42.8
044	0.863	43.00	43.0
045	0.882	43.25	43.3
046	0.902	43.50	43.5
047	0.922	43.75	43.8
048	0.941	44.00	44.0
049	0.961	44.25	44.3
050	0.980	44.50	44.5
051	1.000	44.75	44.8
052	1.020	45.00	45.0
053	1.039	45.25	45.3
054	1.059	45.50	45.5
055	1.078	45.75	45.8
056	1.098	46.00	46.0
057	1.118	46.25	46.3
058	1.137	46.50	46.5
059	1.157	46.75	46.8
060	1.176	47.00	47.0
061	1.196	47.25	47.3
062	1.216	47.50	47.5
063	1.235	47.75	47.8
064	1.255	48.00	48.0
065	1.275	48.25	48.3
066	1.294	48.50	48.5
067	1.314	48.75	48.8
068	1.333	49.00	49.0
069	1.353	49.25	49.3
070	1.373	49.50	49.5
071	1.392	49.75	49.8
072	1.412	50.00	50.0
073	1.431	50.25	50.3
074	1.451	50.50	50.5
075	1.471	50.75	50.8
076	1.490	51.00	51.0
077	1.510	51.25	51.3
078	1.529	51.50	51.5
079	1.549	51.75	51.8
080	1.569	52.00	52.0
081	1.588	52.25	52.3
082	1.608	52.50	52.5
083	1.627	52.75	52.8
084	1.647	53.00	53.0
085	1.667	53.25	53.3
086	1.686	53.50	53.5
087	1.706	53.75	53.8
088	1.725	54.00	54.0
089	1.745	54.25	54.3
090	1.765	54.50	54.5
091	1.784	54.75	54.8
092	1.804	55.00	55.0
093	1.824	55.25	55.3
094	1.843	55.50	55.5
095	1.863	55.75	55.8
096	1.882	56.00	56.0
097	1.902	56.25	56.3
098	1.922	56.50	56.5
099	1.941	56.75	56.8
100	1.961	57.00	57.0
101	1.980	57.25	57.3
102	2.000	57.50	57.5
103	2.020	57.75	57.8
104	2.039	58.00	58.0
105	2.059	58.25	58.3
106	2.078	58.50	58.5
107	2.098	58.75	58.8
108	2.118	59.00	59.0
109	2.137	59.25	59.3
110	2.157	59.50	59.5
111	2.176	59.75	59.8
112	2.196	60.00	60.0
113	2.216	60.25	60.3
114	2.235	60.50	60.5
115	2.255	60.75	60.8
116	2.275	61.00	61.0
117	2.294	61.25	61.3
118	2.314	61.50	61.5
119	2.333	61.75	61.8
120	2.353	62.00	62.0
121	2.373	62.25	62.3
122	2.392	62.50	62.5
123	2.412	62.75	62.8
124	2.431	63.00	63.0
125	2.451	63.25	63.3
126	2.471	63.50	63.5
127	2.490	63.75	63.8
128	2.510	64.00	64.0

Building Automation Systems Analog Input Voltage Conversion Chart Page 2 of 2

32.00° - 95.75° F TEMPERATURE CHART

STANDARD WALL SENSOR RANGE V3.2

HTD	Voltage Input	Temp Act	Temp Ind
129	2.529	64.25	64.3
130	2.549	64.50	64.5
131	2.569	64.75	64.8
132	2.588	65.00	65.0
133	2.608	65.25	65.3
134	2.627	65.50	65.5
135	2.647	65.75	65.8
136	2.667	66.00	66.0
137	2.686	66.25	66.3
138	2.706	66.50	66.5
139	2.725	66.75	66.8
140	2.745	67.00	67.0
141	2.765	67.25	67.3
142	2.784	67.50	67.5
143	2.804	67.75	67.8
144	2.824	68.00	68.0
145	2.843	68.25	68.3
146	2.863	68.50	68.5
147	2.882	68.75	68.8
148	2.902	69.00	69.0
149	2.922	69.25	69.3
150	2.941	69.50	69.5
151	2.961	69.75	69.8
152	2.980	70.00	70.0
153	3.000	70.25	70.3
154	3.020	70.50	70.5
155	3.039	70.75	70.8
156	3.059	71.00	71.0
157	3.078	71.25	71.3
158	3.098	71.50	71.5
159	3.118	71.75	71.8
160	3.137	72.00	72.0
161	3.157	72.25	72.3
162	3.176	72.50	72.5
163	3.196	72.75	72.8
164	3.216	73.00	73.0
165	3.235	73.25	73.3
166	3.255	73.50	73.5
167	3.275	73.75	73.8
168	3.294	74.00	74.0
169	3.314	74.25	74.3
170	3.333	74.50	74.5
171	3.353	74.75	74.8
172	3.373	75.00	75.0
173	3.392	75.25	75.3
174	3.412	75.50	75.5
175	3.431	75.75	75.8
176	3.451	76.00	76.0
177	3.471	76.25	76.3
178	3.490	76.50	76.5
179	3.510	76.75	76.8
180	3.529	77.00	77.0
181	3.549	77.25	77.3
182	3.569	77.50	77.5
183	3.588	77.75	77.8
184	3.608	78.00	78.0
185	3.627	78.25	78.3
186	3.647	78.50	78.5
187	3.667	78.75	78.8
188	3.686	79.00	79.0
189	3.706	79.25	79.3
190	3.725	79.50	79.5
191	3.745	79.75	79.8
192	3.765	80.00	80.0
193	3.784	80.25	80.3
194	3.804	80.50	80.5
195	3.824	80.75	80.8
196	3.843	81.00	81.0
197	3.863	81.25	81.3
198	3.882	81.50	81.5
199	3.902	81.75	81.8
200	3.922	82.00	82.0
201	3.941	82.25	82.3
202	3.961	82.50	82.5
203	3.980	82.75	82.8
204	4.000	83.00	83.0
205	4.020	83.25	83.3
206	4.039	83.50	83.5
207	4.059	83.75	83.8
208	4.078	84.00	84.0
209	4.098	84.25	84.3
210	4.118	84.50	84.5
211	4.137	84.75	84.8
212	4.157	85.00	85.0
213	4.176	85.25	85.3
214	4.196	85.50	85.5
215	4.216	85.75	85.8
216	4.235	86.00	86.0
217	4.255	86.25	86.3
218	4.275	86.50	86.5
219	4.294	86.75	86.8
220	4.314	87.00	87.0
221	4.333	87.25	87.3
222	4.353	87.50	87.5
223	4.373	87.75	87.8
224	4.392	88.00	88.0
225	4.412	88.25	88.3
226	4.431	88.50	88.5
227	4.451	88.75	88.8
228	4.471	89.00	89.0
229	4.490	89.25	89.3
230	4.510	89.50	89.5
231	4.529	89.75	89.8
232	4.549	90.00	90.0
233	4.569	90.25	90.3
234	4.588	90.50	90.5
235	4.608	90.75	90.8
236	4.627	91.00	91.0
237	4.647	91.25	91.3
238	4.667	91.50	91.5
239	4.686	91.75	91.8
240	4.706	92.00	92.0
241	4.725	92.25	92.3
242	4.745	92.50	92.5
243	4.765	92.75	92.8
244	4.784	93.00	93.0
245	4.804	93.25	93.3
246	4.824	93.50	93.5
247	4.843	93.75	93.8
248	4.863	94.00	94.0
249	4.882	94.25	94.3
250	4.902	94.50	94.5
251	4.922	94.75	94.8
252	4.941	95.00	95.0
253	4.961	95.25	95.3
254	4.980	95.50	95.5
255	5.000	95.75	95.8

Building Automation Systems Analog Input Voltage Conversion Chart Page 1 of 2

-12.0° - 115.5° F TEMPERATURE CHART

STANDARD OUTSIDE AIR SENSOR RANGE V3.2

	Voltage	Temp	
HTD	Input	Act	Ind
000	0.000	-12.00	-12
001	0.020	-11.50	-12
002	0.039	-11.00	-11
003	0.059	-10.50	-11
004	0.078	-10.00	-10
005	0.098	-9.50	-10
006	0.118	-9.00	-9
007	0.137	-8.50	-9
008	0.157	-8.00	-8
009	0.176	-7.50	-8
010	0.196	-7.00	-7
011	0.216	-6.50	-7
012	0.235	-6.00	-6
013	0.255	-5.50	-6
014	0.275	-5.00	-5
015	0.294	-4.50	-5
016	0.314	-4.00	-4
017	0.333	-3.50	-4
018	0.353	-3.00	-3
019	0.373	-2.50	-3
020	0.392	-2.00	-2
021	0.412	-1.50	-2
022	0.431	-1.00	-1
023	0.451	-0.50	-1
024	0.471	0.00	0
025	0.490	0.50	1
026	0.510	1.00	1
027	0.529	1.50	2
028	0.549	2.00	2
029	0.569	2.50	3
030	0.588	3.00	3
031	0.608	3.50	4
032	0.627	4.00	4
033	0.647	4.50	5
034	0.667	5.00	5
035	0.686	5.50	6
036	0.706	6.00	6
037	0.725	6.50	7
038	0.745	7.00	7
039	0.765	7.50	8
040	0.784	8.00	8
041	0.804	8.50	9
042	0.824	9.00	9

	Voltage	Temp	
HTD	Input	Act	Ind
043	0.843	9.50	10
044	0.863	10.00	10
045	0.882	10.50	11
046	0.902	11.00	11
047	0.922	11.50	12
048	0.941	12.00	12
049	0.961	12.50	13
050	0.980	13.00	13
051	1.000	13.50	14
052	1.020	14.00	14
053	1.039	14.50	15
054	1.059	15.00	15
055	1.078	15.50	16
056	1.098	16.00	16
057	1.118	16.50	17
058	1.137	17.00	17
059	1.157	17.50	18
060	1.176	18.00	18
061	1.196	18.50	19
062	1.216	19.00	19
063	1.235	19.50	20
064	1.255	20.00	20
065	1.275	20.50	21
066	1.294	21.00	21
067	1.314	21.50	22
068	1.333	22.00	22
069	1.353	22.50	23
070	1.373	23.00	23
071	1.392	23.50	24
072	1.412	24.00	24
073	1.431	24.50	25
074	1.451	25.00	25
075	1.471	25.50	26
076	1.490	26.00	26
077	1.510	26.50	27
078	1.529	27.00	27
079	1.549	27.50	28
080	1.569	28.00	28
081	1.588	28.50	29
082	1.608	29.00	29
083	1.627	29.50	30
084	1.647	30.00	30
085	1.667	30.50	31

	Voltage	Temp	
HTD	Input	Act	Ind
086	1.686	31.00	31
087	1.706	31.50	32
088	1.725	32.00	32
089	1.745	32.50	33
090	1.765	33.00	33
091	1.784	33.50	34
092	1.804	34.00	34
093	1.824	34.50	35
094	1.843	35.00	35
095	1.863	35.50	36
096	1.882	36.00	36
097	1.902	36.50	37
098	1.922	37.00	37
099	1.941	37.50	38
100	1.961	38.00	38
101	1.980	38.50	39
102	2.000	39.00	39
103	2.020	39.50	40
104	2.039	40.00	40
105	2.059	40.50	41
106	2.078	41.00	41
107	2.098	41.50	42
108	2.118	42.00	42
109	2.137	42.50	43
110	2.157	43.00	43
111	2.176	43.50	44
112	2.196	44.00	44
113	2.216	44.50	45
114	2.235	45.00	45
115	2.255	45.50	46
116	2.275	46.00	46
117	2.294	46.50	47
118	2.314	47.00	47
119	2.333	47.50	48
120	2.353	48.00	48
121	2.373	48.50	49
122	2.392	49.00	49
123	2.412	49.50	50
124	2.431	50.00	50
125	2.451	50.50	51
126	2.471	51.00	51
127	2.490	51.50	52
128	2.510	52.00	52

Building Automation Systems Analog Input Voltage Conversion Chart Page 2 of 2

-12.0° - 115.5° F TEMPERATURE CHART

STANDARD OUTSIDE AIR SENSOR RANGE V3.2

HTD	Voltage Input	Temp Act	Temp Ind
129	2.529	52.50	53
130	2.549	53.00	53
131	2.569	53.50	54
132	2.588	54.00	54
133	2.608	54.50	55
134	2.627	55.00	55
135	2.647	55.50	56
136	2.667	56.00	56
137	2.686	56.50	57
138	2.706	57.00	57
139	2.725	57.50	58
140	2.745	58.00	58
141	2.765	58.50	59
142	2.784	59.00	59
143	2.804	59.50	60
144	2.824	60.00	60
145	2.843	60.50	61
146	2.863	61.00	61
147	2.882	61.50	62
148	2.902	62.00	62
149	2.922	62.50	63
150	2.941	63.00	63
151	2.961	63.50	64
152	2.980	64.00	64
153	3.000	64.50	65
154	3.020	65.00	65
155	3.039	65.50	66
156	3.059	66.00	66
157	3.078	66.50	67
158	3.098	67.00	67
159	3.118	67.50	68
160	3.137	68.00	68
161	3.157	68.50	69
162	3.176	69.00	69
163	3.196	69.50	70
164	3.216	70.00	70
165	3.235	70.50	71
166	3.255	71.00	71
167	3.275	71.50	72
168	3.294	72.00	72
169	3.314	72.50	73
170	3.333	73.00	73
171	3.353	73.50	74
172	3.373	74.00	74
173	3.392	74.50	75
174	3.412	75.00	75
175	3.431	75.50	76
176	3.451	76.00	76
177	3.471	76.50	77
178	3.490	77.00	77
179	3.510	77.50	78
180	3.529	78.00	78
181	3.549	78.50	79
182	3.569	79.00	79
183	3.588	79.50	80
184	3.608	80.00	80
185	3.627	80.50	81
186	3.647	81.00	81
187	3.667	81.50	82
188	3.686	82.00	82
189	3.706	82.50	83
190	3.725	83.00	83
191	3.745	83.50	84
192	3.765	84.00	84
193	3.784	84.50	85
194	3.804	85.00	85
195	3.824	85.50	86
196	3.843	86.00	86
197	3.863	86.50	87
198	3.882	87.00	87
199	3.902	87.50	88
200	3.922	88.00	88
201	3.941	88.50	89
202	3.961	89.00	89
203	3.980	89.50	90
204	4.000	90.00	90
205	4.020	90.50	91
206	4.039	91.00	91
207	4.059	91.50	92
208	4.078	92.00	92
209	4.098	92.50	93
210	4.118	93.00	93
211	4.137	93.50	94
212	4.157	94.00	94
213	4.176	94.50	95
214	4.196	95.00	95
215	4.216	95.50	96
216	4.235	96.00	96
217	4.255	96.50	97
218	4.275	97.00	97
219	4.294	97.50	98
220	4.314	98.00	98
221	4.333	98.50	99
222	4.353	99.00	99
223	4.373	99.50	100
224	4.392	100.00	100
225	4.412	100.50	101
226	4.431	101.00	101
227	4.451	101.50	102
228	4.471	102.00	102
229	4.490	102.50	103
230	4.510	103.00	103
231	4.529	103.50	104
232	4.549	104.00	104
233	4.569	104.50	105
234	4.588	105.00	105
235	4.608	105.50	106
236	4.627	106.00	106
237	4.647	106.50	107
238	4.667	107.00	107
239	4.686	107.50	108
240	4.706	108.00	108
241	4.725	108.50	109
242	4.745	109.00	109
243	4.765	109.50	110
244	4.784	110.00	110
245	4.804	110.50	111
246	4.824	111.00	111
247	4.843	111.50	112
248	4.863	112.00	112
249	4.882	112.50	113
250	4.902	113.00	113
251	4.922	113.50	114
252	4.941	114.00	114
253	4.961	114.50	115
254	4.980	115.00	115
255	5.000	115.50	116

Building Automation Systems Analog Input Voltage Conversion Chart Page 1 of 2

30.0° - 157.5° F TEMPERATURE CHART

STANDARD DUCT SENSOR RANGE V3.2

HTD	Voltage Input	Temp Act	Temp Ind	HTD	Voltage Input	Temp Act	Temp Ind	HTD	Voltage Input	Temp Act	Temp Ind
000	0.000	30.00	30	043	0.843	51.50	52	086	1.686	73.00	73
001	0.020	30.50	31	044	0.863	52.00	52	087	1.706	73.50	74
002	0.039	31.00	31	045	0.882	52.50	53	088	1.725	74.00	74
003	0.059	31.50	32	046	0.902	53.00	53	089	1.745	74.50	75
004	0.078	32.00	32	047	0.922	53.50	54	090	1.765	75.00	75
005	0.098	32.50	33	048	0.941	54.00	54	091	1.784	75.50	76
006	0.118	33.00	33	049	0.961	54.50	55	092	1.804	76.00	76
007	0.137	33.50	34	050	0.980	55.00	55	093	1.824	76.50	77
008	0.157	34.00	34	051	1.000	55.50	56	094	1.843	77.00	77
009	0.176	34.50	35	052	1.020	56.00	56	095	1.863	77.50	78
010	0.196	35.00	35	053	1.039	56.50	57	096	1.882	78.00	78
011	0.216	35.50	36	054	1.059	57.00	57	097	1.902	78.50	79
012	0.235	36.00	36	055	1.078	57.50	58	098	1.922	79.00	79
013	0.255	36.50	37	056	1.098	58.00	58	099	1.941	79.50	80
014	0.275	37.00	37	057	1.118	58.50	59	100	1.961	80.00	80
015	0.294	37.50	38	058	1.137	59.00	59	101	1.980	80.50	81
016	0.314	38.00	38	059	1.157	59.50	60	102	2.000	81.00	81
017	0.333	38.50	39	060	1.176	60.00	60	103	2.020	81.50	82
018	0.353	39.00	39	061	1.196	60.50	61	104	2.039	82.00	82
019	0.373	39.50	40	062	1.216	61.00	61	105	2.059	82.50	83
020	0.392	40.00	40	063	1.235	61.50	62	106	2.078	83.00	83
021	0.412	40.50	41	064	1.255	62.00	62	107	2.098	83.50	84
022	0.431	41.00	41	065	1.275	62.50	63	108	2.118	84.00	84
023	0.451	41.50	42	066	1.294	63.00	63	109	2.137	84.50	85
024	0.471	42.00	42	067	1.314	63.50	64	110	2.157	85.00	85
025	0.490	42.50	43	068	1.333	64.00	64	111	2.176	85.50	86
026	0.510	43.00	43	069	1.353	64.50	65	112	2.196	86.00	86
027	0.529	43.50	44	070	1.373	65.00	65	113	2.216	86.50	87
028	0.549	44.00	44	071	1.392	65.50	66	114	2.235	87.00	87
029	0.569	44.50	45	072	1.412	66.00	66	115	2.255	87.50	88
030	0.588	45.00	45	073	1.431	66.50	67	116	2.275	88.00	88
031	0.608	45.50	46	074	1.451	67.00	67	117	2.294	88.50	89
032	0.627	46.00	46	075	1.471	67.50	68	118	2.314	89.00	89
033	0.647	46.50	47	076	1.490	68.00	68	119	2.333	89.50	90
034	0.667	47.00	47	077	1.510	68.50	69	120	2.353	90.00	90
035	0.686	47.50	48	078	1.529	69.00	69	121	2.373	90.50	91
036	0.706	48.00	48	079	1.549	69.50	70	122	2.392	91.00	91
037	0.725	48.50	49	080	1.569	70.00	70	123	2.412	91.50	92
038	0.745	49.00	49	081	1.588	70.50	71	124	2.431	92.00	92
039	0.765	49.50	50	082	1.608	71.00	71	125	2.451	92.50	93
040	0.784	50.00	50	083	1.627	71.50	72	126	2.471	93.00	93
041	0.804	50.50	51	084	1.647	72.00	72	127	2.490	93.50	94
042	0.824	51.00	51	085	1.667	72.50	73	128	2.510	94.00	94

Building Automation Systems Analog Input Voltage Conversion Chart Page 2 of 2

30.0° - 157.5° F TEMPERATURE CHART

STANDARD DUCT SENSOR RANGE V3.2

HTD	Voltage Input	Temp Act	Temp Ind
129	2.529	94.50	95
130	2.549	95.00	95
131	2.569	95.50	96
132	2.588	96.00	96
133	2.608	96.50	97
134	2.627	97.00	97
135	2.647	97.50	98
136	2.667	98.00	98
137	2.686	98.50	99
138	2.706	99.00	99
139	2.725	99.50	100
140	2.745	100.00	100
141	2.765	100.50	101
142	2.784	101.00	101
143	2.804	101.50	102
144	2.824	102.00	102
145	2.843	102.50	103
146	2.863	103.00	103
147	2.882	103.50	104
148	2.902	104.00	104
149	2.922	104.50	105
150	2.941	105.00	105
151	2.961	105.50	106
152	2.980	106.00	106
153	3.000	106.50	107
154	3.020	107.00	107
155	3.039	107.50	108
156	3.059	108.00	108
157	3.078	108.50	109
158	3.098	109.00	109
159	3.118	109.50	110
160	3.137	110.00	110
161	3.157	110.50	111
162	3.176	111.00	111
163	3.196	111.50	112
164	3.216	112.00	112
165	3.235	112.50	113
166	3.255	113.00	113
167	3.275	113.50	114
168	3.294	114.00	114
169	3.314	114.50	115
170	3.333	115.00	115
171	3.353	115.50	116
172	3.373	116.00	116
173	3.392	116.50	117
174	3.412	117.00	117
175	3.431	117.50	118
176	3.451	118.00	118
177	3.471	118.50	119
178	3.490	119.00	119
179	3.510	119.50	120
180	3.529	120.00	120
181	3.549	120.50	121
182	3.569	121.00	121
183	3.588	121.50	122
184	3.608	122.00	122
185	3.627	122.50	123
186	3.647	123.00	123
187	3.667	123.50	124
188	3.686	124.00	124
189	3.706	124.50	125
190	3.725	125.00	125
191	3.745	125.50	126
192	3.765	126.00	126
193	3.784	126.50	127
194	3.804	127.00	127
195	3.824	127.50	128
196	3.843	128.00	128
197	3.863	128.50	129
198	3.882	129.00	129
199	3.902	129.50	130
200	3.922	130.00	130
201	3.941	130.50	131
202	3.961	131.00	131
203	3.980	131.50	132
204	4.000	132.00	132
205	4.020	132.50	133
206	4.039	133.00	133
207	4.059	133.50	134
208	4.078	134.00	134
209	4.098	134.50	135
210	4.118	135.00	135
211	4.137	135.50	136
212	4.157	136.00	136
213	4.176	136.50	137
214	4.196	137.00	137
215	4.216	137.50	138
216	4.235	138.00	138
217	4.255	138.50	139
218	4.275	139.00	139
219	4.294	139.50	140
220	4.314	140.00	140
221	4.333	140.50	141
222	4.353	141.00	141
223	4.373	141.50	142
224	4.392	142.00	142
225	4.412	142.50	143
226	4.431	143.00	143
227	4.451	143.50	144
228	4.471	144.00	144
229	4.490	144.50	145
230	4.510	145.00	145
231	4.529	145.50	146
232	4.549	146.00	146
233	4.569	146.50	147
234	4.588	147.00	147
235	4.608	147.50	148
236	4.627	148.00	148
237	4.647	148.50	149
238	4.667	149.00	149
239	4.686	149.50	150
240	4.706	150.00	150
241	4.725	150.50	151
242	4.745	151.00	151
243	4.765	151.50	152
244	4.784	152.00	152
245	4.804	152.50	153
246	4.824	153.00	153
247	4.843	153.50	154
248	4.863	154.00	154
249	4.882	154.50	155
250	4.902	155.00	155
251	4.922	155.50	156
252	4.941	156.00	156
253	4.961	156.50	157
254	4.980	157.00	157
255	5.000	157.50	158

Building Automation Systems Analog Input Voltage Conversion Chart Page 1 of 2

0° - 255° F TEMPERATURE CHART

STANDARD WELL SENSOR RANGE V3.2

	Voltage	Temp	
HTD	Input	Act	Ind
000	0.000	0.00	0
001	0.020	1.00	1
002	0.039	2.00	2
003	0.059	3.00	3
004	0.078	4.00	4
005	0.098	5.00	5
006	0.118	6.00	6
007	0.137	7.00	7
008	0.157	8.00	8
009	0.176	9.00	9
010	0.196	10.00	10
011	0.216	11.00	11
012	0.235	12.00	12
013	0.255	13.00	13
014	0.275	14.00	14
015	0.294	15.00	15
016	0.314	16.00	16
017	0.333	17.00	17
018	0.353	18.00	18
019	0.373	19.00	19
020	0.392	20.00	20
021	0.412	21.00	21
022	0.431	22.00	22
023	0.451	23.00	23
024	0.471	24.00	24
025	0.490	25.00	25
026	0.510	26.00	26
027	0.529	27.00	27
028	0.549	28.00	28
029	0.569	29.00	29
030	0.588	30.00	30
031	0.608	31.00	31
032	0.627	32.00	32
033	0.647	33.00	33
034	0.667	34.00	34
035	0.686	35.00	35
036	0.706	36.00	36
037	0.725	37.00	37
038	0.745	38.00	38
039	0.765	39.00	39
040	0.784	40.00	40
041	0.804	41.00	41
042	0.824	42.00	42

	Voltage	Temp	
HTD	Input	Act	Ind
043	0.843	43.00	43
044	0.863	44.00	44
045	0.882	45.00	45
046	0.902	46.00	46
047	0.922	47.00	47
048	0.941	48.00	48
049	0.961	49.00	49
050	0.980	50.00	50
051	1.000	51.00	51
052	1.020	52.00	52
053	1.039	53.00	53
054	1.059	54.00	54
055	1.078	55.00	55
056	1.098	56.00	56
057	1.118	57.00	57
058	1.137	58.00	58
059	1.157	59.00	59
060	1.176	60.00	60
061	1.196	61.00	61
062	1.216	62.00	62
063	1.235	63.00	63
064	1.255	64.00	64
065	1.275	65.00	65
066	1.294	66.00	66
067	1.314	67.00	67
068	1.333	68.00	68
069	1.353	69.00	69
070	1.373	70.00	70
071	1.392	71.00	71
072	1.412	72.00	72
073	1.431	73.00	73
074	1.451	74.00	74
075	1.471	75.00	75
076	1.490	76.00	76
077	1.510	77.00	77
078	1.529	78.00	78
079	1.549	79.00	79
080	1.569	80.00	80
081	1.588	81.00	81
082	1.608	82.00	82
083	1.627	83.00	83
084	1.647	84.00	84
085	1.667	85.00	85

	Voltage	Temp	
HTD	Input	Act	Ind
086	1.686	86.00	86
087	1.706	87.00	87
088	1.725	88.00	88
089	1.745	89.00	89
090	1.765	90.00	90
091	1.784	91.00	91
092	1.804	92.00	92
093	1.824	93.00	93
094	1.843	94.00	94
095	1.863	95.00	95
096	1.882	96.00	96
097	1.902	97.00	97
098	1.922	98.00	98
099	1.941	99.00	99
100	1.961	100.00	100
101	1.980	101.00	101
102	2.000	102.00	102
103	2.020	103.00	103
104	2.039	104.00	104
105	2.059	105.00	105
106	2.078	106.00	106
107	2.098	107.00	107
108	2.118	108.00	108
109	2.137	109.00	109
110	2.157	110.00	110
111	2.176	111.00	111
112	2.196	112.00	112
113	2.216	113.00	113
114	2.235	114.00	114
115	2.255	115.00	115
116	2.275	116.00	116
117	2.294	117.00	117
118	2.314	118.00	118
119	2.333	119.00	119
120	2.353	120.00	120
121	2.373	121.00	121
122	2.392	122.00	122
123	2.412	123.00	123
124	2.431	124.00	124
125	2.451	125.00	125
126	2.471	126.00	126
127	2.490	127.00	127
128	2.510	128.00	128

Building Automation Systems Analog Input Voltage Conversion Chart Page 2 of 2

0° - 255° F TEMPERATURE CHART

STANDARD WELL SENSOR RANGE V3.2

HTD	Voltage Input	Temp Act	Temp Ind
129	2.529	129.00	129
130	2.549	130.00	130
131	2.569	131.00	131
132	2.588	132.00	132
133	2.608	133.00	133
134	2.627	134.00	134
135	2.647	135.00	135
136	2.667	136.00	136
137	2.686	137.00	137
138	2.706	138.00	138
139	2.725	139.00	139
140	2.745	140.00	140
141	2.765	141.00	141
142	2.784	142.00	142
143	2.804	143.00	143
144	2.824	144.00	144
145	2.843	145.00	145
146	2.863	146.00	146
147	2.882	147.00	147
148	2.902	148.00	148
149	2.922	149.00	149
150	2.941	150.00	150
151	2.961	151.00	151
152	2.980	152.00	152
153	3.000	153.00	153
154	3.020	154.00	154
155	3.039	155.00	155
156	3.059	156.00	156
157	3.078	157.00	157
158	3.098	158.00	158
159	3.118	159.00	159
160	3.137	160.00	160
161	3.157	161.00	161
162	3.176	162.00	162
163	3.196	163.00	163
164	3.216	164.00	164
165	3.235	165.00	165
166	3.255	166.00	166
167	3.275	167.00	167
168	3.294	168.00	168
169	3.314	169.00	169
170	3.333	170.00	170
171	3.353	171.00	171
172	3.373	172.00	172
173	3.392	173.00	173
174	3.412	174.00	174
175	3.431	175.00	175
176	3.451	176.00	176
177	3.471	177.00	177
178	3.490	178.00	178
179	3.510	179.00	179
180	3.529	180.00	180
181	3.549	181.00	181
182	3.569	182.00	182
183	3.588	183.00	183
184	3.608	184.00	184
185	3.627	185.00	185
186	3.647	186.00	186
187	3.667	187.00	187
188	3.686	188.00	188
189	3.706	189.00	189
190	3.725	190.00	190
191	3.745	191.00	191
192	3.765	192.00	192
193	3.784	193.00	193
194	3.804	194.00	194
195	3.824	195.00	195
196	3.843	196.00	196
197	3.863	197.00	197
198	3.882	198.00	198
199	3.902	199.00	199
200	3.922	200.00	200
201	3.941	201.00	201
202	3.961	202.00	202
203	3.980	203.00	203
204	4.000	204.00	204
205	4.020	205.00	205
206	4.039	206.00	206
207	4.059	207.00	207
208	4.078	208.00	208
209	4.098	209.00	209
210	4.118	210.00	210
211	4.137	211.00	211
212	4.157	212.00	212
213	4.176	213.00	213
214	4.196	214.00	214
215	4.216	215.00	215
216	4.235	216.00	216
217	4.255	217.00	217
218	4.275	218.00	218
219	4.294	219.00	219
220	4.314	220.00	220
221	4.333	221.00	221
222	4.353	222.00	222
223	4.373	223.00	223
224	4.392	224.00	224
225	4.412	225.00	225
226	4.431	226.00	226
227	4.451	227.00	227
228	4.471	228.00	228
229	4.490	229.00	229
230	4.510	230.00	230
231	4.529	231.00	231
232	4.549	232.00	232
233	4.569	233.00	233
234	4.588	234.00	234
235	4.608	235.00	235
236	4.627	236.00	236
237	4.647	237.00	237
238	4.667	238.00	238
239	4.686	239.00	239
240	4.706	240.00	240
241	4.725	241.00	241
242	4.745	242.00	242
243	4.765	243.00	243
244	4.784	244.00	244
245	4.804	245.00	245
246	4.824	246.00	246
247	4.843	247.00	247
248	4.863	248.00	248
249	4.882	249.00	249
250	4.902	250.00	250
251	4.922	251.00	251
252	4.941	252.00	252
253	4.961	253.00	253
254	4.980	254.00	254
255	5.000	255.00	255

Building Automation Systems Analog Input Voltage Conversion Chart Page 1 of 2

4-20 mA dc Analog Device

Input to RSC V3.2

HTD	Voltage Input	mA Input Act	Ind	HTD	Voltage Input	mA Input Act	Ind	HTD	Voltage Input	mA Input Act	Ind
000	0.000	0.00	0	043	0.843	3.37	3	086	1.686	6.74	7
001	0.020	0.08	0	044	0.863	3.45	3	087	1.706	6.82	7
002	0.039	0.16	0	045	0.882	3.53	4	088	1.725	6.90	7
003	0.059	0.24	0	046	0.902	3.61	4	089	1.745	6.98	7
004	0.078	0.31	0	047	0.922	3.69	4	090	1.765	7.06	7
005	0.098	0.39	0	048	0.941	3.76	4	091	1.784	7.14	7
006	0.118	0.47	0	049	0.961	3.84	4	092	1.804	7.22	7
007	0.137	0.55	1	050	0.980	3.92	4	093	1.824	7.29	7
008	0.157	0.63	1	051	1.000	4.00	4	094	1.843	7.37	7
009	0.176	0.71	1	052	1.020	4.08	4	095	1.863	7.45	7
010	0.196	0.78	1	053	1.039	4.16	4	096	1.882	7.53	8
011	0.216	0.86	1	054	1.059	4.24	4	097	1.902	7.61	8
012	0.235	0.94	1	055	1.078	4.31	4	098	1.922	7.69	8
013	0.255	1.02	1	056	1.098	4.39	4	099	1.941	7.76	8
014	0.275	1.10	1	057	1.118	4.47	4	100	1.961	7.84	8
015	0.294	1.18	1	058	1.137	4.55	5	101	1.980	7.92	8
016	0.314	1.25	1	059	1.157	4.63	5	102	2.000	8.00	8
017	0.333	1.33	1	060	1.176	4.71	5	103	2.020	8.08	8
018	0.353	1.41	1	061	1.196	4.78	5	104	2.039	8.16	8
019	0.373	1.49	1	062	1.216	4.86	5	105	2.059	8.24	8
020	0.392	1.57	2	063	1.235	4.94	5	106	2.078	8.31	8
021	0.412	1.65	2	064	1.255	5.02	5	107	2.098	8.39	8
022	0.431	1.73	2	065	1.275	5.10	5	108	2.118	8.47	8
023	0.451	1.80	2	066	1.294	5.18	5	109	2.137	8.55	9
024	0.471	1.88	2	067	1.314	5.25	5	110	2.157	8.63	9
025	0.490	1.96	2	068	1.333	5.33	5	111	2.176	8.71	9
026	0.510	2.04	2	069	1.353	5.41	5	112	2.196	8.78	9
027	0.529	2.12	2	070	1.373	5.49	5	113	2.216	8.86	9
028	0.549	2.20	2	071	1.392	5.57	6	114	2.235	8.94	9
029	0.569	2.27	2	072	1.412	5.65	6	115	2.255	9.02	9
030	0.588	2.35	2	073	1.431	5.73	6	116	2.275	9.10	9
031	0.608	2.43	2	074	1.451	5.80	6	117	2.294	9.18	9
032	0.627	2.51	3	075	1.471	5.88	6	118	2.314	9.25	9
033	0.647	2.59	3	076	1.490	5.96	6	119	2.333	9.33	9
034	0.667	2.67	3	077	1.510	6.04	6	120	2.353	9.41	9
035	0.686	2.75	3	078	1.529	6.12	6	121	2.373	9.49	9
036	0.706	2.82	3	079	1.549	6.20	6	122	2.392	9.57	10
037	0.725	2.90	3	080	1.569	6.27	6	123	2.412	9.65	10
038	0.745	2.98	3	081	1.588	6.35	6	124	2.431	9.73	10
039	0.765	3.06	3	082	1.608	6.43	6	125	2.451	9.80	10
040	0.784	3.14	3	083	1.627	6.51	7	126	2.471	9.88	10
041	0.804	3.22	3	084	1.647	6.59	7	127	2.490	9.96	10
042	0.824	3.29	3	085	1.667	6.67	7	128	2.510	10.04	10

Building Automation Systems Analog Input Voltage Conversion Chart Page 2 of 2

4-20 mA dc Analog Device

Input to RSC V3.2

HTD	Voltage Input	mA Input Act	mA Input Ind
129	2.529	10.12	10
130	2.549	10.20	10
131	2.569	10.27	10
132	2.588	10.35	10
133	2.608	10.43	10
134	2.627	10.51	11
135	2.647	10.59	11
136	2.667	10.67	11
137	2.686	10.74	11
138	2.706	10.82	11
139	2.725	10.90	11
140	2.745	10.98	11
141	2.765	11.06	11
142	2.784	11.14	11
143	2.804	11.22	11
144	2.824	11.29	11
145	2.843	11.37	11
146	2.863	11.45	11
147	2.882	11.53	12
148	2.902	11.61	12
149	2.922	11.69	12
150	2.941	11.76	12
151	2.961	11.84	12
152	2.980	11.92	12
153	3.000	12.00	12
154	3.020	12.08	12
155	3.039	12.16	12
156	3.059	12.24	12
157	3.078	12.31	12
158	3.098	12.39	12
159	3.118	12.47	12
160	3.137	12.55	13
161	3.157	12.63	13
162	3.176	12.71	13
163	3.196	12.78	13
164	3.216	12.86	13
165	3.235	12.94	13
166	3.255	13.02	13
167	3.275	13.10	13
168	3.294	13.18	13
169	3.314	13.25	13
170	3.333	13.33	13
171	3.353	13.41	13
172	3.373	13.49	13
173	3.392	13.57	14
174	3.412	13.65	14
175	3.431	13.73	14
176	3.451	13.80	14
177	3.471	13.88	14
178	3.490	13.96	14
179	3.510	14.04	14
180	3.529	14.12	14
181	3.549	14.20	14
182	3.569	14.27	14
183	3.588	14.35	14
184	3.608	14.43	14
185	3.627	14.51	15
186	3.647	14.59	15
187	3.667	14.67	15
188	3.686	14.74	15
189	3.706	14.82	15
190	3.725	14.90	15
191	3.745	14.98	15
192	3.765	15.06	15
193	3.784	15.14	15
194	3.804	15.22	15
195	3.824	15.29	15
196	3.843	15.37	15
197	3.863	15.45	15
198	3.882	15.53	16
199	3.902	15.61	16
200	3.922	15.69	16
201	3.941	15.76	16
202	3.961	15.84	16
203	3.980	15.92	16
204	4.000	16.00	16
205	4.020	16.08	16
206	4.039	16.16	16
207	4.059	16.24	16
208	4.078	16.31	16
209	4.098	16.39	16
210	4.118	16.47	16
211	4.137	16.55	17
212	4.157	16.63	17
213	4.176	16.71	17
214	4.196	16.78	17
215	4.216	16.86	17
216	4.235	16.94	17
217	4.255	17.02	17
218	4.275	17.10	17
219	4.294	17.18	17
220	4.314	17.25	17
221	4.333	17.33	17
222	4.353	17.41	17
223	4.373	17.49	17
224	4.392	17.57	18
225	4.412	17.65	18
226	4.431	17.73	18
227	4.451	17.80	18
228	4.471	17.88	18
229	4.490	17.96	18
230	4.510	18.04	18
231	4.529	18.12	18
232	4.549	18.20	18
233	4.569	18.27	18
234	4.588	18.35	18
235	4.608	18.43	18
236	4.627	18.51	19
237	4.647	18.59	19
238	4.667	18.67	19
239	4.686	18.74	19
240	4.706	18.82	19
241	4.725	18.90	19
242	4.745	18.98	19
243	4.765	19.06	19
244	4.784	19.14	19
245	4.804	19.22	19
246	4.824	19.29	19
247	4.843	19.37	19
248	4.863	19.45	19
249	4.882	19.53	20
250	4.902	19.61	20
251	4.922	19.69	20
252	4.941	19.76	20
253	4.961	19.84	20
254	4.980	19.92	20
255	5.000	20.00	20

Building Automation Systems Analog Input Voltage Conversion Chart Page 1 of 2

0-5.00 Vdc Analog Device

Input to RSC V3.2

HTD	Voltage Input	Input Act	Ind
000	0.000	0.00	0
001	0.020	0.02	0
002	0.039	0.04	0
003	0.059	0.06	0
004	0.078	0.08	0
005	0.098	0.10	0
006	0.118	0.12	0
007	0.137	0.14	0
008	0.157	0.16	0
009	0.176	0.18	0
010	0.196	0.20	0
011	0.216	0.22	0
012	0.235	0.24	0
013	0.255	0.25	0
014	0.275	0.27	0
015	0.294	0.29	0
016	0.314	0.31	0
017	0.333	0.33	0
018	0.353	0.35	0
019	0.373	0.37	0
020	0.392	0.39	0
021	0.412	0.41	0
022	0.431	0.43	0
023	0.451	0.45	0
024	0.471	0.47	0
025	0.490	0.49	0
026	0.510	0.51	1
027	0.529	0.53	1
028	0.549	0.55	1
029	0.569	0.57	1
030	0.588	0.59	1
031	0.608	0.61	1
032	0.627	0.63	1
033	0.647	0.65	1
034	0.667	0.67	1
035	0.686	0.69	1
036	0.706	0.71	1
037	0.725	0.73	1
038	0.745	0.75	1
039	0.765	0.76	1
040	0.784	0.78	1
041	0.804	0.80	1
042	0.824	0.82	1
043	0.843	0.84	1
044	0.863	0.86	1
045	0.882	0.88	1
046	0.902	0.90	1
047	0.922	0.92	1
048	0.941	0.94	1
049	0.961	0.96	1
050	0.980	0.98	1
051	1.000	1.00	1
052	1.020	1.02	1
053	1.039	1.04	1
054	1.059	1.06	1
055	1.078	1.08	1
056	1.098	1.10	1
057	1.118	1.12	1
058	1.137	1.14	1
059	1.157	1.16	1
060	1.176	1.18	1
061	1.196	1.20	1
062	1.216	1.22	1
063	1.235	1.24	1
064	1.255	1.26	1
065	1.275	1.27	1
066	1.294	1.29	1
067	1.314	1.31	1
068	1.333	1.33	1
069	1.353	1.35	1
070	1.373	1.37	1
071	1.392	1.39	1
072	1.412	1.41	1
073	1.431	1.43	1
074	1.451	1.45	1
075	1.471	1.47	1
076	1.490	1.49	1
077	1.510	1.51	2
078	1.529	1.53	2
079	1.549	1.55	2
080	1.569	1.57	2
081	1.588	1.59	2
082	1.608	1.61	2
083	1.627	1.63	2
084	1.647	1.65	2
085	1.667	1.67	2
086	1.686	1.69	2
087	1.706	1.71	2
088	1.725	1.73	2
089	1.745	1.75	2
090	1.765	1.76	2
091	1.784	1.78	2
092	1.804	1.80	2
093	1.824	1.82	2
094	1.843	1.84	2
095	1.863	1.86	2
096	1.882	1.88	2
097	1.902	1.90	2
098	1.922	1.92	2
099	1.941	1.94	2
100	1.961	1.96	2
101	1.980	1.98	2
102	2.000	2.00	2
103	2.020	2.02	2
104	2.039	2.04	2
105	2.059	2.06	2
106	2.078	2.08	2
107	2.098	2.10	2
108	2.118	2.12	2
109	2.137	2.14	2
110	2.157	2.16	2
111	2.176	2.18	2
112	2.196	2.20	2
113	2.216	2.22	2
114	2.235	2.24	2
115	2.255	2.26	2
116	2.275	2.27	2
117	2.294	2.29	2
118	2.314	2.31	2
119	2.333	2.33	2
120	2.353	2.35	2
121	2.373	2.37	2
122	2.392	2.39	2
123	2.412	2.41	2
124	2.431	2.43	2
125	2.451	2.45	2
126	2.471	2.47	2
127	2.490	2.49	2
128	2.510	2.51	3

Building Automation Systems Analog Input Voltage Conversion Chart Page 2 of 2

0-5.00 Vdc Analog Device

Input to RSC V3.2

HTD	Voltage Input	Input Act	Ind
129	2.529	2.53	3
130	2.549	2.55	3
131	2.569	2.57	3
132	2.588	2.59	3
133	2.608	2.61	3
134	2.627	2.63	3
135	2.647	2.65	3
136	2.667	2.67	3
137	2.686	2.69	3
138	2.706	2.71	3
139	2.725	2.73	3
140	2.745	2.75	3
141	2.765	2.77	3
142	2.784	2.78	3
143	2.804	2.80	3
144	2.824	2.82	3
145	2.843	2.84	3
146	2.863	2.86	3
147	2.882	2.88	3
148	2.902	2.90	3
149	2.922	2.92	3
150	2.941	2.94	3
151	2.961	2.96	3
152	2.980	2.98	3
153	3.000	3.00	3
154	3.020	3.02	3
155	3.039	3.04	3
156	3.059	3.06	3
157	3.078	3.08	3
158	3.098	3.10	3
159	3.118	3.12	3
160	3.137	3.14	3
161	3.157	3.16	3
162	3.176	3.18	3
163	3.196	3.20	3
164	3.216	3.22	3
165	3.235	3.24	3
166	3.255	3.26	3
167	3.275	3.27	3
168	3.294	3.29	3
169	3.314	3.31	3
170	3.333	3.33	3
171	3.353	3.35	3
172	3.373	3.37	3
173	3.392	3.39	3
174	3.412	3.41	3
175	3.431	3.43	3
176	3.451	3.45	3
177	3.471	3.47	3
178	3.490	3.49	3
179	3.510	3.51	4
180	3.529	3.53	4
181	3.549	3.55	4
182	3.569	3.57	4
183	3.588	3.59	4
184	3.608	3.61	4
185	3.627	3.63	4
186	3.647	3.65	4
187	3.667	3.67	4
188	3.686	3.69	4
189	3.706	3.71	4
190	3.725	3.73	4
191	3.745	3.75	4
192	3.765	3.77	4
193	3.784	3.78	4
194	3.804	3.80	4
195	3.824	3.82	4
196	3.843	3.84	4
197	3.863	3.86	4
198	3.882	3.88	4
199	3.902	3.90	4
200	3.922	3.92	4
201	3.941	3.94	4
202	3.961	3.96	4
203	3.980	3.98	4
204	4.000	4.00	4
205	4.020	4.02	4
206	4.039	4.04	4
207	4.059	4.06	4
208	4.078	4.08	4
209	4.098	4.10	4
210	4.118	4.12	4
211	4.137	4.14	4
212	4.157	4.16	4
213	4.176	4.18	4
214	4.196	4.20	4
215	4.216	4.22	4
216	4.235	4.24	4
217	4.255	4.26	4
218	4.275	4.27	4
219	4.294	4.29	4
220	4.314	4.31	4
221	4.333	4.33	4
222	4.353	4.35	4
223	4.373	4.37	4
224	4.392	4.39	4
225	4.412	4.41	4
226	4.431	4.43	4
227	4.451	4.45	4
228	4.471	4.47	4
229	4.490	4.49	4
230	4.510	4.51	5
231	4.529	4.53	5
232	4.549	4.55	5
233	4.569	4.57	5
234	4.588	4.59	5
235	4.608	4.61	5
236	4.627	4.63	5
237	4.647	4.65	5
238	4.667	4.67	5
239	4.686	4.69	5
240	4.706	4.71	5
241	4.725	4.73	5
242	4.745	4.75	5
243	4.765	4.77	5
244	4.784	4.78	5
245	4.804	4.80	5
246	4.824	4.82	5
247	4.843	4.84	5
248	4.863	4.86	5
249	4.882	4.88	5
250	4.902	4.90	5
251	4.922	4.92	5
252	4.941	4.94	5
253	4.961	4.96	5
254	4.980	4.98	5
255	5.000	5.00	5

Chapter 3

Analog Outputs

Overview

The **Energy Zone®** System has the capacity for four Analog Outputs at every RSC.

Features

- Quad Analog Output Cards are capable of both 4-20 mA and 0-10 Vdc
- Connection to RSC with single 16 pin ribbon cable

Specifications

General - Four modulating analog outputs are provided by a Quad Analog Output (QAO) card. The QAO is 5 1/2”w x 7”h and is mounted in a 7 1/2”w x 9”h NEMA 1 metal enclosure. Electrical conduit knockouts are provided in both 1/2” and 3/4” sizes. QAOs are available from BAS without an enclosure and can be mounted directly to any flat surface using plastic standoffs. The QAO is rated as Class 2 limited energy electrical device.

The QAO receives its digital control data from the RSC. This data is used to generate 4 individual modulating outputs. The output resolution is 8 bits, or 256 steps. Each output is jumper selectable as either 4-20 mA or 0-10 Vdc.

The QAO provides a linear output from 0-10 Vdc or 4-20 mA. The card receives power from both the 5 Vdc and the 18 Vdc supply of the RSC. Two calibration pots are located on the circuit board for each channel. They are used adjust the output gain, one for the 0-10 Vdc and one for the 4-20 mA dc output.

Operation

Analog Output Card

The RSC sends information on the serial data line that corresponds to the percentage full scale. The AO Card will translate this information to a voltage or current output signal.

Installation

Location and Mounting

The QAO must be mounted in close proximity to the RSC for the Zone it serves. The QAO must be either mounted in a dry location or a field supplied enclosure used.

Setup

Two jumpers need to be set for each AO channel used. Set both jumpers to either V, for 0-10 Vdc output, or I, for 4-20 mA dc output.

Wiring

1. The AO card connects to the RSC by means of a factory provided 16 pin ribbon cable and connector. This cable should not exceed 18” in length. The connector and cable will fit through a 3/4” conduit nipple.
2. A standard Class 2 wire is used between the QAO and the controlled device. The wire should be a minimum 20 AWG.

System Startup/Checkout

The easiest way to check AO Cards is to activate the output after connecting the actuator (or other controlled device). If the actuator is correctly positioned then the AO Card is wired and functioning correctly.

1. Use the Handheld Tester or the Command Center to set the output to 100% open (value of 255). The output and the actuator load should go to the commanded state.
2. Adjust the gain using the pot on the circuit card as necessary to set the actuator to 100%.
3. Check the actuator at other points as desired. If using the Handheld Tester, see the conversion chart in this chapter to determine output values for any given desired % open position.

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ANALOG OUTPUT CONVERSION CHART

0-10 Vdc and 4-20 mA dc Outputs

HTD	4-20 mA	0-10 Vdc	% Opn	HTD	4-20 mA	0-10 Vdc	% Opn	HTD	4-20 mA	0-10 Vdc	% Opn
000	4.00	0.00	0.0	043	6.70	1.69	16.9	086	9.40	3.37	33.7
001	4.06	0.04	0.4	044	6.76	1.73	17.3	087	9.46	3.41	34.1
002	4.13	0.08	0.8	045	6.82	1.76	17.6	088	9.52	3.45	34.5
003	4.19	0.12	1.2	046	6.89	1.80	18.0	089	9.58	3.49	34.9
004	4.25	0.16	1.6	047	6.95	1.84	18.4	090	9.65	3.53	35.3
005	4.31	0.20	2.0	048	7.01	1.88	18.8	091	9.71	3.57	35.7
006	4.38	0.24	2.4	049	7.07	1.92	19.2	092	9.77	3.61	36.1
007	4.44	0.27	2.7	050	7.14	1.96	19.6	093	9.84	3.65	36.5
008	4.50	0.31	3.1	051	7.20	2.00	20.0	094	9.90	3.69	36.9
009	4.56	0.35	3.5	052	7.26	2.04	20.4	095	9.96	3.73	37.3
010	4.63	0.39	3.9	053	7.33	2.08	20.8	096	10.02	3.77	37.6
011	4.69	0.43	4.3	054	7.39	2.12	21.2	097	10.09	3.80	38.0
012	4.75	0.47	4.7	055	7.45	2.16	21.6	098	10.15	3.84	38.4
013	4.82	0.51	5.1	056	7.51	2.20	22.0	099	10.21	3.88	38.8
014	4.88	0.55	5.5	057	7.58	2.24	22.4	100	10.28	3.92	39.2
015	4.94	0.59	5.9	058	7.64	2.27	22.7	101	10.34	3.96	39.6
016	5.00	0.63	6.3	059	7.70	2.31	23.1	102	10.40	4.00	40.0
017	5.07	0.67	6.7	060	7.77	2.35	23.5	103	10.46	4.04	40.4
018	5.13	0.71	7.1	061	7.83	2.39	23.9	104	10.53	4.08	40.8
019	5.19	0.75	7.5	062	7.89	2.43	24.3	105	10.59	4.12	41.2
020	5.26	0.78	7.8	063	7.95	2.47	24.7	106	10.65	4.16	41.6
021	5.32	0.82	8.2	064	8.02	2.51	25.1	107	10.71	4.20	42.0
022	5.38	0.86	8.6	065	8.08	2.55	25.5	108	10.78	4.24	42.4
023	5.44	0.90	9.0	066	8.14	2.59	25.9	109	10.84	4.27	42.7
024	5.51	0.94	9.4	067	8.20	2.63	26.3	110	10.90	4.31	43.1
025	5.57	0.98	9.8	068	8.27	2.67	26.7	111	10.97	4.35	43.5
026	5.63	1.02	10.2	069	8.33	2.71	27.1	112	11.03	4.39	43.9
027	5.69	1.06	10.6	070	8.39	2.75	27.5	113	11.09	4.43	44.3
028	5.76	1.10	11.0	071	8.46	2.78	27.8	114	11.15	4.47	44.7
029	5.82	1.14	11.4	072	8.52	2.82	28.2	115	11.22	4.51	45.1
030	5.88	1.18	11.8	073	8.58	2.86	28.6	116	11.28	4.55	45.5
031	5.95	1.22	12.2	074	8.64	2.90	29.0	117	11.34	4.59	45.9
032	6.01	1.26	12.5	075	8.71	2.94	29.4	118	11.40	4.63	46.3
033	6.07	1.29	12.9	076	8.77	2.98	29.8	119	11.47	4.67	46.7
034	6.13	1.33	13.3	077	8.83	3.02	30.2	120	11.53	4.71	47.1
035	6.20	1.37	13.7	078	8.89	3.06	30.6	121	11.59	4.75	47.5
036	6.26	1.41	14.1	079	8.96	3.10	31.0	122	11.66	4.78	47.8
037	6.32	1.45	14.5	080	9.02	3.14	31.4	123	11.72	4.82	48.2
038	6.38	1.49	14.9	081	9.08	3.18	31.8	124	11.78	4.86	48.6
039	6.45	1.53	15.3	082	9.15	3.22	32.2	125	11.84	4.90	49.0
040	6.51	1.57	15.7	083	9.21	3.26	32.5	126	11.91	4.94	49.4
041	6.57	1.61	16.1	084	9.27	3.29	32.9	127	11.97	4.98	49.8
042	6.64	1.65	16.5	085	9.33	3.33	33.3	128	12.03	5.02	50.2

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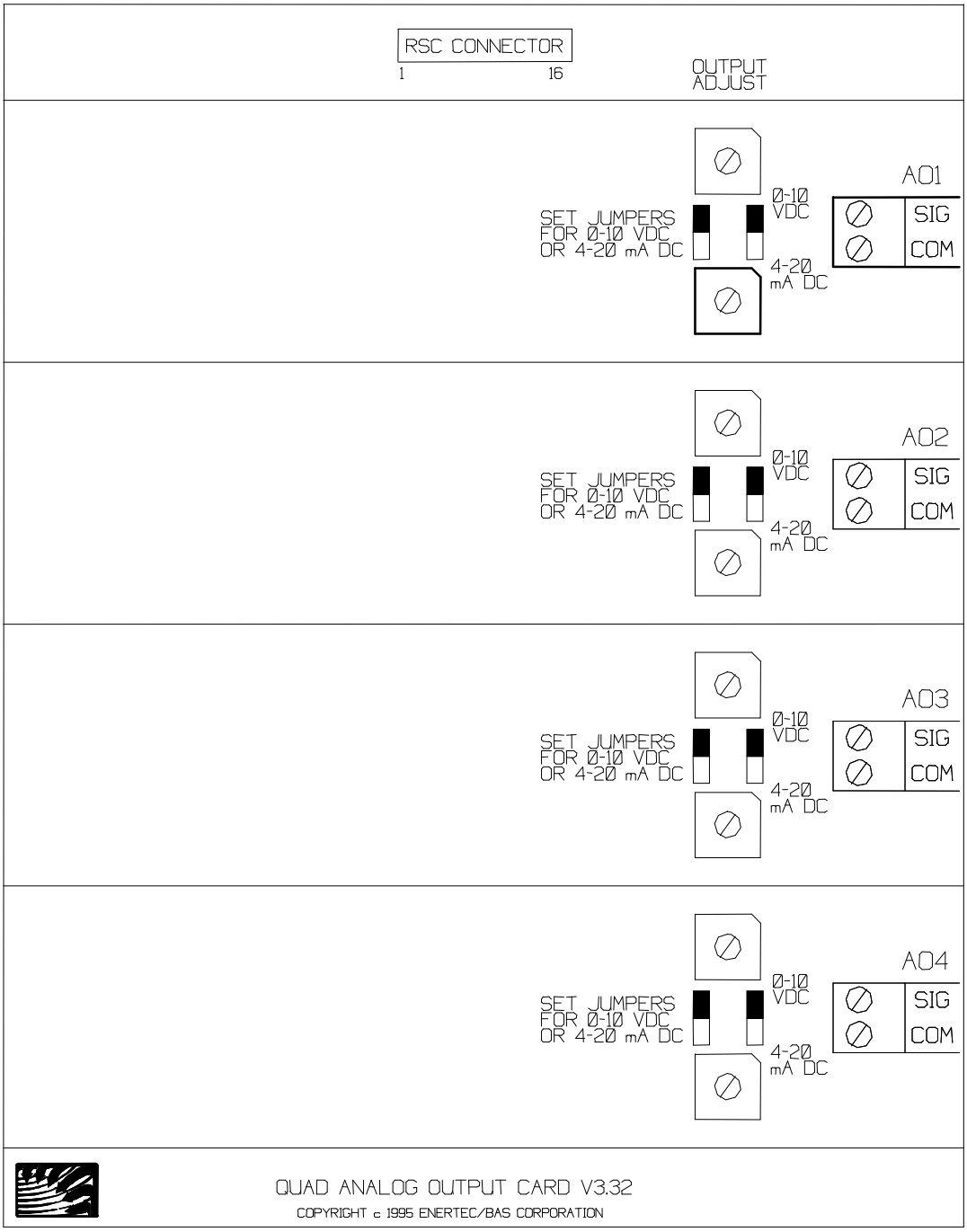
ANALOG OUTPUT CONVERSION CHART

0-10 Vdc and 4-20 mA dc Outputs

HTD	4-20 mA	0-10 Vdc	% Opn	HTD	4-20 mA	0-10 Vdc	% Opn	HTD	4-20 mA	0-10 Vdc	% Opn
129	12.09	5.06	50.6	172	14.79	6.75	67.5	215	17.49	8.43	84.3
130	12.16	5.10	51.0	173	14.86	6.79	67.8	216	17.55	8.47	84.7
131	12.22	5.14	51.4	174	14.92	6.82	68.2	217	17.62	8.51	85.1
132	12.28	5.18	51.8	175	14.98	6.86	68.6	218	17.68	8.55	85.5
133	12.35	5.22	52.2	176	15.04	6.90	69.0	219	17.74	8.59	85.9
134	12.41	5.26	52.5	177	15.11	6.94	69.4	220	17.81	8.63	86.3
135	12.47	5.29	52.9	178	15.17	6.98	69.8	221	17.87	8.67	86.7
136	12.53	5.33	53.3	179	15.23	7.02	70.2	222	17.93	8.71	87.1
137	12.60	5.37	53.7	180	15.30	7.06	70.6	223	17.99	8.75	87.5
138	12.66	5.41	54.1	181	15.36	7.10	71.0	224	18.06	8.79	87.8
139	12.72	5.45	54.5	182	15.42	7.14	71.4	225	18.12	8.82	88.2
140	12.79	5.49	54.9	183	15.48	7.18	71.8	226	18.18	8.86	88.6
141	12.85	5.53	55.3	184	15.55	7.22	72.2	227	18.24	8.90	89.0
142	12.91	5.57	55.7	185	15.61	7.26	72.5	228	18.31	8.94	89.4
143	12.97	5.61	56.1	186	15.67	7.29	72.9	229	18.37	8.98	89.8
144	13.04	5.65	56.5	187	15.73	7.33	73.3	230	18.43	9.02	90.2
145	13.10	5.69	56.9	188	15.80	7.37	73.7	231	18.50	9.06	90.6
146	13.16	5.73	57.3	189	15.86	7.41	74.1	232	18.56	9.10	91.0
147	13.22	5.77	57.6	190	15.92	7.45	74.5	233	18.62	9.14	91.4
148	13.29	5.80	58.0	191	15.99	7.49	74.9	234	18.68	9.18	91.8
149	13.35	5.84	58.4	192	16.05	7.53	75.3	235	18.75	9.22	92.2
150	13.41	5.88	58.8	193	16.11	7.57	75.7	236	18.81	9.26	92.5
151	13.48	5.92	59.2	194	16.17	7.61	76.1	237	18.87	9.30	92.9
152	13.54	5.96	59.6	195	16.24	7.65	76.5	238	18.93	9.33	93.3
153	13.60	6.00	60.0	196	16.30	7.69	76.9	239	19.00	9.37	93.7
154	13.66	6.04	60.4	197	16.36	7.73	77.3	240	19.06	9.41	94.1
155	13.73	6.08	60.8	198	16.42	7.77	77.6	241	19.12	9.45	94.5
156	13.79	6.12	61.2	199	16.49	7.80	78.0	242	19.19	9.49	94.9
157	13.85	6.16	61.6	200	16.55	7.84	78.4	243	19.25	9.53	95.3
158	13.91	6.20	62.0	201	16.61	7.88	78.8	244	19.31	9.57	95.7
159	13.98	6.24	62.4	202	16.68	7.92	79.2	245	19.37	9.61	96.1
160	14.04	6.28	62.7	203	16.74	7.96	79.6	246	19.44	9.65	96.5
161	14.10	6.31	63.1	204	16.80	8.00	80.0	247	19.50	9.69	96.9
162	14.17	6.35	63.5	205	16.86	8.04	80.4	248	19.56	9.73	97.3
163	14.23	6.39	63.9	206	16.93	8.08	80.8	249	19.62	9.77	97.6
164	14.29	6.43	64.3	207	16.99	8.12	81.2	250	19.69	9.81	98.0
165	14.35	6.47	64.7	208	17.05	8.16	81.6	251	19.75	9.84	98.4
166	14.42	6.51	65.1	209	17.11	8.20	82.0	252	19.81	9.88	98.8
167	14.48	6.55	65.5	210	17.18	8.24	82.4	253	19.88	9.92	99.2
168	14.54	6.59	65.9	211	17.24	8.28	82.7	254	19.94	9.96	99.6
169	14.60	6.63	66.3	212	17.30	8.31	83.1	255	20.00	10.00	100
170	14.67	6.67	66.7	213	17.37	8.35	83.5				
171	14.73	6.71	67.1	214	17.43	8.39	83.9				

Quad Analog Output Board Layout



Chapter 4

EnerNet®

Overview

EnerNet® is the network of hardware, software, and wiring used for communications between the Command Center and Remote System Controllers (RSCs) in an **Energy Zone®** System. **EnerNet®** is extremely robust and reliable. The heart of EnerNet is the Advanced Communication Link (ACL). The ACL resides in the Command Center and manages the **EnerNet®** and all communications between the Command Center and the Remote System Controllers.

Features

- Uses 2-Wire RS-485 trunk line
- Up to 8 trunk lines per System
- Up to 32 RSCs per trunk line
- Minimum of hardware, operated by 1 plug-in card (ACL) at the Command Center
- Transmits at 9600 baud
- Resistant to noise and electrical interference
- Protection from electrical spikes
- LED indication of Trunk Line status
- Terminations at ACL made with standard RJ-11 connectors

Specifications

General Description - **EnerNet®** communicates with all RSCs in the System once every 8 seconds. During each 8 second cycle, commands are transmitted to each RSC and each RSC in turn responds with the status of all analog and digital inputs. Each data packet, both to and from the ACL, is checked for data errors. Any data packet in which the data can not be verified is rejected. In the event of data errors, or any problem affecting communications, the RSC will maintain all of its outputs at their current state for 3 minutes. After the end of three minutes the RSC will enter default mode.

Command Center - All communications begin at the Command Center. The **Energy Zone®** software transmits its data to and receives data from the ACL through dual ported RAM in the Command Center. The Command Center directs the ACL when to transmit and receive data from the RSCs. Any communication errors identified by the ACL are reported to the Command Center, where appropriate action can be taken by the **Energy Zone®** software. Any RSC that does not transmit valid data for 3 minutes is considered off-line by the Command Center.

Advanced Communication Link (ACL) - The ACL is an intelligent serial communication board, designed to operate in one of the full length standard ISA 8 bit slots of the Command Center. The ACL is powered by an 8 MHz 8088 microprocessor, which manages the 8 RS-232 serial ports. These serial ports are connected by a 37 pin cable to an 8 port breakout box. The ACL continuously monitors the condition of the network and the communication status of all RSCs. Any communication errors are reported to the Command Center and logged in the Alarm Log.

Breakout Box - The breakout box is connected by a 37 pin cable to the ACL. The breakout box performs the conversion from RS-232 to RS-485 and provides the means for connection of the trunk lines from the field.

Trunk Line - Communication between each RSC and the Command Center follows the RS-485 specification. Up to 32 RSCs can be placed on each of eight trunk lines. Communication is on a standard 2-conductor, 18 AWG, twisted shielded pair (tsp), with all RSCs on a trunk line wired in parallel. Maximum length of the trunk line is 5000'. The trunk line is protected from voltage spikes at each RSC by surge suppressers. Automatic resetting solid state fuses prevent damage to the surge suppressers by sustained faults.

Remote System Controller - The RSCs are all connected in parallel to the trunk line. The RSC stores the status of all analog and digital inputs and will transmit this data in response to a command by the ACL. Communication via the RS-232 specification is also available at the RSC, used for the Handheld Tester.

Two LEDs at each RSC indicate the status of communication, one for incoming and one for outgoing transmissions. A green LED will indicate any traffic on the trunk, both from the Command Center and from all other connected RSCs. A yellow LED will indicate the outgoing data from the RSC.

Sequence of Operation

Normal Operation

1. The Command Center will calculate the correct state for each output and place this data in the dual ported RAM.
2. The ACL will retrieve this data from the dual ported ram and transmit on each trunk line once every 8 seconds. This block of data contains commands for each RSC connected to the trunk line. The ACL will cycle through all trunk lines in order (1 first - 8 last).
3. The RSCs will then respond in order of address (address 1 first - address 32 last). The response from the RSC will include address, equipment schedule, analog input values, and digital input values.
4. The ACL will place the response data from the RSC in the dual ported ram.
5. The Command Center will use this data to determine the next commanded state for each RSC and repeat the cycle.

Error Conditions

1. The ACL continuously monitors each trunk line for several alarm conditions. Any errors are reported immediately to the Command Center.
2. The Command Center will store this information in the Alarm Log.
3. If the total time since the last good data received from any RSC exceeds 3 minutes, that RSC is considered off-line at the Command Center. This timer can be monitored on the Troubleshooting Screen at the Command Center.
4. A separate timer at the RSC will begin a countdown after loss of communication with the Command Center. During this countdown, the RSC will maintain the last commanded state on all outputs. After 3 minutes, the RSC will enter default mode and control its outputs based on the default software located in the EPROM.
5. Both the RSC and the Command Center will continuously attempt to reestablish a communication link. If one good data packet is received, this will reset the countdown timers at both locations.

Installation

Location and Mounting

1. ACL - The ACL is installed in the Command Center by BAS.

2. Breakout Box - The Breakout Box is connected to a the ACL with a 6' long 37 pin cable. The Breakout Box should be set directly adjacent to the Command Center.

3. Termination Box - The Termination Box connects to the Breakout Box using standard RJ-11 connectors. Many varieties of Termination Boxes can be used. The type of Termination Box will determine the mounting procedure. The Termination Box must be within 25' of the Breakout Box. The Termination Box should be mounted in an accessible location.

Wiring

1. The following rules must be carefully followed for a trouble free installation (These instructions are not intended to conflict with National or local Electrical Codes. It is the responsibility of the installer to ensure Code compliance.):
   a. A 2 conductor twisted shielded pair cable is used for all trunk line wiring. See wiring layout at the end of this chapter for correct wire size.
   b. Do not run the trunk line through an electrically noisy environment.
   c. The shield around the trunk line must maintain continuity throughout the System. Splice the shield within the RSC enclosure. Tape the splice to prevent shorting the shield to the enclosure. The shield from the trunk line should not terminate or be grounded anywhere except at the Termination Box.
   d. A 120 Ohm termination resistor must be placed across the Trunk Line at the RSC located farthest from the Command Center. This is done by inserting a jumper on the factory provided termination resistor terminals.
   e. All RSCs are to be wired in parallel. The polarity of the trunk line must be maintained throughout. The black wire must be connected to the - terminal on all RSCs and the white or red wire must be connected to the + terminal on all RSCs.
   f. The trunk line should be wired from RSC to RSC in a daisy chain fashion. A star configuration will work in some applications, but is more prone to communication errors.
   g. It is not necessary to have the RSCs addressed consecutively. The RSCs may be addressed and wired in any order.
   h. Do not allow either side of the trunk line to make contact with any voltage source. This is likely to cause severe damage to both the ACL and all RSCs connected to the trunk line.

Table of Trunk Line Wiring Terminations

Function	9 Pin Connector	9 Pin to RJ-11	RJ-11 ACL End	RJ-11 Term Box	Term Box Color	Trunk Wire	RSC
Trunk Line -	2/7	Yellow	2	5	Black	Black	- Terminal
Trunk Line +	4/9	Green	3	4	Red	Red/White	+Terminal
Ground	5	Red	4	3	Green	Bare/Shield	N/A

System Startup/Checkout

General Procedure

1. Install trunk line.
2. Verify with a multimeter that no shorts exist (trunk - to trunk +, trunk - to shield, trunk + to shield).
3. Check the resistance between the - trunk and the + trunk with a multimeter. This value should be 100 - 200 ohms.
4. Verify with a multimeter that the shield is properly grounded.
5. Apply power to the Command Center.
6. Apply power to all RSCs.
7. Set communication trunk logging level to Detailed Comm Errs.
8. Verify all connected RSCs respond to the Command Center.
9. Check Alarm Log for communication errors after 24 hours of logging. Make repairs or corrections as necessary.
10. After trunk line is verified, reduce logging level to Minimal.

ACL

1. On initial bootup, the ACL software is downloaded to the ACL. If the ACL is functioning correctly, the following message is displayed: "Load of ACLEMS.CP onto ACL is completed"
2. If the ACL has a problem, the following message is displayed: "ACL does not respond". If this message occurs, contact BAS.

RSC

1. Each RSC will indicate communication with the Command Center using the heartbeat LED. The LED will flash once every 3 seconds if communication has been established with the Command Center. If communication has been lost, the LED will flash twice every three seconds.
2. Communications can also be monitored using the trunk status LEDs. Each RSC and the Command Center will activate the green LED when transmitting. Each individual RSC will indicate a transmission of data be activating the yellow LED on that RSC.

Command Center

1. The Command Center will give an overall indication of communication status using the icon in the main EZ list box. If communication has been established any time during the previous 3 minutes, the icon will indicate one of the possible on-line control modes.
2. The Troubleshooting screen will give a detailed indication of the communication status at each RSC. The System displays the length of time since the last valid packet was received. This time should be generally less than 10 seconds. If this value exceeds 12 seconds, communication errors are occurring which cause data loss.
3. The Alarm Log will maintain a record of all communication errors. These alarms are only indicated in the Alarm Log. An explanation of those error messages is:

   a. Level 1 (Minimal) Logging

   - `Fri Aug 14 17:38:18 ** RSC 1-13 ALARM: BAD RSC CHECKSUM`

   Some part of the packet became corrupted during transmission from the RSC. This is generally not a problem if it only appears occasionally.

- `Fri Aug 14 17:38:18 ** RSC 3-4 ALARM: RSC assumed in default.`

Over three minutes have elapsed since the last valid packet was received from the RSC. This RSC is now assumed to be running in its default mode of operation. From this time until the first valid packet is received, the System will send initialization packets to the RSC. Unless it is known that an RSC was manually taken off-line, this is an important message and should be taken seriously.

b. Level 2 (Loosing Packets) Logging - All Level 1 messages are logged in addition to the following:

- `Fri Aug 14 17:38:18 ** RSC 1-2 ALARM: We're loosing packets.`

Over one minute has elapsed since the last valid packet was received from the RSC. This message should be taken seriously as an indicator that the network connection is weak or in the process of failing.

c. Level 3 (Hardware Errors) Logging - This is the same as Level 2. No additional messages are logged at this time.

d. Level 4 (Detailed Comm Errs) Logging - All Level 1, 2, and 3 messages are logged in addition to the following:

- `Fri Aug 14 17:38:18 ** Trunk 3 ALARM: Bad Packet length = 47`
- `Fri Aug 14 17:38:18 ** RSC 2-14 ALARM: Bad Packet Address = 39`

These two messages should be rare. If they are appearing, treat them as a bad checksum error.

- `Fri Aug 14 17:38:18 ** Trunk 4 ALARM: Overrun Error`

This error will occur when a character is received before the previous character has been removed from the buffer on the ACL. This error should not occur.

- `Fri Aug 14 17:38:18 ** Trunk 4 ALARM: Parity Error`

This error occurs when the parity bit does not concur with the previous bit. **EnerNet®** does not use parity bits and this error should not occur.

- `Fri Aug 14 17:38:18 ** Trunk 4 ALARM: Framing Error`

This error occurs when an incomplete byte of data was received (i.e. missing stop bit). This error generally indicates poor connections.

- `Fri Aug 14 17:38:18 ** Trunk 4 ALARM: Received Break`

This error indicates that the ACL thought it was receiving data but the serial line fell to zero volts. This occurs when pull-up/pull-down resistors are missing from the Breakout Box (these are installed at the factory) or a poor connection exists somewhere on the trunk.

Troubleshooting Trunk Line Problems

Note: An oscilloscope can be very useful in troubleshooting communication problems. The same procedures are followed as when using a multimeter, but the indication is clearer. The scope should be battery powered to prevent grounding the trunk line when connected to the scope.

1. If a complete communication failure has occurred, repeat the steps in the General Procedure above. If everything checks out, continue.
2. With the System all connected and energized, check the trunk line dc voltage with a multimeter at the Termination Box.
   a. Place the positive probe on + trunk and the negative probe on - trunk
   b. The voltage when the ACL is in an idle state should be .25 +/- .05 Vdc.
   c. Once every 8 seconds, the voltage on the line should jump to 1.8 +/- .8 Vdc.
3. If the System checks out at the Termination Box, then repeat step 2 at each RSC location. Also check the Trunk Status LEDs at the RSC. If everything checks out at each RSC location, but communication problems persist, contact **BAS** for assistance.
4. If the System does not check out at the Termination Box, then disconnect the trunk line from the field and repeat step 2. If the ACL does not check out, contact **BAS** for assistance. If the ACL checks out, then the problem is in the wiring or a failed RSC. The RSCs must be eliminated one at a time until the problem is identified.

   Note: If the problem is isolated to a couple of RSCs, verify that the addresses are correctly set. If two or more RSCs are set to the same address, they can not communicate with the Command Center.

EnerNet® Wiring Layout