USER MANUAL

Installation, Operation & Maintenance

AERCO Control System (ACS)

AERCO Control System (ACS) Front Panel

For Control of Up to Thirty-two (32) AERCO Boilers, including:

- **Benchmark Series**
- **Modulex MLX Series**
- **Modulex EXT Series**
- **KC-1000**

Latest Update: 11/22/2017

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Page **1** of **139**
GF-131

Table of Contents:

Page **2** of **139**
GF-131

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Page **7** of **139**
GF-131

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Page **8** of **139**
GF-131

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11/22/2017
OMM-0081_0F

FOREWARD

The AERCO Control System (ACS) is AERCO's solution for a flexible boiler plant controller. The system can control a boiler plant comprised of AERCO Benchmark Series, Modulex MLX Series, Modulex EXT Series or KC1000 Boilers. The ACS can stage and coordinate the operation of up to thirty-two (32) AERCO Boilers with maximized efficiency. With individual boilers with turn-down ratios as high as 20:1, a 5-boiler plant can deliver a system turn-down ratio of 100:1 when the boilers are staged to operate sequentially.

The ACS can also be used in a combination boiler plant to both supply building heat and also heat water for domestic applications. There are multiple options built in to do this. Some of these options require a mated AERCO Relay Box to be installed along with the ACS in order to effectively and safely control the supporting hydronic valves and their interaction with the boilers.

The ACS is fully compatible with a wide array of Building Automation Systems (BAS) or Energy Management Systems (EMS) utilizing Modbus Protocol. The BAS or EMS communicates with the ACS utilizing a RS232 interface. If the BAS or EMS uses a RS485 port, the ACS can be ordered with a RS485-to-RS232 Converter which can be easily installed within the ACS wiring compartment.

Technical Terms and Acronyms

The phrases, abbreviations and acronyms used in this document are listed in the following table:

Technical Terms and Acronyms	
Term/Acronym	**Meaning**
A (Amp)	Ampere
ACS	AERCO Control System
ADDR	Address
ALRM	Alarm
AUX	Auxiliary
BAS	Building Automation System, often used interchangeably with EMS (see below)
Baud Rate	Symbol rate, or simply the number of distinct symbol changes (signaling events) transmitted per second. It is not equal to bits per second, unless each symbol is 1 bit long.
BCM	Boiler Control Module used with AERCO Modulex Series Boilers
BLR	Boiler
BND	Band
Bias Resistors	A pair of resistors used to force the communication line to a definite logic state so that noise is not picked up as invalid data during communication.
BLDG (Bldg)	Building
C-More Controller (or Control Box)	A control system developed by AERCO and currently used in all Benchmark and KC1000 Series product lines.
CNTL	Control
DHW	Domestic Hot Water
DYN	Dynamic
EMS	Energy Management System; often used interchangeably with BAS
Ethernet	A computer networking technology for Local Area Networks (LANs)
FDX	Full-Duplex
FLT	Fault

11/22/2017
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Phone: 800-526-0288

Page **9** of **139**
GF-131

Technical Terms and Acronyms

Term/Acronym	Meaning
GND	Ground
HDR	Header
HDX	Half-Duplex
Hex	Hexadecimal Number (0 - 9, A - F)
Hz	Hertz (Cycles Per Second)
INTLK	Interlock
I/O	Input/Output
I/O Box	Input/Output (I/O) Box currently used on all Benchmark and KC Series products
IP	Internet Protocol
ISO	Isolated
LSB	Least Significant Byte
LSD	Least Significant Digit
MA (mA)	Milliampere
MAX (Max)	Maximum
MIN (Min)	Minimum
Modbus®	A serial, half-duplex data transmission protocol developed by AEG Modicon
MSB	Most Significant Byte
MSD	Most Significant Digit
MS/TP	Master-Slave/Token-Passing (usually over RS485 networks)
OFFS	Offset
OUTD	Outdoor
PTP	Point-to-Point (usually over RS232 networks)
REF (Ref)	Reference
Response Time	The maximum amount of time allowed to receive a response to a request
RS232 (or EIA-232)	A standard for serial, full-duplex (FDX) transmission of data based on the RS232 Standard
RS422 (or EIA-422)	A standard for serial, full-duplex (FDX) transmission of data based on the RS422 Standard
RS485 (or EIA-485)	A standard for serial, half-duplex (HDX) transmission of data based on the RS485 Standard
RTN	Return
RTU	Remote Terminal Unit
SEN	Sensor
SETPT (Setpt)	Setpoint Temperature
SHLD (Shld)	Shield
SLTA	Serial LonTalk Adapter
SYS	System
TEMP (Temp)	Temperature
Terminating Resistor	A resistor placed at each end of a daisy-chain or multi-drop network in order to prevent reflections that may cause invalid data in the communication
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
VFD	Vacuum Fluorescent Display

Page **10** of **139**
GF-131

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CHAPTER 1: ACS GENERAL INFORMATION

1.1 SAFETY PRECAUTIONS AND WARNINGS

The warnings and cautions appearing throughout this manual should be reviewed and thoroughly understood prior to attempting to install, operate, troubleshoot or repair the ACS Controller.

1.2 INTRODUCTION

This manual provides installation, operation and troubleshooting instructions for the AERCO Control System, Model 5R5-384.

1.3 GENERAL DESCRIPTION

The ACS (Figure 1-1) is a rugged and flexible controller, designed to stage and coordinate the operation of up to 32 AERCO Benchmark Series, Modulex Series or KC1000 Boilers while maximizing operational efficiency. Under normal load conditions, the ACS can precisely regulate the header temperature of the boiler plant within ±2°F.

Boiler plant control is accomplished via a RS485 network utilizing Modbus protocol. For facilities that have taken a building-wide approach to energy efficiency, the ACS can be easily integrated with an Energy Management System (EMS) or Building Automation System (BAS) utilizing Modbus protocol. Physical connection to the remote EMS or BAS is accomplished via an RS232 interface. EMS/BAS integration will also permit utilization of the pass-thru function incorporated in the ACS. The pass-thru function permits the remote system to monitor up to 35 operating parameters from each boiler in the plant.

The ACS is housed in a NEMA 13 enclosure. A hinged clear-plastic cover over the unit's panel controls protects against incidental contact of control settings and provides a degree of protection against airborne debris and the spraying or splashing of water. The physical dimensions, weight and electrical power requirements for the ACS are as follows:

ACS (AERCO Control System) Specifications	
Dimensions	9.50" W x 7.25" H x 4.00" D
Weight	3 lbs.
Power Requirements	85-to-265 VAC, Single-Phase, 50-60 Hz @ 1A

Each ACS shipment includes a Header Sensor Kit (P/N GM-122790) which is required for all modes of operation. Other available options which can be ordered with your shipment include:

- Outdoor Air Sensor Kit, P/N GM-122781: Required for Outdoor Reset Mode Operation

- Return Sensor Kit, P/N 122790 (Same as Header Sensor Kit): Used for external monitoring of boiler water return temperature

- RS485-to-RS232 Converter, P/N 124943: For use with EMS or BAS equipment that has a RS485 Port.
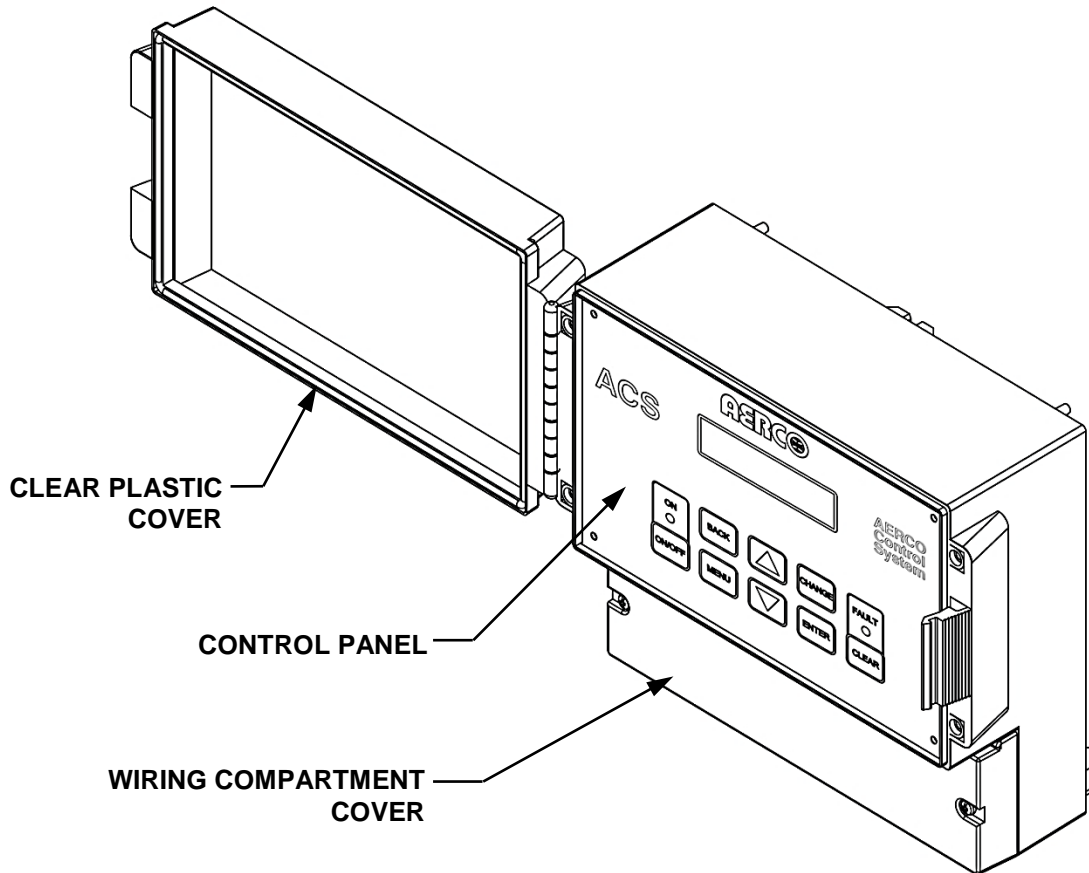
Figure 1-1: AERCO Control System (ACS)

1.4 FEATURES

The following paragraphs briefly describe some of the unique features incorporated in the ACS.

1.4.1 Simplified Installation and Set-Up

The ACS system operates on single-phase input power ranging from 85 to 265 VAC, 50-60 Hz. Connections to the boiler plant are accomplished utilizing a 2-wire RS485 network connected in a daisy-chain configuration. When an EMS or BAS is used with the ACS, connections are made via the RS232 port terminals. In the event that the EMS or BAS is not equipped with a RS232 port, the ACS can be ordered with a RS485 to RS232 Converter which can be easily installed within the wiring compartment of the ACS. With the exception of AC power, interlock and setback inputs and relay outputs, ACS connections are accomplished using shielded-twisted pair cable.

1.4.2 Control System Interface

The unit incorporates a menu-driven architecture which is comprised of 9 primary menus. The user interface to these menus is accomplished via the ACS control panel and a Vacuum Fluorescent Display (VFD). The display is capable of displaying two lines with 16 characters per line. Virtually all of the control panel keys are identical to the C-More Control System currently used on AERCO Benchmark Series and KC1000 Boilers. This commonality will help simplify the time required for system setup of the ACS.

1.4.3 Retention of Menu Option Settings

By using non-volatile memory, the ACS retains program and menu settings during shut-down or when input AC power is interrupted. Settings can be retained for more than 2 years.

1.4.4 Configuration Options

Four different configuration options can be selected to match the needs of any closed-loop system. These configurations are: Outdoor Reset, Constant Setpoint, Remote Setpoint via a 4-20 Ma input and Remote Setpoint via Modbus.

Three different domestic hot water (DHW) options are selectable for controlling the combination boilers and valves that are being used to provide heated domestic water.

1.4.5 Sequential and Parallel Operation

Boilers can be programmed for either sequential or parallel operation using the ACS keypad controls. When set for sequential operation, the boilers are brought on-line one at a time as needed. When set for parallel operation, the boilers are all brought on-line together at the same firing rate.

1.4.6 Accuracy

Using PID (Proportional Integral Derivative) and Ramp-Up/Ramp-Down Modulation Control Algorithms, the ACS provides dynamic responses to all changes in boiler plant operation. Header temperatures, as well as percentages of boiler input are precisely controlled with virtually no over-shoot or short-cycling of boiler units. A header temperature accuracy of ±2°F is virtually assured during continuous plant operation.

1.4.7 Sequential Operation

When operated sequentially, The ACS stages boilers on and off at selectable firing rate percentages. The result is a seamless transition with undetectable room temperature changes. In addition, when in sequential mode, the ACS sequences boilers using a first-on, first-off basis, thereby equalizing the accumulated run time of all boilers in the plant.

The ACS also continuously monitors the number of Boilers that are available for operation. In the event of a boiler malfunction, or required servicing, the ACS automatically compensates for a lack of response from any unit and brings on the next available boiler to satisfy the demand. This feature operates in both sequential and parallel modes.

1.4.8 Fault Alarm Surveillance

If an EMS or BAS is not used with the ACS to monitor faults, a Fault Alarm Relay can be activated thereby notifying facility managers of faults associated with the ACS.

1.4.9 ACS Programming Via RS232 Port

If desired, the ACS can be programmed by connecting a Laptop Computer or other terminal emulation device to the RS232 Port terminals on the ACS. Detailed set-up instructions and available command listings are provided in Appendix G. Most settings are also programmable using Modbus.

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Page **14** of **139**

GF-131

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11/22/2017

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CHAPTER 2: ACS INSTALLATION

2.1 INTRODUCTION

This Chapter provides the descriptions and procedures necessary to mount the ACS and connect all boiler plant units and applicable sensors. Guidelines are also provided for connection of an EMS or BAS being used with the system. Refer to the wiring diagram provided in Appendix E when making all wiring connections to the ACS.

2.2 SITE SELECTION AND MOUNTING

Ensure that the site selected for installation of the ACS provides the following:

- Access to single-phase AC power from 110 to 240 VAC, 60 Hz nominal

- Sufficient clearances to permit maintenance and setup/operational tasks on the ACS.

2.2.1 Mounting the ACS

AERCO recommends that the ACS be wall-mounted using a sheet of plywood or other suitable material. For easy viewing, the ACS controls and display should be at eye level. Mounting is accomplished using three screws (not provided). The spacing for the three screws are indicated on the rear of the ACS in millimeters. Figure 2-1 shows the rear of the panel enclosure and also indicates the required spacing for the three mounting screws in inches. Proceed as shown below, to mount the unit:

Mounting the ACS Controller

1. First install a screw on the mounting surface at the top center location shown in Figure 2-1. Leave a space of approximately 1/8 inch between the mounting surface and the head of the screw.

2. Remove the wiring compartment cover from the front of the ACS (see Figure 1-1) to provide access to the slots for the two lower mounting screw locations.

3. Hang the ACS on the installed top screw. Position the unit so it is level.

4. Mark the locations for the two lower screws.

5. Remove the ACS and drill two pilot holes for the lower screws.

6. Replace the ACS on the installed top-center screw.

7. Secure the ACS to the wall by installing the two lower screws. DO NOT over-tighten the screws.

REAR VIEW
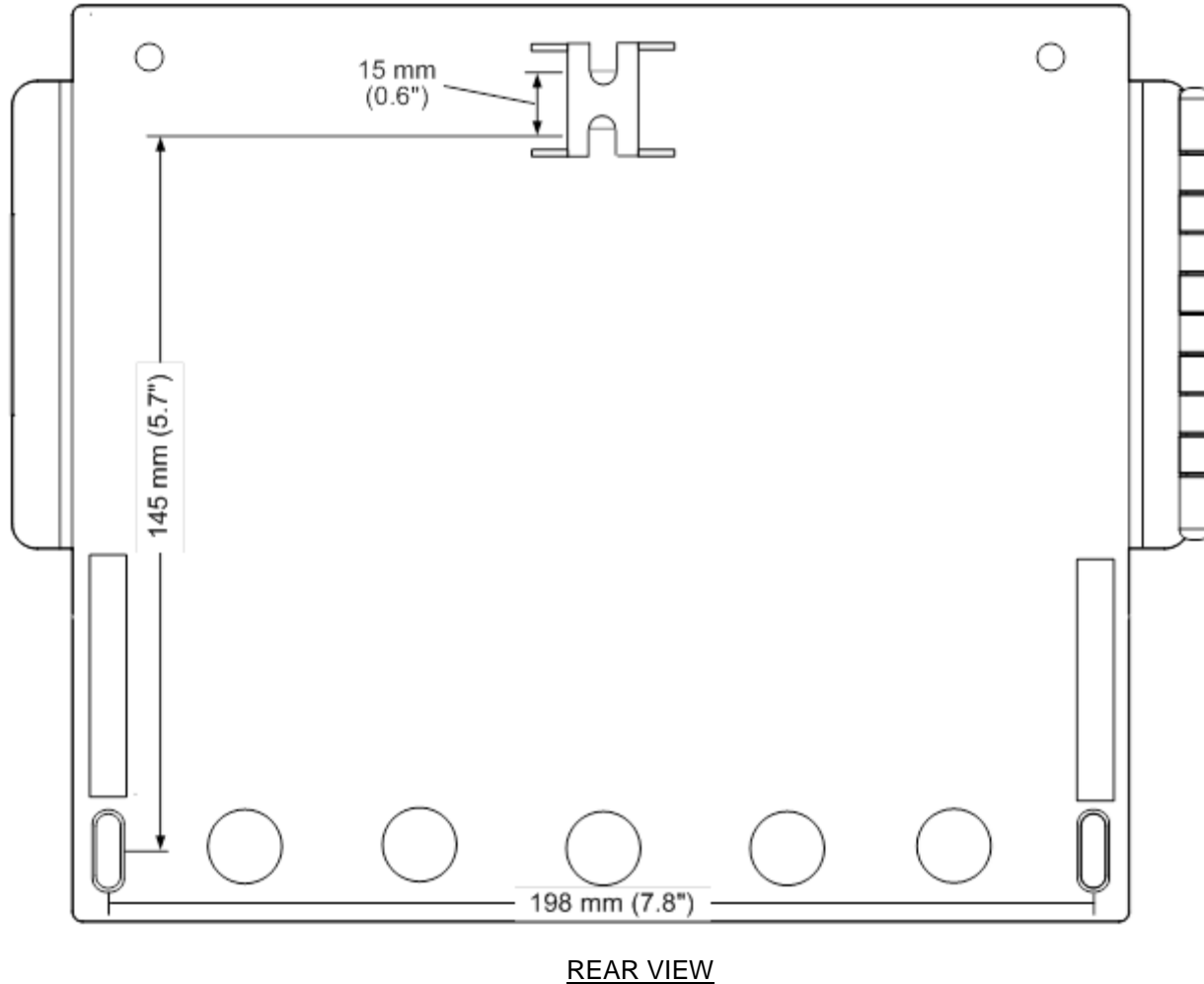
Figure 2-1: ACS Mounting Provisions

2.3 SITE SELECTION AND MOUNTING

All wiring connections to the ACS are made at the terminals located behind the wiring compartment cover as shown in Figure 2-2. Run all wiring through the knock-outs provided on the bottom surface of the unit. Shielded, twisted-pair cable should be used for sensor and communication wiring. This wiring should be 18 to 24 AWG. Examples of suitable sensor and communication wire are: Belden 9841, 8761, 3105A or equivalent. AC power wiring should be 14 to 18 AWG. The ACS wiring diagram is provided in Appendix E. Once mounting is complete and the ACS is secured in place, loosen the two captive screws on the wiring compartment cover using a Phillips screwdriver. Feed all wiring through the knock-outs provided on the bottom of the panel.

NOTE

Refer to the wiring diagram provided in Appendix E when making all wiring connections to the ACS.

> **WARNING!**
>
> The ACS can be powered by single-phase AC voltages ranging from 85 to 265 VAC. Therefore, exercise extreme care when connecting power wiring to the unit. Ensure that the external circuit breaker supplying line voltage to the ACS is **turned off** to avoid severe electrical shock.

2.4 POWER WIRING

Use 14 to 18 AWG wire for AC power connections and proceed as shown below:

Wiring ACS Power Connections

1. Feed the power wiring through the right-most knock-out in the bottom of the panel enclosure (**Figure 2-2**).

2. Connect the Line (black), Neutral (white) and Ground (green) wire leads to the L, N and ⏚ (GND) terminals. The terminal blocks can be detached from the ACS headers if necessary to simplify field wiring connections.

3. Following completion of power wiring, turn on the external circuit breaker or switch and apply power to the unit. The ACS display will momentarily show:

    AERCO ACS

    REV X.XX

    (Where: X.XX represents the revision level of the installed ACS software)

4. Next, since the Header Sensor is not yet installed, the display will then show:

    HEADER TEMP

    SENSOR ERROR

    The red FAULT LED indicator will also light and a fault message will alternately be displayed as follows:

    HEADER SENSOR

    ERROR

5. Press the ON-OFF key on the keypad. The green ON LED indicator will light and the ACS display will continue to show the above message.

6. After verifying proper power connections, press the ON-OFF key. The ON LED will turn off.

7. Turn off the external power switch and/or circuit breaker. The ACS display will go blank.

8. DO NOT apply power to the ACS until all of the required external connections described in **paragraphs 2.5** through **2.11** have been completed.

SENSORS & 4-20 mA   INTERLOCKS & SETBACKS   RS485 & RS232   RELAYS   AC POWER
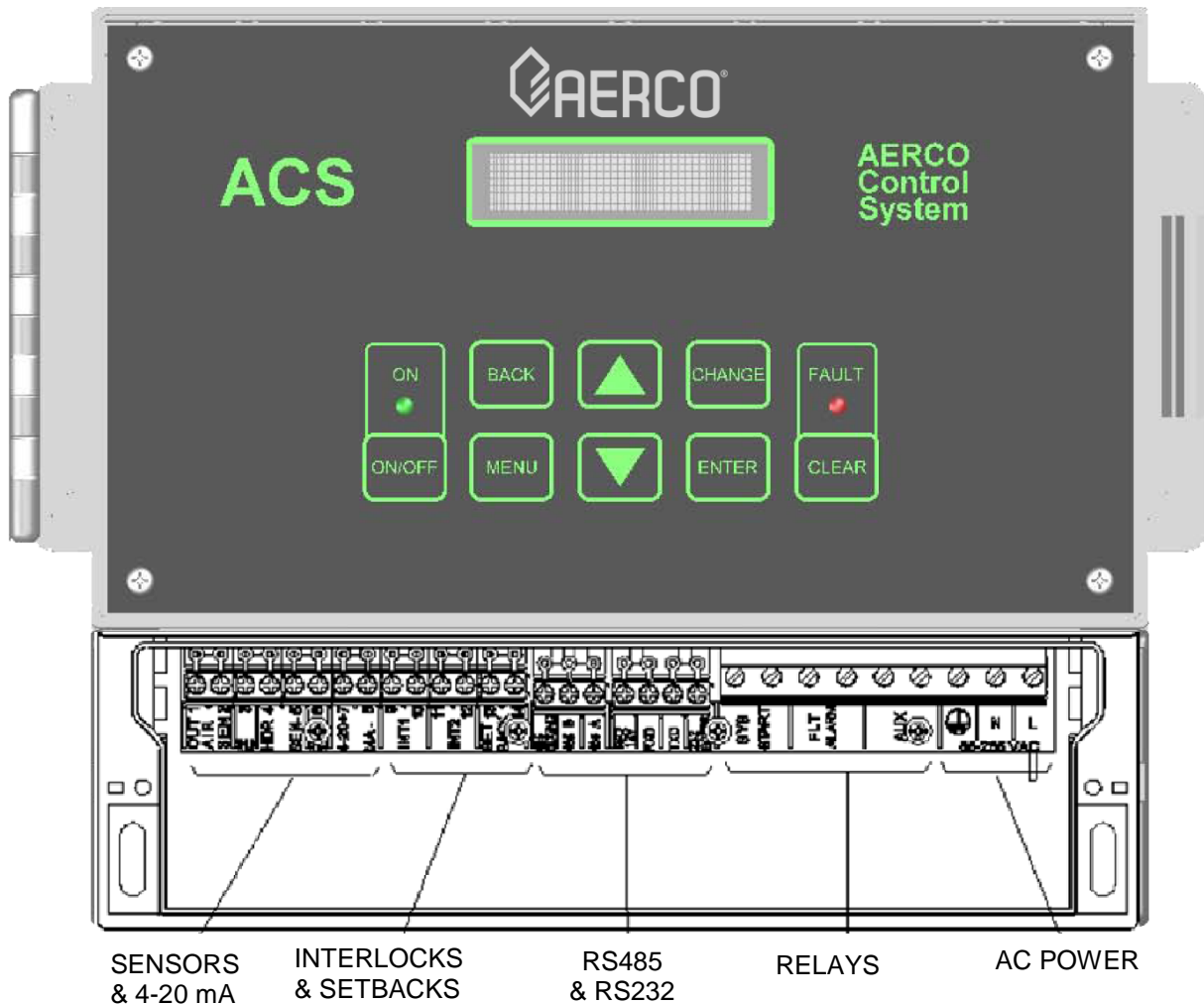
Figure 2-2: ACS with Wiring Compartment Cover Removed

2.5 SENSOR INSTALLATION AND WIRING

Two types of sensors may be installed, including a Header Sensor and an Outside Air Sensor. The Header Sensor is required for <u>all</u> modes of operation. The Outdoor Air Sensor is required for operation in the Outdoor Reset Mode. All Sensor wiring should be run separately from power wiring to avoid inducing electrical noise on the sensor wiring.

If desired, an optional Return Sensor may also be installed, which is the same type and part number as the Header Sensor, however it is only used for Plant DT limit operation and for monitoring purposes.

2.5.1 Header Sensor Installation

A Header Sensor Kit, (P/N 122790) is provided with the ACS. This Kit contains the Header Sensor (P/N 64038), a thermowell (P/N 122758) and some heat conductive grease which MUST be used with the Sensor. When installing the Sensor, use a 1/2 inch NPT tapped coupling or a 4 x 4 x 1/2 inch Tee fitting. Shielded pair, 18 AWG cable (Belden # 8760 or equiv.) is recommended for Header Sensor wiring. The Header Sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the boiler plant's supply water header. Install the Header Sensor as shown below:

NOTE

The Header Sensor is a thermistor type sensor. The Resistance vs. Temperature Chart for this sensor is provided in Appendix D. Length of Header Sensor wire leads should not exceed 600 feet.

<div style="border:1px solid blue">

Installing the Header Sensor

1. Refer to Figure 2-3 for the Header Sensor installation details.

2. Install the Header Sensor and Thermowell into the 1/2 inch NPT tapped coupling or a 4 x 4 x 1/2 inch Tee fitting using heat-conductive grease provided. This will aid in its response.

3. For proper response, ensure that the Header Sensor probe is inserted at least 2 inches into the water flow.

4. Using shielded pair cable (Belden #8760 or equiv.) connect the Header Sensor leads to HDR SEN terminals 4 and 5 on the ACS. There is no polarity to observe when making these connections.

5. Terminate the cable shield at SHLD terminal 3 of the ACS. DO NOT terminate the shield at the Sensor end of the cable.

</div>

2.5.2 Return Sensor Installation

The Return Sensor is required to activate the Plant Delta Temperature function, as described in section 3.9.14, on page 54.

As mentioned in paragraph 2.5, the Return Sensor is identical to the Header Sensor. Therefore, if a Return Sensor is being installed, another Header Sensor Kit (P/N 122790) is required. The Return Sensor should be installed in the boiler water return line within 3 feet of the first boiler in the boiler plant's return water line. The installation details shown in Figure 2-3 for the Header Sensor also apply to the Return Sensor. If used, install the Return Sensor as shown below:

<div style="border:1px solid blue">

Installing the Return Sensor

1. Refer to Figure 2-3 and install the Return Sensor and Thermowell into the 1/2 inch tapped coupling or Tee fitting using heat conductive grease.

2. Using shielded pair cable (Belden #8760 or equiv.), connect Return Sensor leads to terminals 6 and 5 on the ACS. There is no polarity to observe when making these connections.

3. Terminate the cable shield at SHLD terminal 3 of the ACS. DO NOT terminate the shield at the Sensor end of the cable.

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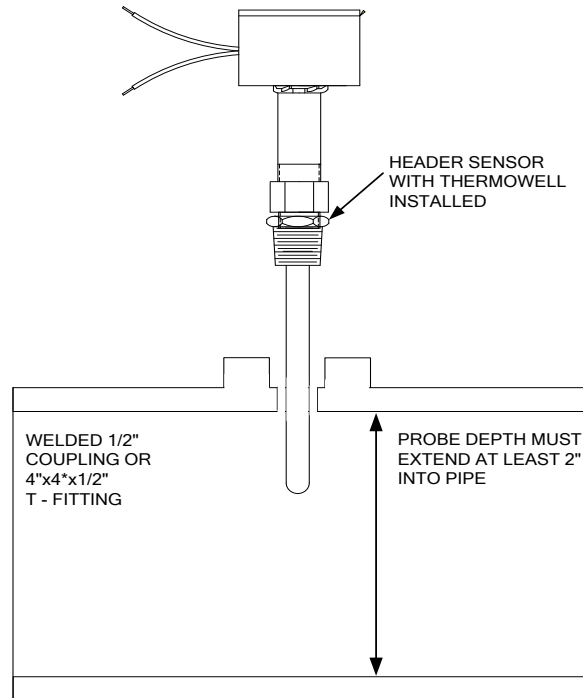
Figure 2-3: Header Sensor Installation Details

2.5.3 Outdoor Air Sensor Installation

The Outdoor Air Temperature Sensor (P/N GP-122662) is required when operating in the ACS in the Outdoor Reset Mode (paragraph 4.2). An Outdoor Air Sensor Kit (P/N GM-122781) is also available. This kit contains the Sensor (GP-122662) and a Mounting Bracket for wall mounting. The Outdoor Air Sensor should be mounted on the North side of the building, shielded from direct sunlight, and away from air intakes or outlets from the building. Shielded pair 18 AWG cable (Belden # 8760 or equiv.) is recommended for sensor wiring. The Outdoor Air Sensor can be mounted up to 600 feet from the ACS. See instructions below.

NOTE

The Outdoor Air Sensor is a thermistor type sensor. The Resistance vs. Temperature Chart for this sensor is provided in Appendix E. Length of Header Sensor wire leads should not exceed 600 feet.

Installing the Outdoor Air Sensor

1. Refer to Figure 2-4 for a typical Outdoor Air Sensor installation.

2. Attach the sensor to the mounting bracket and secure the bracket in a suitable location on the North side of the building.

3. Using shielded pair cable (Belden #8760 or equiv.), connect the two Sensor leads to terminals 1 and 2 on the ACS. There is no polarity to observe when connecting the sensor.

4. Terminate the cable shield at SHLD terminal 3 of the ACS. DO NOT terminate the shield at the Sensor end of the cable.

INSTALL SENSOR ON NORTH FACING
WALL OUT OF DIRECT SUNLIGHT AND
AWAY FROM ALL AIR INLETS/OUTLETS
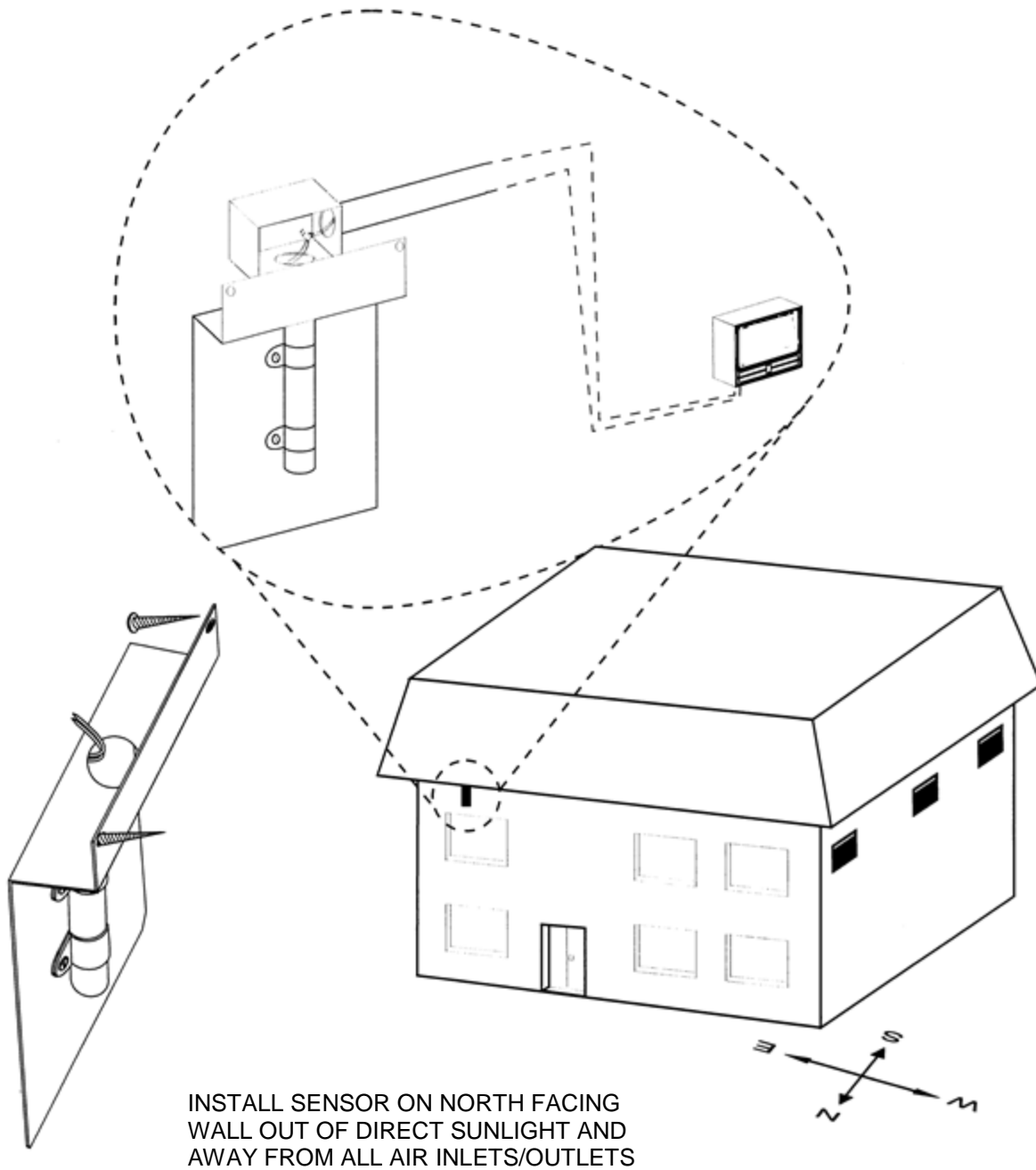
Figure 2-4: Outdoor Air Sensor Installation

2.6 RS485 (MODBUS) WIRING AT THE ACS

The ACS communicates with the AERCO Boilers over a RS485 network using Modbus protocol. All Modbus networks are implemented utilizing a Master/Slave scenario where only one device, the Master, can initiate a communication sequence. AERCO Boilers equipped with C-More or E8/BCM (Modulex) control systems can only function as Slaves on a Modbus network. However, the ACS can function as a Master controlling C-More or BCM Boiler Slaves, or as a Slave controlled by an Energy Management System (EMS) developed by other manufacturers. Additional information on implementing Modbus networks is provided in AERCO Modbus Communication Manual GF-114.

RS485 (Modbus) networks are wired in a "daisy chain" configuration similar to the example shown in Figure 2-5. Shielded twisted-pair, 18 – 24 AWG cable (Belden #9841, #3105A, #8760 or equiv.) is recommended for RS485 wiring connections.
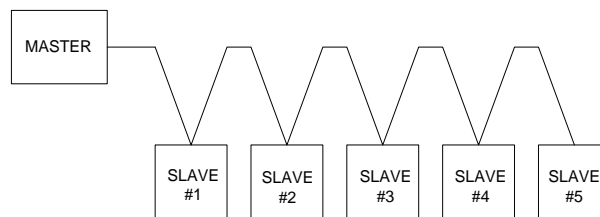
Figure 2-5: Typical Daisy-Chain Modbus/RS485 Network

At the ACS, RS485 (Modbus) wiring connections are made at the wiring terminals labeled 485 B+ and 485 A-. The cable shield is terminated at the SHLD terminal (3) of the ACS.

2.6.1 ACS Bias Switches & Loop Termination Resistors

Each ACS contains a built-in 120 ohm loop termination resistor and two bias DIP switches which are mounted on the lower portion of the motherboard (Figure 2-6). The 120 ohm termination resistor is always active and is designed to match the electrical impedance at the ACS end of the RS485 loop. Therefore, only one additional termination resistor will be required at the boiler end of the RS485 loop. The two bias switches are used to activate or deactivate bias voltage on the RS485 network and should be positioned as follows, depending on the type of AERCO boilers being used. See the instructions below:

NOTE

Refer to paragraph 2.7 for detailed instructions and illustrations describing how to implement loop termination, bias and wiring connections on the RS485 loop.

Positioning the Two Bias Switches

1. When wiring to Boiler Control Modules (BCMs) controlling Modulex Boilers, the ACS bias switches must be activated by placing them in the on (down or towards wall) position. Loop termination is accomplished by activating the termination resistor in the last BCM on the RS485 loop.

2. When wiring to C-More control systems (Benchmark & KC1000 Boilers), the positions of the ACS bias switches will depend on which one of the two available methods is used. Loop termination will also depend on the method employed. See **paragraph 2.7** for details.
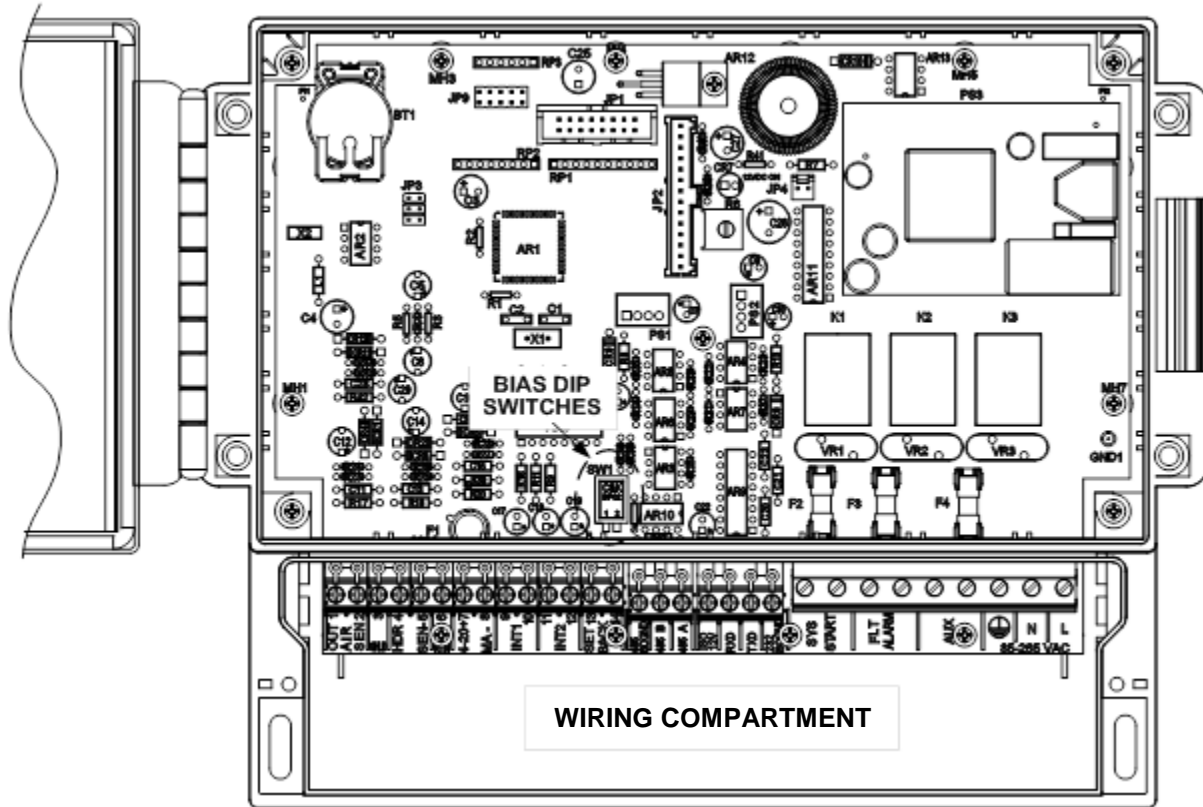
NOTE:
THE BIAS DIP SWITCHES CAN BE ACCESSED FROM
THE WIRING COMPARTMENT WITHOUT REMOVING
THE FRONT PANEL FROM THE UNIT.

Figure 2-6: Location of ACS DIP Switches

2.7 AERCO RS485 (MODBUS) WIRING, BIAS, AND TERMINATION

The RS485 wiring connections at the AERCO Boilers will depend on the type of AERCO Boilers and Control Systems being used on the Modbus Network. Benchmark Series and KC1000 Boilers currently utilize C-More Control Systems. Modulex Series Boilers utilize Boiler Control Modules (BCMs) with E8 Controllers.

2.7.1 RS485 Wiring, Bias, & Termination (BMK & KC1000 Boilers)

RS485 wiring connections are made at the RS485 terminals of each boiler's I/O Box (Figures 2-7 or 2-8). However, activating bias and loop termination can be performed using one of two available methods as described below in *Method A* and on the following page in *Method B*. Where possible, *Method B* is the preferred method.

Method A: For Method A, the bias switches in the ACS are left in the deactivated (up) position. Bias and termination are controlled at the boiler end of the RS485 loop by activating the bias and termination DIP switches on the PMC board of the last C-More Control Box on the daisy-chain. Refer to sheet 1 of Figure 2-7 (Benchmark), or Figure 2-8 (KC1000) and proceed as shown below:

AERCO BIAS/Loop Term: METHOD A

1. Using a daisy-chain wiring configuration, connect the RS485 positive lead to the RS485 **+** terminal in the I/O Box for each boiler.

2. Connect the RS485 negative lead to the RS485 **-** terminal in the I/O Box for each boiler.

3. DO NOT terminate the shields to the Ground (**GND**) terminal at the boiler end of the RS485 loop. Connect the shields of the incoming and outgoing leads together. The RS485 loop shield should only be terminated at terminal 3 of the ACS.

4. At the last boiler in the daisy-chain, activate the BIAS1, BIAS2 and TERM switches on the PMC board in the C-More Control Box. Refer to GF-114, paragraph 4.3.2 for detailed instructions on accessing the PMC board.

5. If an Oxygen Sensor is used, ensure that R1 DIP Switch is set to OFF (Disabled). Set it to ON (Enabled) if there is no Oxygen Sensor used.

6. DO NOT activate the bias switches on the ACS. These switches must be in the up position towards the operator when using Method 1.

NOTE

With Method A, the last C-More on the daisy chain must remain powered for the bus to be stable.

The advantage of using Method B is that the bias and termination of the RS485 loop do not require any changes to be made to the DIP switches on the PMC board in the last C-More Control Box. The bus is independent of any C-More control box.

Method B: For Method B, bias is controlled at the ACS by setting the two bias switches (Figure 2-6) to the active (down) position. Termination at the boiler end of RS485 loop is accomplished by activating the "MODBUS R6-ON" switch in the I/O Box in the last boiler on the daisy-chain. If this is an older box, install a 120 ohm, 1/2 Watt termination resistor in the I/O Box of the last boiler on the daisy-chain. Refer to sheet 2 of Figure 2-7 (Benchmark), or Figure 2-8 (KC1000) and proceed as shown below:

AERCO BIAS/Loop Term: METHOD B

1. Using a daisy-chain wiring configuration, connect the RS485 positive lead to the RS485 **+** terminal in the I/O Box for each boiler.

2. Connect the RS485 negative lead to the RS485 **-** terminal in the I/O Box for each boiler.

3. DO NOT terminate the shields to the Ground (**GND**) terminal at the boiler end of the RS485 loop. Connect the shields of the incoming and outgoing leads together. The RS485 loop shield should only be terminated at terminal 3 of the ACS.

4. At the last boiler in the daisy-chain, activate the "MODBUS R6-ON" dipswitch, or install a 120 ohm, 1/2 Watt termination resistor across the RS485 **+** and **-** terminals in the boiler's I/O Box.

5. When using Method 2, activate the two bias switches in the ACS (Figure 2-6) by placing them in the down or toward the wall position toward the wall.

ACTIVATE BIAS1, BIAS2 &
TERM DIP SWITCHES ON
PCM BOARD OF <u>LAST</u> C-
MORE CONTROL BOX

OPEN DOOR TO
ACCESS I/O BOX

BENCHMARK

DO NOT USE
THESE TERMINALS

RS485 CONNECTIONS
(SEE NOTE)

NOTE

...o not terminate the shields of the
...S485 leads to the ground (GND)
...rminal. The shields must be
...rminated at the source ends
...nly. Connect the shields of the
...coming and outgoing RS485
...ads together.
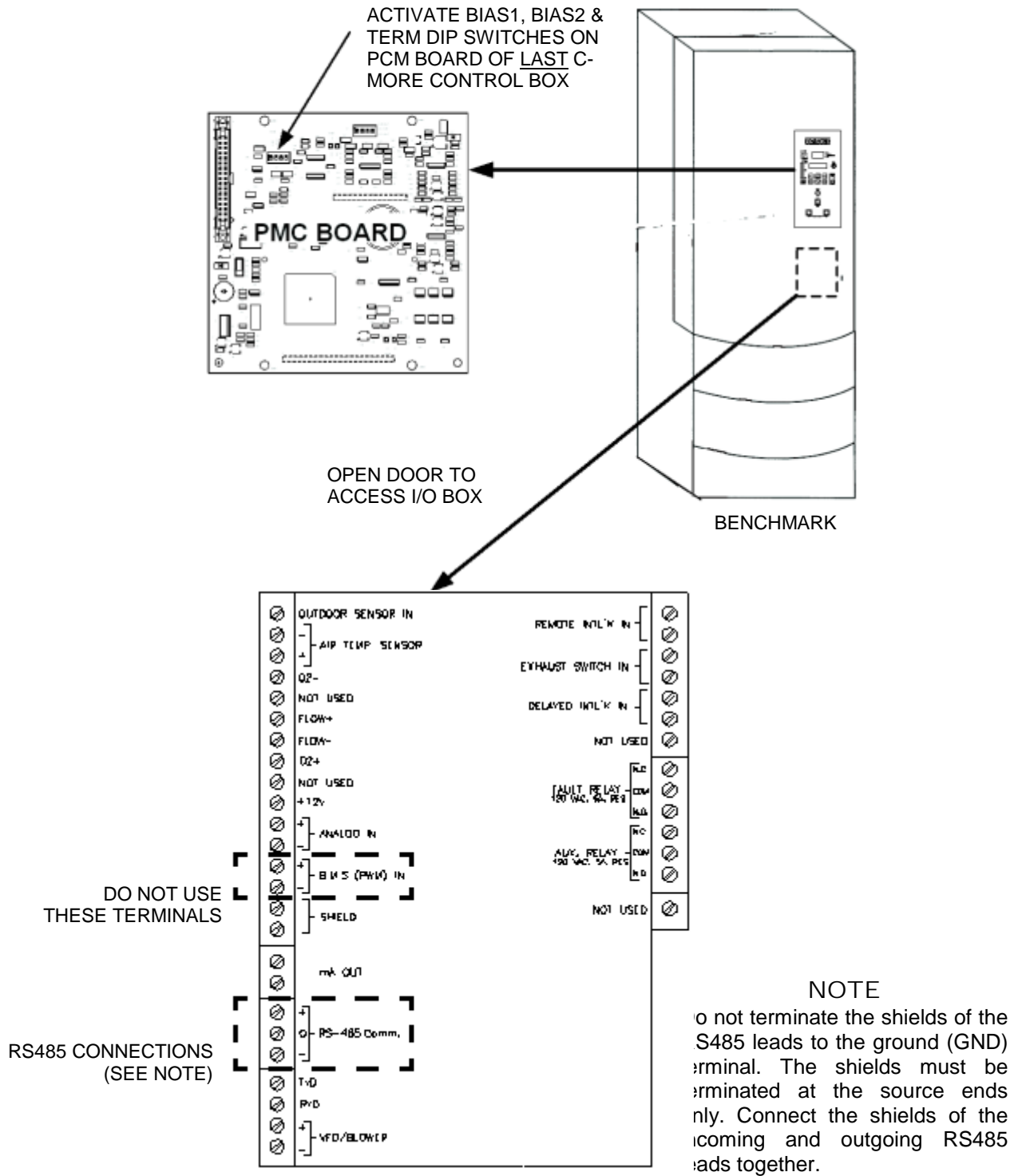
METHOD A – BIAS & TERMINATION ACTIVATED AT C-MORE PMC BOARD

Figure 2-7: RS485 (Modbus) Wiring For Benchmark Series Boilers (Sheet 1 of 2)

OPEN DOOR TO
ACCESS I/O BOX

BENCHMARK

I/O Board

DO NOT USE
THESE TERMINALS

RS485
CONNECTIONS
(SEE NOTE)

**Connect 120 OHM,
½ Watt resister
between + and −
RS485 terminals on
the LAST C-More
Box.**

NOTE

Do not terminate the shields of the RS485 leads to the ground (GND) terminal. The shields must be terminated at the source ends only. Connect the shields of the incoming and outgoing RS485 leads together.

METHOD B – TERMINATION ACTIVATED AT I/O BOX

Figure 2-7: RS485 (Modbus) Wiring For Benchmark Series Boilers (Sheet 2 of 2)

ACTIVATE BIAS1, BIAS2 & TERM
DIP SWITCHES ON PCM BOARD OF
<u>LAST</u> C-MORE CONTROL BOX

PMC BOARD

REMOVE SHEET METAL
COVER TO ACCESS I/O BOX

KC1000

I/O Board

DO NOT USE
THESE TERMINALS

RS485 CONNECTIONS
(SEE NOTE)

NOTE

Do not terminate the shields of the RS485 leads to the ground (GND) terminal. The shields must be terminated at the source ends only. Connect the shields of the incoming and outgoing RS485 leads together.

METHOD A – BIAS & TERMINATION ACTIVATED AT C-MORE PMC BOARD

Figure 2-8: RS485 (Modbus) Wiring For KC1000 Boilers (Sheet 1 of 2)

REMOVE SHEET METAL
COVER TO ACCESS I/O BOX

I/O Board

DO NOT USE
THESE TERMINALS

RS485
CONNECTIONS
(SEE NOTE)

**Connect 120 OHM,
½ Watt resister
between + and –
RS485 terminals on
the LAST C-More
Box.**

NOTE
Do not terminate the shields of the RS485 leads to the ground (GND) terminal. The shields must be terminated at the source ends only. Connect the shields of the incoming and outgoing RS485 leads together.
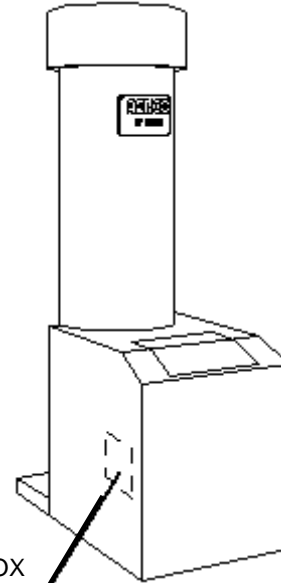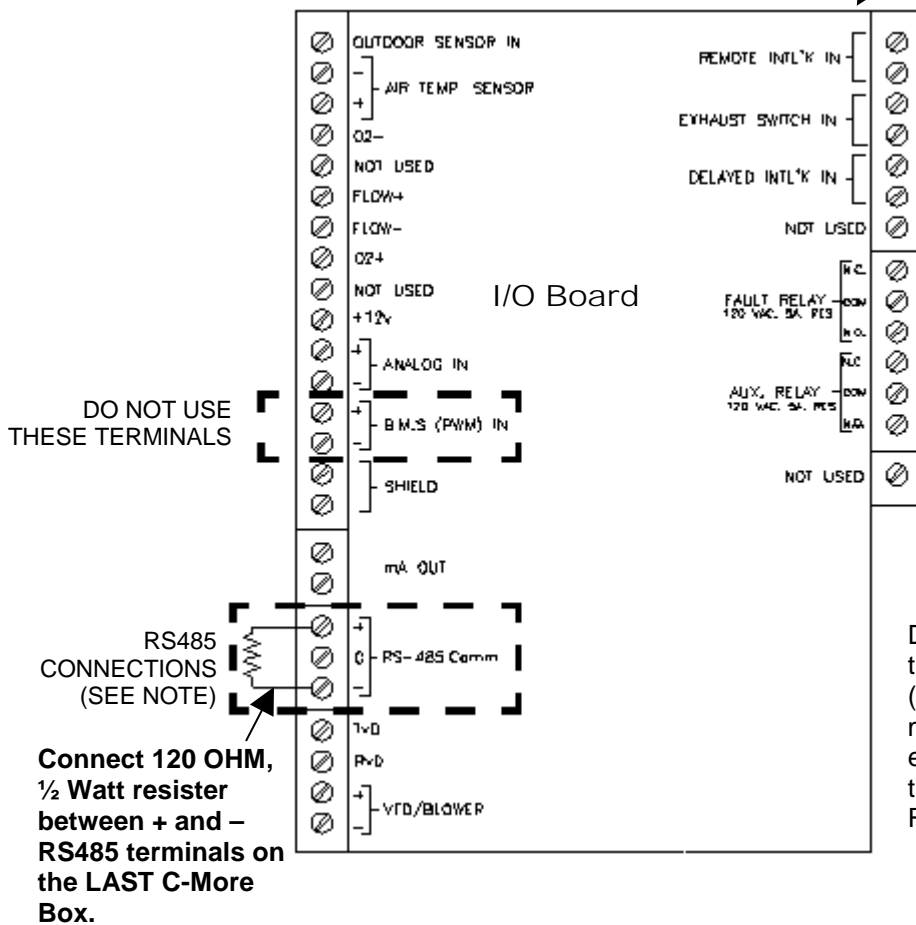
METHOD B – TERMINATION ACTIVATED AT I/O BOX

Figure 2-8: RS485 (Modbus) Wiring For KC1000 Boilers (Sheet 2 of 2)

2.7.2 RS485 Wiring for Modulex Series Boilers

RS485 wiring connections are made at the MODBUS terminals of each Boiler's BCM Module as shown in Figure 2-9. Connect the wiring as shown below:

RS485 Wiring at Boiler BCM of Modulex Boiler(s)

1. Connect the positive lead to terminal **1** (MODBUS B +) of connector Y2.

2. Connect the negative lead to terminal **2** (MODBUS A -) of connector Y2.

3. DO NOT terminate the shields at the Boiler end of the RS485 loop. Connect the shields of the incoming and outgoing leads together. The RS485 loop shield should only be terminated at the ACS.

4. The last BCM in the daisy-chain must have the termination jumper engaged as shown in **Figure 2-9**.

5. The two ACS bias switches (**Figure 2-6**) must be activated by placing them in the down position.

BCM FRONT VIEW
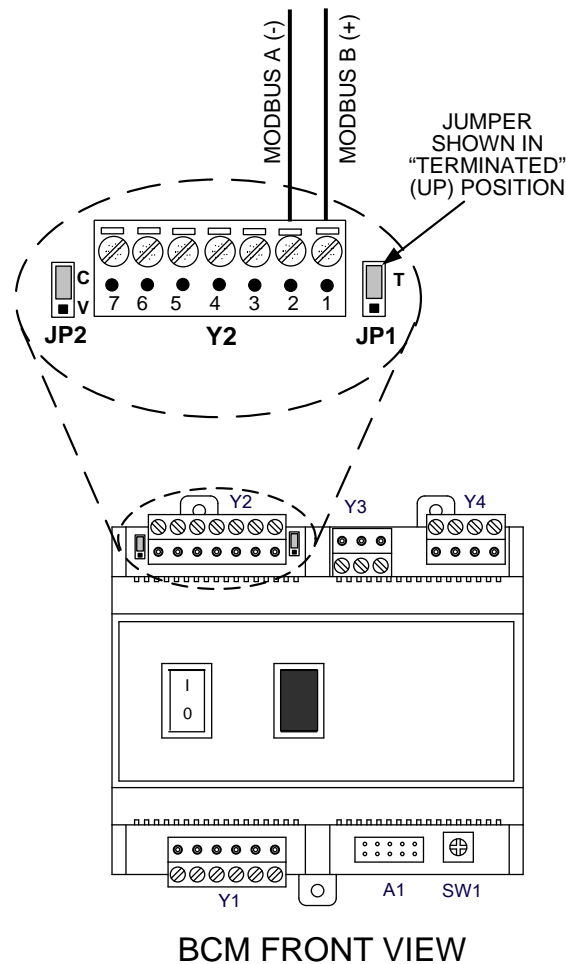
Figure 2-9: RS485 (Modbus) Wiring For Modulex Series Boilers

2.8 SAMPLE RS485 (MODBUS) NETWORK DIAGRAMS

Figure 2-10 shows a sample RS485 (Modbus) Network diagram with the ACS connected to KC1000 or Benchmark Series Boilers equipped with C-More Control Systems. Figure 2-11 shows a similar sample diagram with the ACS connected to Modulex Series Boilers equipped with BCMs and E8 Controllers.

NOTE

The last C-More slave on the RS485 loop must have its termination resister (TERM) and bias (BIAS1, BIAS2) DIP Switches turned on. Refer to Section 2.7 of this manual for details on activating bias and termination.
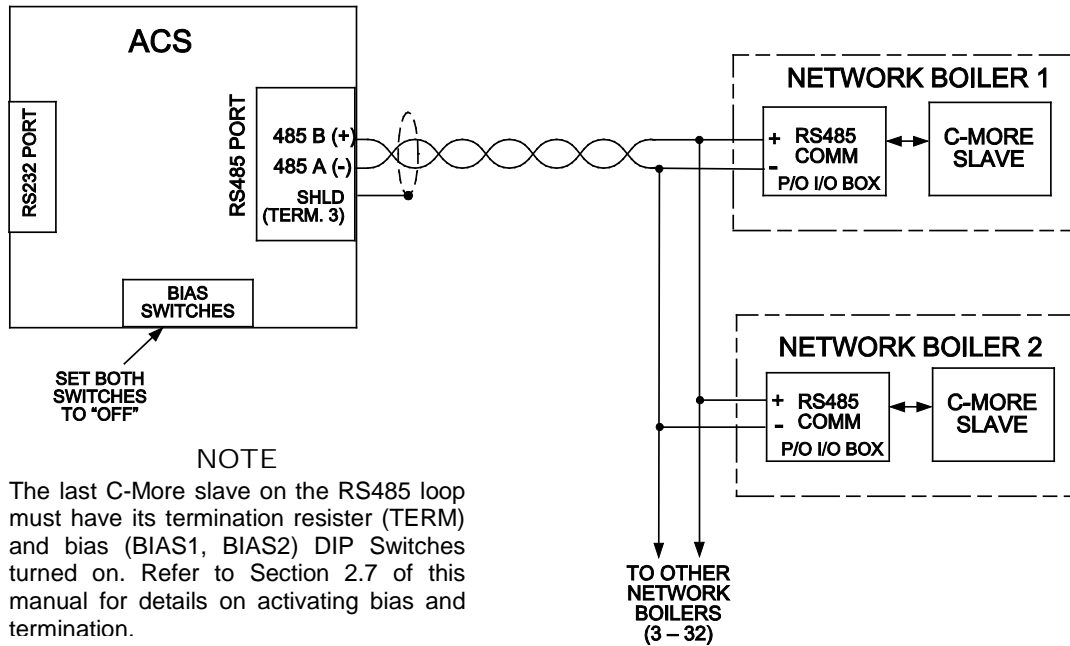
Figure 2-10: Sample RS485 (Modbus) Network For Benchmark or KC1000 Boilers

NOTE

The last BCM slave on the RS485 loop must have its termination resister (T) activated. Refer to GF-115C for more information.

The bias switches in the ACS should both be turned to "ON"
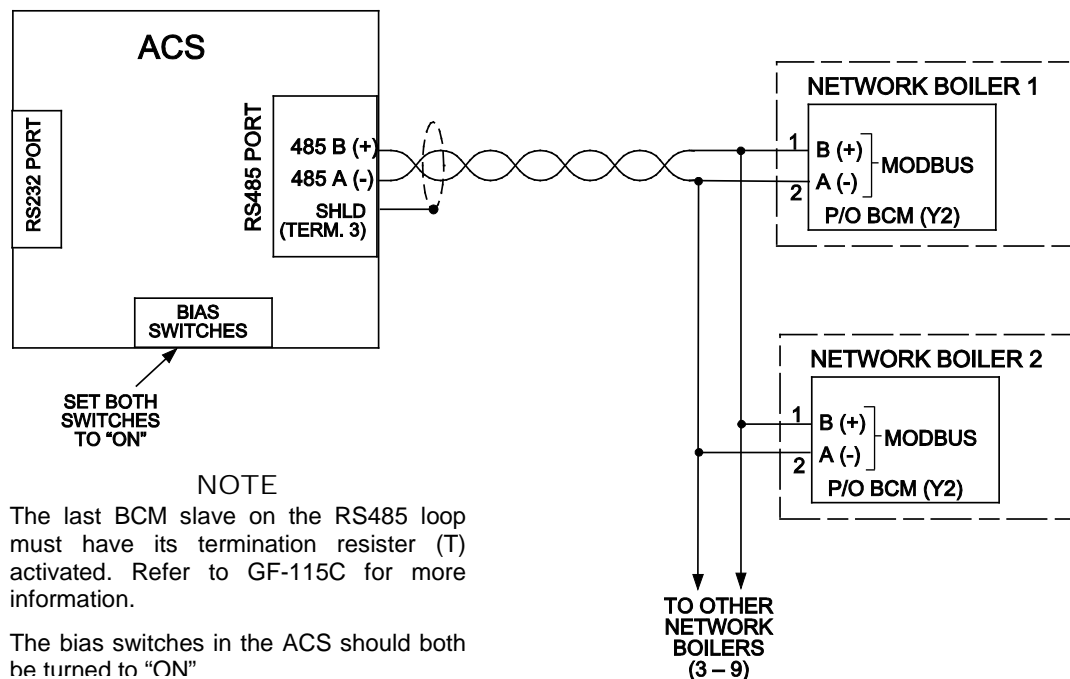
Figure 2-11: Sample RS485 (Modbus) Network For Modulex Series Boilers

2.9 RS485 WIRING AT THE ACS

The ACS communicates with an external Energy Management System (EMS) or Building Automation System (BAS) utilizing the wiring terminals labeled RXD (Receive Data), TXD (Transmit Data) and 232 ISO GND (Isolated Ground). If the EMS does not contain an RS232 port, a RS485-to-RS232 Converter (AERCO P/N 124943) is required to communicate with the ACS. If a Converter is required, it can be installed inside the wiring compartment of the ACS, or installed externally. The ACS provides an isolated 12 VDC output terminal (ISO 12V) which can be used to power AERCO's RS485-to-RS232 Converter if needed. Refer to Figure 2-12 for sample network layouts.
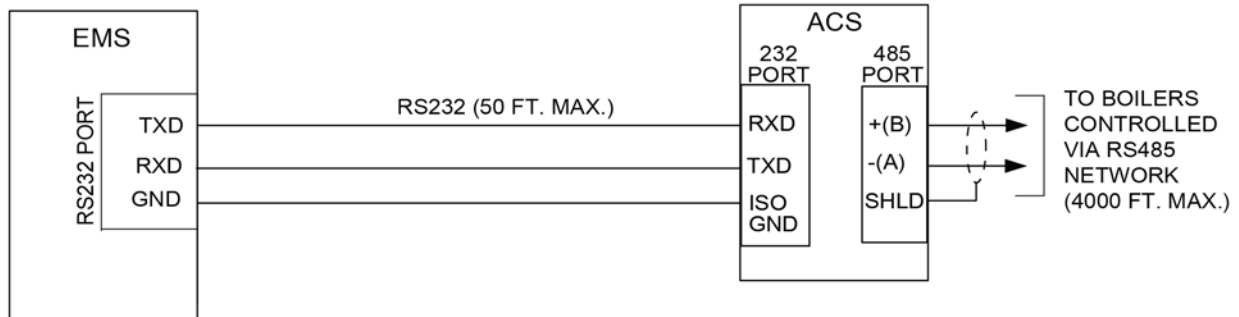
EMS WITH RS232 PORT
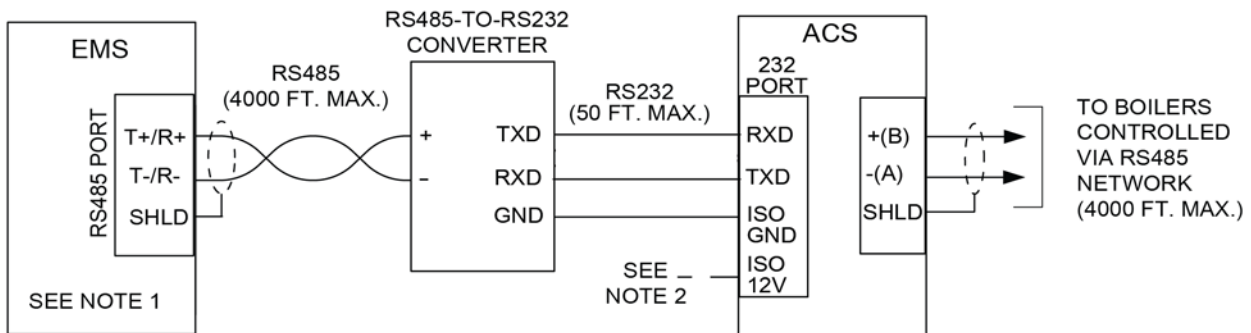
NOTES:

1. IF THE EMS CONTAINS A 4-WIRE RS485 PORT, SEE DETAIL "A".

2. THE BMS II PROVIDES A 12V OUTPUT IF NEEDED TO POWER THE RS485-TO-RS232 CONVERTER.
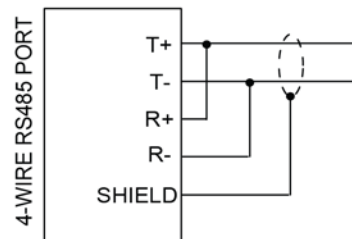
DETAIL "A"

EMS WITH ONLY RS485 PORT

Figure 2-12: Sample Network Connections to EMS

2.10 INTERLOCK WIRING

The ACS is equipped with two interlocks designated Interlock 1 (INT 1) and Interlock 2 (INT 2). Since both interlocks must be closed for the ACS to operate the boiler plant, the associated wiring terminals are jumpered, prior to shipment. If desired, proving device switches can be connected to <u>either</u> interlock in place of the jumper. If used, interlock wiring connections are made as described in the following paragraphs.

CAUTION!

DO NOT remove the factory-installed jumpers for INT1 or INT2 unless the respective Interlock is being connected to an external proving device. The boiler plant WILL NOT operate if one or both Interlocks remain open.

NOTES

- If necessary, Interlock 1, Interlock 2 or both can be programmed to operate the boilers only when the outdoor air temperature falls below the system start temperature. The selection is made with "SYS START INTLK" in the Relay Menu. The default is set to Interlock 1. See paragraph 3.11 for details.

- NO power should be sent to the INT1, INT2, and SETBK terminals. Only a dry contact may be applied.

2.10.1 Interlock 1 (INT 1) Wiring

Interlock 1 is often used with auxiliary equipment, such as air dampers or flow switches. It can also be used as a general purpose interlock. If used, connect the end proving switch to INT 1 terminals 9 and 10 as shown in wiring diagram in Appendix E.

2.10.2 Interlock 2 (INT 2) Wiring

Similar to Interlock 1, Interlock 2 is a general purpose interlock which can be used with a variety of devices or equipment or conditions that must be "proved" prior to enabling the boiler plant. If used, connect the end proving switch to INT 2 terminals 11 and 12 as shown in wiring diagram in Appendix E.

2.11 SETBACK WIRING

The SET BACK terminals, shown in the wiring diagram in Appendix E, are used only when implementing a manually-controlled header temperature offset. If used, connect a dry contact switch across SET BACK terminals 13 and 14. See the sub-section entitled Manual Offset included in paragraph 3.8 (Field Adjust Menu),

2.12 RELAY WIRING

The ACS contains a System Start (SYS START) Relay, a Fault Alarm (FLT ALARM) Relay and an Auxiliary (AUX) Relay which can be connected to external monitoring or control devices. The contacts for each of these relays are rated at 120 VAC, 5A and are fused internally at 5A with replaceable fuses. The contact terminals for these relays are shown in the wiring diagram in Appendix E.

NOTE
The state of the SYS START, FLT ALARM and AUX Relays are controlled by options contained in the Relay Menu described in Chapter 3, paragraph 3.11.

2.12.1 System Start Relay

The state of the System Start (SYS START) relay contacts are controlled by the value set for the SYS START TEMP and SYS START OPTION in the Relay Menu. The contacts are closed either when the outdoor air temperature is less than the System Start Temperature (SYS START TEMP) or when there is a load, or both. The default value for this temperature setting is 70°F. See paragraph 4.5 for additional information.

2.12.2 Fault Alarm Relay

The state of the Fault Alarm (FLT ALARM) relay contacts are controlled by the option selected for the FAULT ALRM RELAY, FAULT ALARM BLR and FAULT ALRM CLEAR in the Relay Menu. Contact closure can be set to: ALL FAULTS, NO INTERLOCK, INTERLOCK 2 or INTERLOCK 1. The default for this option is ALL FAULTS.

2.12.3 Auxiliary Relay

The state of the Auxiliary (AUX) relay contacts are controlled by the AUX RELAY CLOSE and AUX RELAY OPEN options selected in the Relay Menu. Contact closure can be set to occur either when all available boilers are at the 100% Fire Rate or for either when all boilers are at 100% Fire Rate or no boilers are available (all boilers faulted or turned off).

2.13 4-20 MA WIRING

The ACS can accept a remote 4 – 20 mA current signal representing a setpoint. This input is fused internally at 0.63A. Connect the signal leads to the 4-20 + and 4–20 – terminals. Refer to Chapter 4, paragraph 4.3 for Remote Setpoint programming using a 4 -20 mA input.

2.14 MOUNTING & WIRING THE OPTIONAL ACS RELAY BOX

The ACS (AERCO Control System) Relay Panel is used in combination with the ACS to control up to 2 isolation valves, boiler interlocks, and a Domestic Hot Water (DHW) pump in a Combination heating plant where AERCO boilers are bring used for both Building Heat and Domestic Hot Water heating.
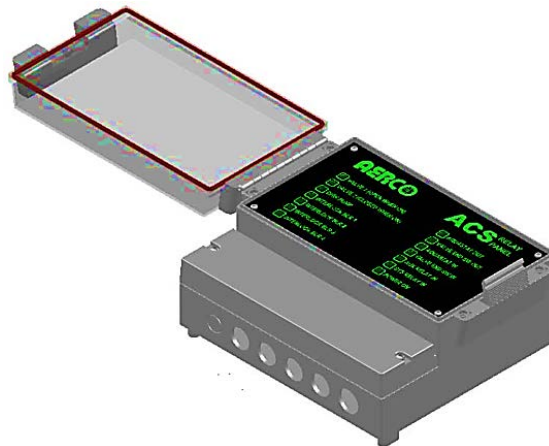
Figure 2-13: AERCO Control System (ACS) Relay Box

11/22/2017
OMM-0081_0F

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Page **33** of **139**
GF-131

2.15 RELAY PANEL INSTALLATION AND WIRING

The ACS Relay Panel should be installed on a wall next to or as near as possible to the ACS. The enclosure is the same as the ACS and so similar hardware can be used. See Section 2.2, "Site Selection and Mounting" for further installation information.
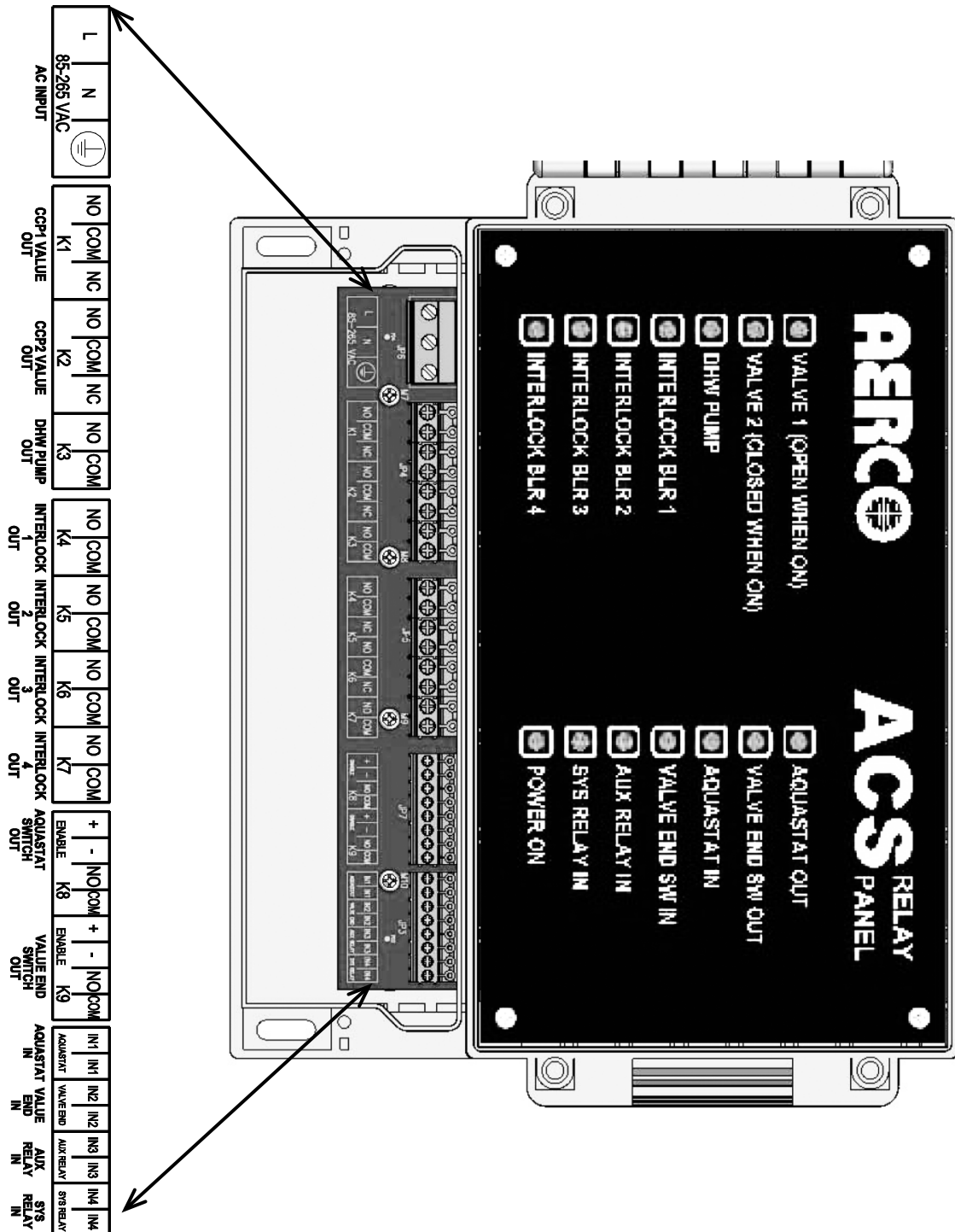
Figure 2-14: AERCO Control System (ACS) Relay Box with Wiring Cover Removed and Breakout Illustration of Connection Silk-Screening

Page **34** of **139**
GF-131

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11/22/2017
OMM-0081_0F

Figure 2-14a shows sample wiring diagram of the relay box wiring and Figure 2-14b shows the wiring to the ACS unit for a two-valve combination system. Your actual wiring may vary depending on the type of valves being used:

Relay Box (for ACS)
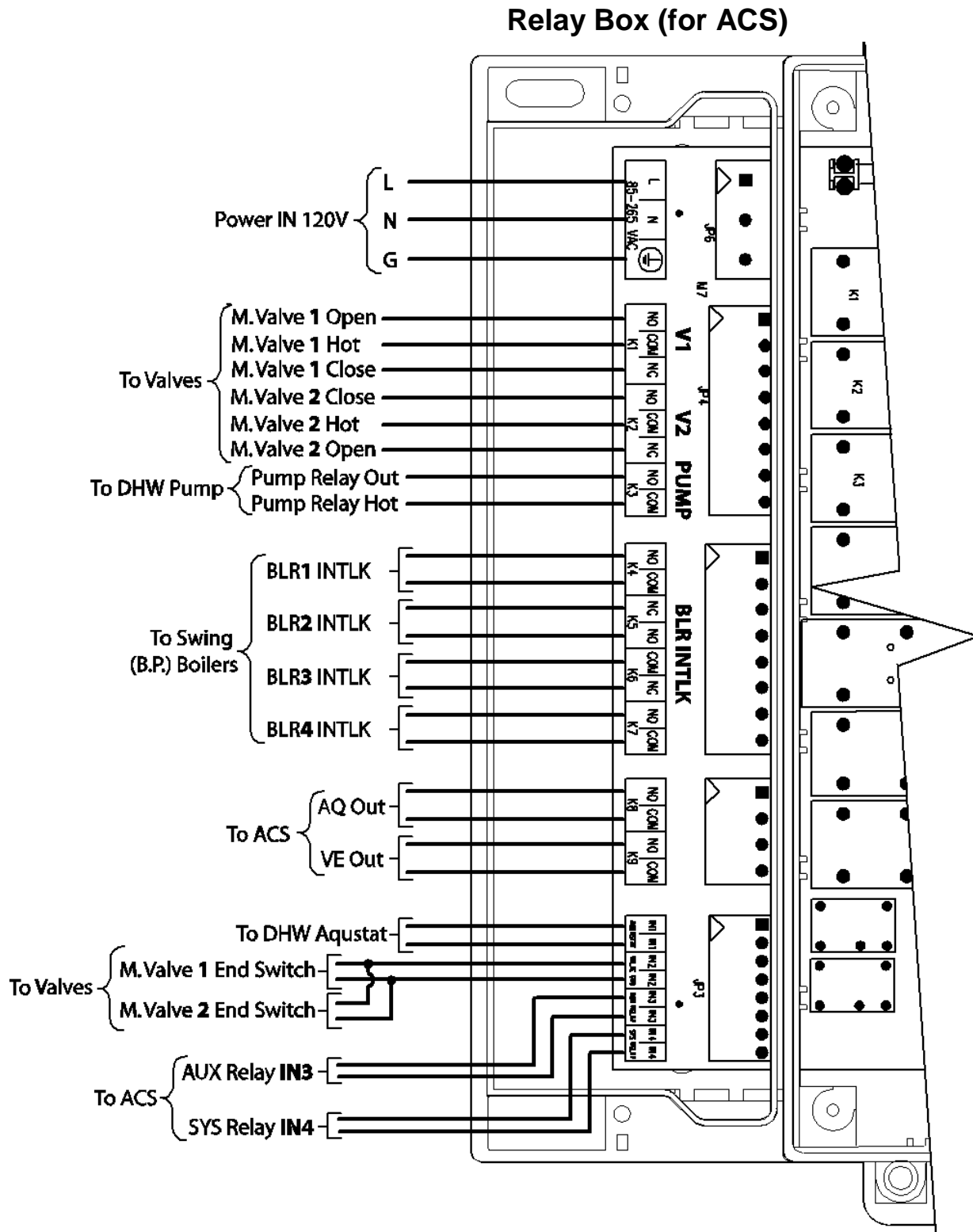
Figure 2-14a: Wiring of the Relay Box (to the AERCO Control System (ACS)
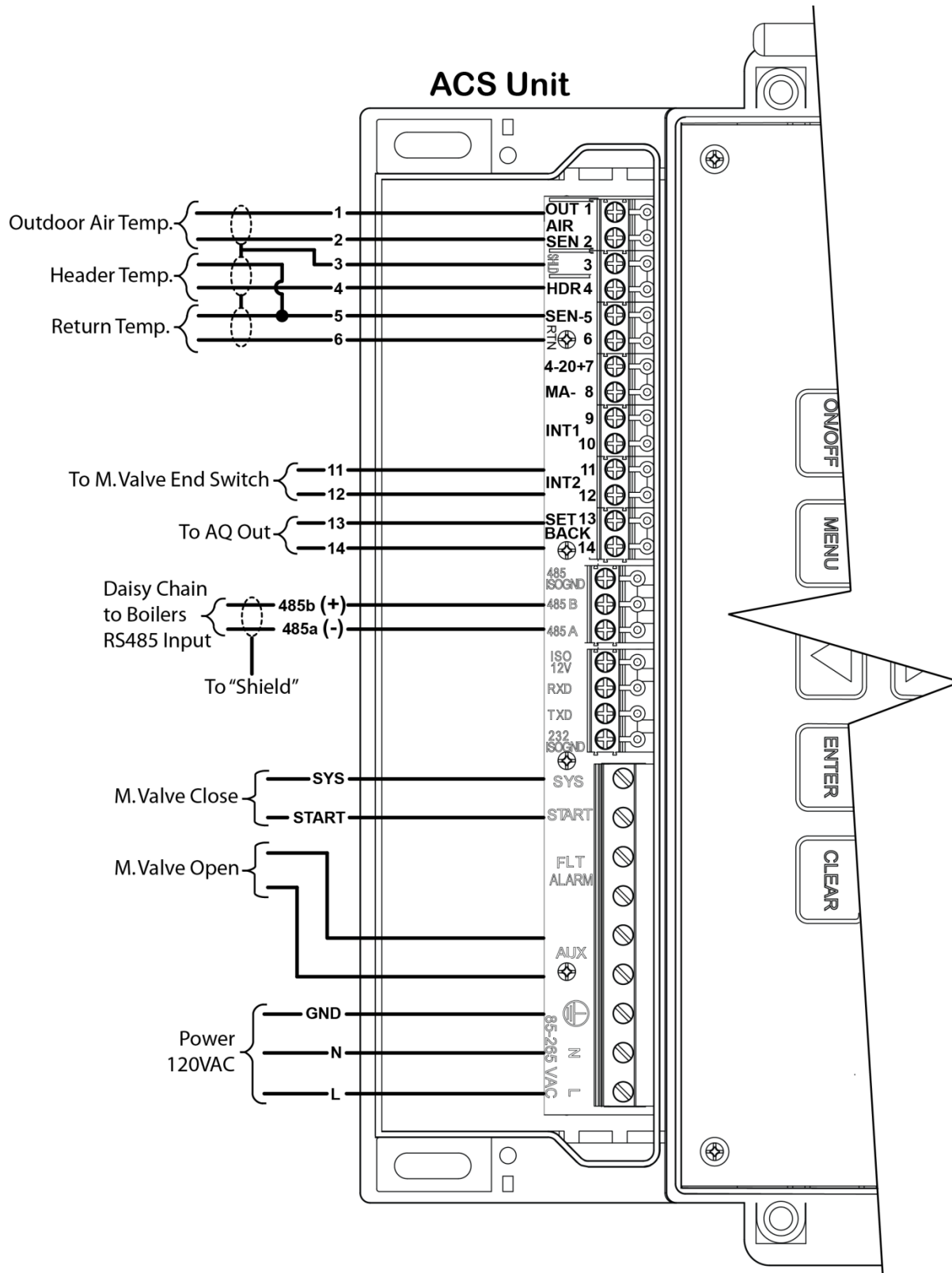
Figure 2-14b: ACS Wiring: DHW Option 1
(DHW Pump Enabled/Disabled by Building Controls)

ACS Unit
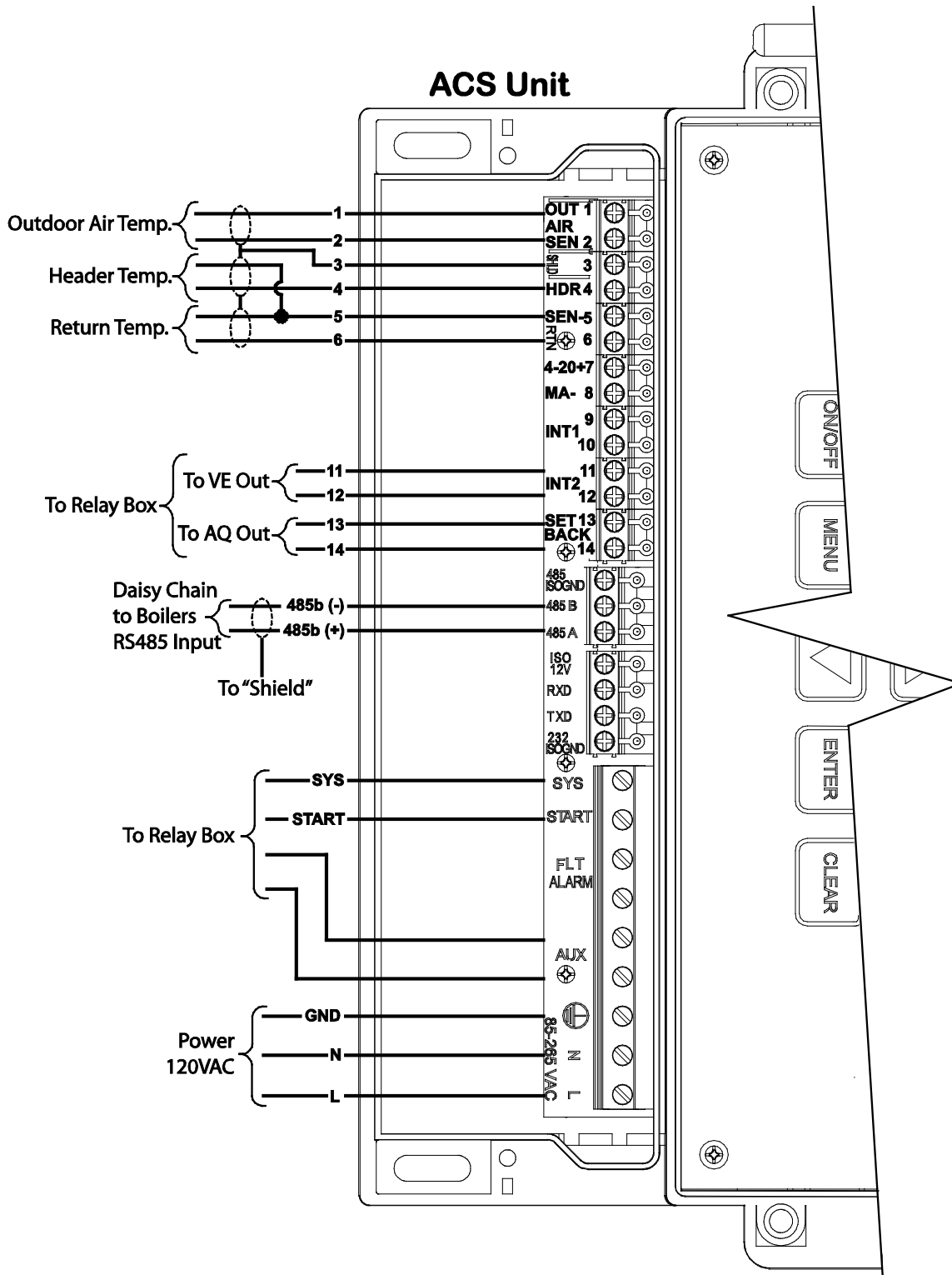
Figure 2-14c: ACS Wiring: DHW Option 2
(DHW Pump Enabled/Disabled by ACS)

ACS Unit

Outdoor Air Temp. — 1 — OUT 1
— 2 — AIR SEN 2
Header Temp. — 3 — 3
— 4 — HDR 4
Return Temp. — 5 — SEN-5
— 6 — RTN 6

4-20+7
MA- 8
9
INT1 10
To AQ Out — 11 — 11
— 12 — INT2 12
SET 13
BACK 14

Daisy Chain to Boilers RS485 Input — 485b (-) — 485 ISOGND
— 485 B
485b (+) — 485 A

To "Shield"

ISO 12V
RXD
TXD
232 ISOGND

SYS
START
FLT ALARM
AUX

Power 120VAC — GND / N / L — 85-265 VAC

ON/OFF
MENU
ENTER
CLEAR
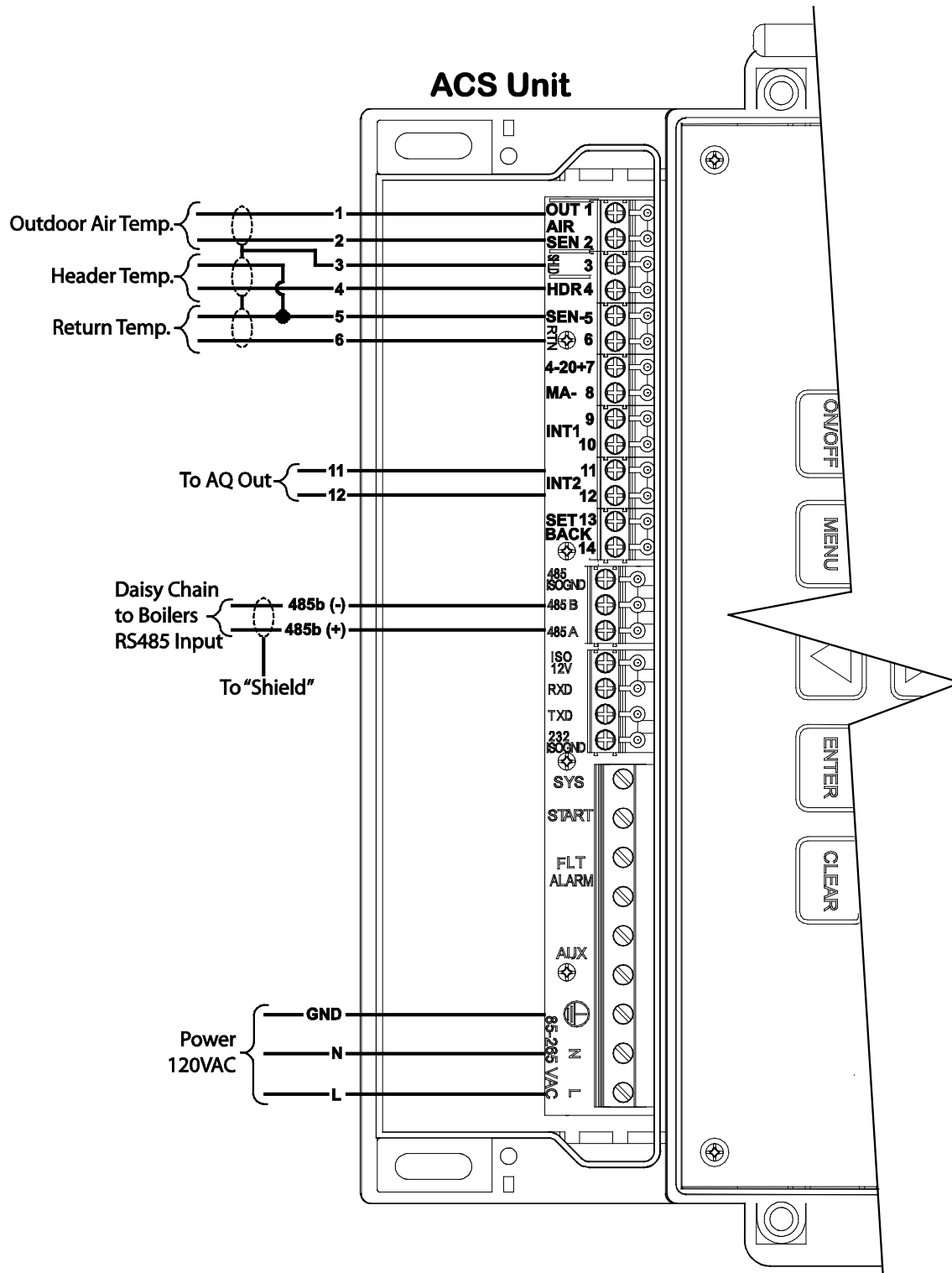
Figure 2-14d: ACS Wiring: DHW Option 3

2.16 RELAY PANEL COMPONENTS

2.16.1 Power

The power connector is located at the left side of the wiring panel. It uses single phase AC power from 110 to 240 VAC, 60 Hertz.

2.16.2 Inputs

The inputs are all dry switch (digital) inputs.   The specifics are below:

- **Aquastat In (Temperature) Switch**
  This switch input comes from the aquastat temperature switch located in the DWH storage tank. The switch should have at least a 3 degree hysteresis or deadband.

- **Valve End Switch In 1 & 2**
  These switch inputs come from the end switches of Valve 1 and Valve 2, respectively. The valve end switches should close when the valves are completely open.

- **Aux Relay Contact In**
  This switch input comes from the dry contact "Aux Relay" output of the ACS.

- **Sys Relay Contact In**
  This switch input comes from the dry contact "Sys Relay" output of the ACS.

2.16.3 Outputs

The relay outputs are all dry contact and can switch up to 5A at 120VAC, or ?240 VAC. The switch outputs connect directly to the ACS and are all dry contacts. The specifics are below:

- **DHW Pump Relay**
  This SPST relay is used to activate a DHW pump when the DHW Aquastat is calling for heat. When the Aquastat stops calling, the relay will remain activated for 1 minute before turning off.

- **Valve I Relay**
  This SPDT relay controls the valve between the Building Priority boilers and the DHW Priority boilers. The Normally Open (N.O.) contact is connected to the Valve 1 Open and the Normally Closed (N.C.) contact is connected to the Valve 1 Close input. For a valve with "spring return open" or "capacitor return open", the N.O. contact would not be used.

- **Valve 2 Relay**
  This SPDT relay controls the valve between the Building boilers and the Building Priority boilers. The Normally Open (N.O.) contact is connected to the Valve 2 Close and the Normally Closed (N.C.) contact is connected to the Valve 2 Open input. For a valve with "spring return open" or "capacitor return open", the N.C. contact would not be used.

- **4 Relay**
  These are 4 SPST relays used to enable or disable the Building Priority boilers in this 2-valve system.

- **Aquastat Switch Out**
  This SPST contact connects to the "Setback" input of the ACS.

- **Valve End Switch Out**
  This SPST contact connects to the "Interlock 1" input of the ACS.

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Page **39** of **139**
GF-131

2.17 RELAY PANEL OPERATION
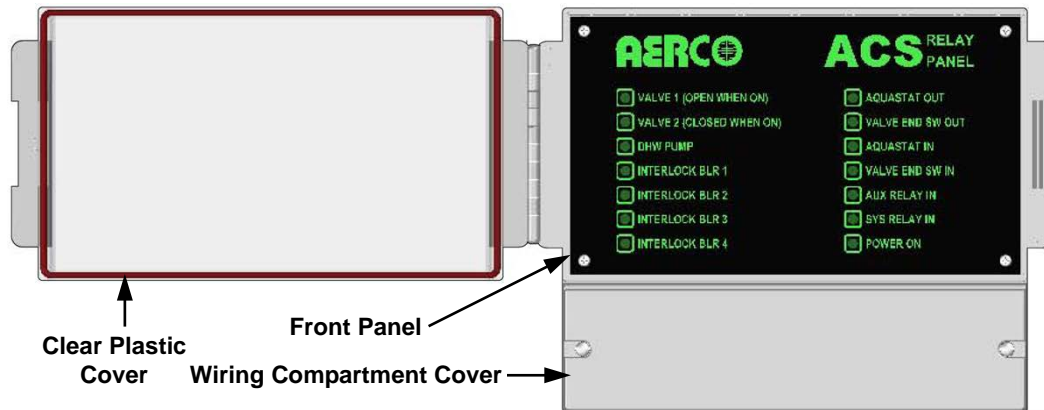
Figure 2-15: ACS Relay Panel Front Panel

The board operates basically as follows:

Relay Panel Operation

a) In the normal idle state, all the inputs, except one of the Valve End Switch In inputs, would be open. As a result, the Aquastat Out would be open and the Valve End Switch Out would be closed. All the relays except the Interlocks Relay will be in their unpowered state – DHW Pump off, Valve 1 closed(N.C. powered), and Valve 2 open (N.C. powered). Since the Valve End Switch Output would be activated, all the Interlocks relays will be activated and all its contacts closed thereby enabling the Building Priority boilers to run if needed.

NOTE
If no Valve 2 (Sys Relay) is used, the Interlocks Relay connection will not need to be used.

b) When the tank calls for heat and the Aquastat Input closes, the DHW Pump relay will activate. The ACS will activate Valve 1 to close if it is not already closed. Once closed the ACS will allow the DHW Priority boilers to run to provide heat to the tank.

If all the DHW Priority boilers are running at 100% for more than 2 minutes, the ACS will open Valve 1 and close Valve 2 and activate the Building Priority boilers to help with DHW heating.

When the Aquastat Input opens, the DHW Pump will turn off after some time delay (currently 60 seconds). The DHW Priority boilers will also shut down and Valve 1 will close and Valve 2 open.

c) Generally if any of the two valves is fully open and its Valve End Switch Input closes, the Interlock relays will activate to allow the Building Priority boilers to run. When the Valve End Switch Input opens, the Interlock relays will de-activate.

d) The Valve 1 Relay output is labeled such that the Normally Closed (N.C.) contact is Valve 1 Close and the Normally Open (N.O.) contact is Valve 1 Open. The Valve 2 Relay output is labeled such that the Normally Closed (N.C.) contact is Valve 2 Open and the Normally Open (N.O.) contact is Valve 2 Close. It is important to make these connections correctly. In this way, the unpowered state of the relay panel will keep the valves in the default state with Valve 1 closed and Valve 2 open.

2.18 ACS PROGRAMMING FOR USE WITH THE ACS RELAY PANEL

The AERCO CONTROL SYSTEM (ACS) can be programmed for 3 different types of DHW options. For "Option 1" and "Option 3" operation, the ACS Relay Panel is not needed. However, it is needed for Option 2 operation.

Below we will illustrate programming the ACS for a total of 8 boilers with 2 DHW Priority boilers, 2 Building Priority boilers, and the rest Building boilers. Valve 1 is in the boiler outlet header between the Building Priority boilers and the DHW Priority boilers. Valve 2 is in the boiler outlet header between the Building boilers and the Building Priority boilers. Program the ACS as follows:

2.18.1 RS485 Menu Settings for Relay Panel Programming

RS485 Menu Settings for Relay Panel Programming

1. In the RS485 Menu be sure to include all the boilers being controlled via Modbus in the "NUMBER NETWK BLRS" number.

2. When programming "NETW BOILER XX ADDRESS" include the number of DHW Priority boilers and Building Priority boilers at the end of the addresses up to "NETW BOILER 32 ADDRESS". For our example, you would program them as follows:

   - **Building boilers would be programmed at NETW BOILER 1 ADDRESS, NETW BOILER 2 ADDRESS, NETW BOILER 3 ADDRESS, and NETW BOILER 4 ADDRESS.**

   - **Building Priority boilers would be programmed at NETW BOILER 29 ADDRESS and NETW BOILER 30 ADDRESS.**

   - **DHW Priority boilers would be programmed at NETW BOILER 31 ADDRESS and NETW BOILER 32 ADDRESS.**

2.18.2 Configuration Menu - Relay Panel Settings

Configuration Menu Settings for Relay Panel Programming

1. For "DHW OPTION" select OPTION 2. This will trigger other sub-menus to appear.

2. Set "NUMBER DHW BLRS" to 4 to indicate that our system will have 4 boilers that can be used to help with DHW heating – 2 Building Priority and 2 DHW Priority.

3. Set "DHW SIGNAL" to the signal the C-more requires to do DHW heating when it is set for Combination mode. Currently it is "No Signal".

4. Set "Valve Wait State" to the state in which you want the DHW boilers to remain while the valve is opening. If "Off" is selected, they will be commanded to shut down, if they were running. If "On" is selected and any were fired, they will remain fired while the valve is opening as long as the Valve End Switch is made within the "Valve Wait Time"(with a default of 120 seconds). Of course if the boiler interlocks are opened during this time, the boilers will shut down.

5. Set "NUM DHW PRIORITY" to 2 to indicate that 2 of the boilers are DHW Priority boilers. The rest will be assumed to be Building Priority boilers.

The steps above will program the ACS to operate with the ACS Relay Panel. You would adjust

the number of boilers to your particular system.

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Page **42** of **139**

GF-131

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11/22/2017

OMM-0081_0F

CHAPTER 3: OPERATION

3.1 INTRODUCTION

The information in this Chapter provides a guide to the operation of the ACS using the controls and display mounted on the front panel of the unit. This Chapter describes the basic procedure to navigate through the extensive array of menus and options incorporated in the ACS design. Descriptions for all menus and options are also provided.

3.2 FRONT PANEL OPERATING CONTROLS AND DISPLAYS

The front panel of the ACS contains an vacuum fluorescent display (VFD) and an 8-key touch-pad. The display and controls are illustrated and described in **Figure 3-1** and **Table 3-1** respectively.
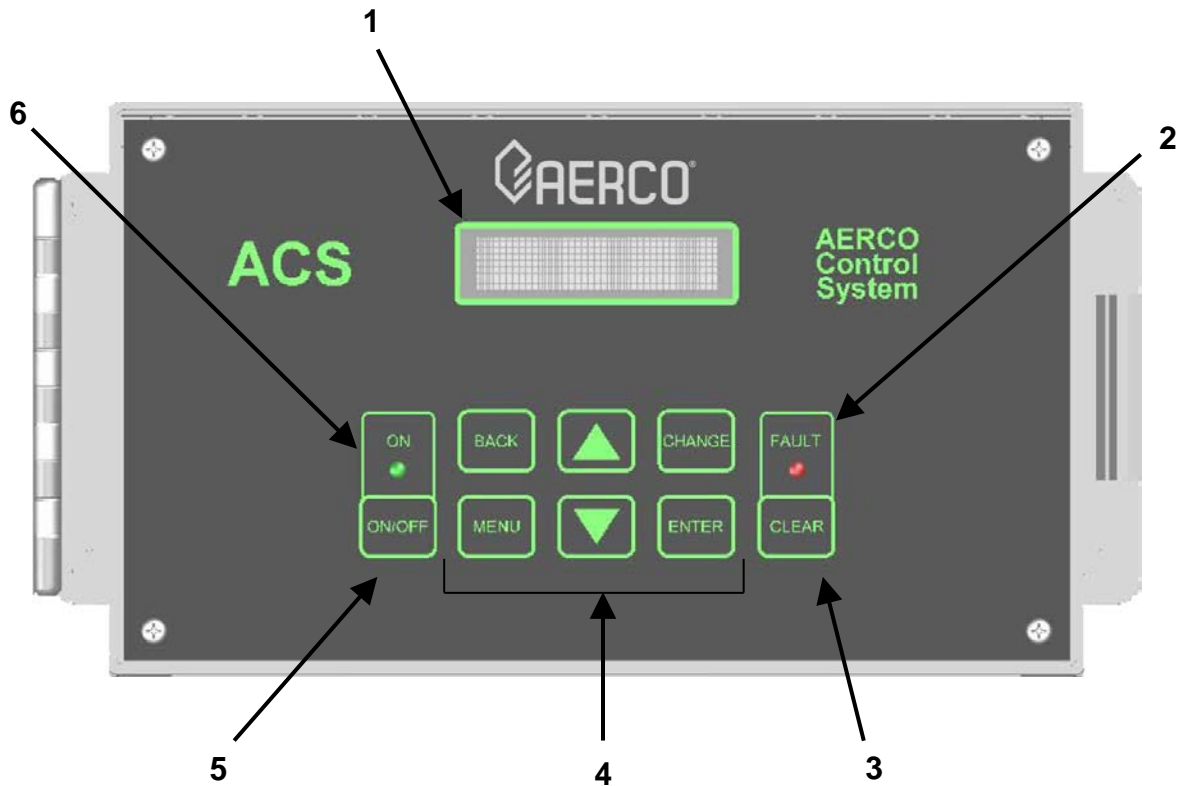
Figure 3-1: ACS Front Panel Controls and Displays

TABLE 3-1: ACS Front Panel Controls and Display		
Item#	**Features**	**Functions**
1	VFD Display	The Vacuum Fluorescent Display (VFD) display consists of 2 lines each capable of displaying up to 16 alphanumeric characters. The information displayed includes: • Startup Messages • Alarm Messages • Operating Status Messages • Menu Selections
2	**FAULT** Indicator	Red **FAULT** LED indicator lights when a ACS alarm condition occurs. An alarm message will also appear in the VFD display.
3	**CLEAR** Key	Turns off the **FAULT** indicator and relay if FAULT ALRM CLEAR is set to Manual and the fault is still active or no longer active. If FAULT ALRM CLEAR is set to Automatic and the fault is still active, this will also turn off the fault relay and indicator. In both cases the alarm message will remain until the alarm is no longer valid.
4	**MENU Keypad** Consists of 6 keys which provide the following functions for the ACS menus:	
	MENU	Steps through the main menu categories shown in Figure 2-1. The Menu categories wrap around in the order shown.
	BACK	Allows you to go back to the previous menu level without changing any information. Continuously pressing this key will bring you back to the default status display in the Operating Menu. Also, this key allows you to go back to the top of a main menu category.
	▲ (Up) Arrow	When in one of the main menu categories, pressing this key will move you forward through the displayed menu category. If the **CHANGE** key was pressed and the menu item is flashing, press the ▲ arrow key increment the setting.
	▼ (Down) Arrow	When in one of the main menu categories, pressing this key will select the displayed menu category. If the **CHANGE** key was pressed and the menu item is flashing, pressing the ▼ (Down) arrow key will decrement the selected setting.
	CHANGE	Permits a setting to be changed (edited). A valid password must be entered before changing most menu items. When the **CHANGE** key is pressed, the displayed menu item will alternate in color with the background (reverse video). Pressing the ▲ or ▼ arrow key when this occurs will increment or decrement the displayed setting.
	ENTER	Saves the modified menu information in memory. The display will return to the normal state.
5	**ON/OFF** Key	Enables and disables ACS operation.
6	**ON** Indicator	Green **ON** LED lights when the ACS is enabled.

Page **44** of **139**

GF-131

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11/22/2017

OMM-0081_0F

The ACS incorporates an extensive menu structure which permits the operator to set up, and configure the unit. The menu structure consists of nine major menu categories as shown in Figure 3-2. Each of the menus shown, contain options which permit operating parameters to be viewed or changed. The menus are protected by two different password levels to prevent unauthorized use. These passwords provide access as follows:

- Password Level 1 (**159**) allows viewing of all menu categories. In addition, this Password Level allows all Menu options to be changed, except for Calibration Menu options.

- Password Level 2 (**6817**) allows viewing and changing of the options contained in the Calibration Menu. In addition, it allows all Level 1 menu categories to be viewed or changed. The Calibration Menu should only be used by factory-trained personnel.

Prior to entering the correct password, the options contained in all of the Menu categories (except the Calibration Menu) can be viewed. However, except for Internal Setpoint Temperature (Field Adjust Menu), none of the viewable menu options can be changed.

Once the valid Level 1 (**159**) or Level 2 (**6817**) password is entered, the options listed in the available menus can be viewed and changed, if desired.

3.3.1 Menu Processing Procedure

Accessing each menu and option is accomplished using the Menu Keys shown in Figure 3-1. Therefore, it is imperative that you be thoroughly familiar with the following basic steps shown in Instruction 3.1.1 before attempting to perform specific menu processing procedures.

Menu Processing Procedure

1. The ACS will normally be in the Operating Menu and the VFD will display the current unit status. Pressing the ▲ or ▼ arrow key will display the other available data in the Operating Menu.

2. Press the **MENU** key. The display will show the Setup Menu which is the next menu category shown in Figure 3-2. This menu contains the Password option which must be entered if other menu options will be changed.

3. Continue pressing the **MENU** key until the desired menu is displayed.

4. With the desired menu displayed, press the ▲ arrow key. The first option in the selected menu will be displayed.

5. Continue pressing the ▲or ▼ arrow key until the desired menu option is displayed. Pressing the ▲ arrow key will display the available menu options in the Top-Down sequence. Pressing the ▼ arrow key will display the options in the Bottom-Up sequence. The menu options will stop when the last option is reached, going forward, or the first option is reached, going backwards. They do not wrap-around after the first or last available option.

6. To change the value or setting of a displayed menu option, press the **CHANGE** key. The displayed option will appear in reverse video. Press the ▲ or ▼ arrow key to scroll through the available menu option choices for the option to be changed. The menu option choices do not wrap around.

7. To select and store a changed menu option, press the **ENTER** key.

11/22/2017

OMM-0081_0F

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Phone: 800-526-0288

Page **45** of **139**

GF-131
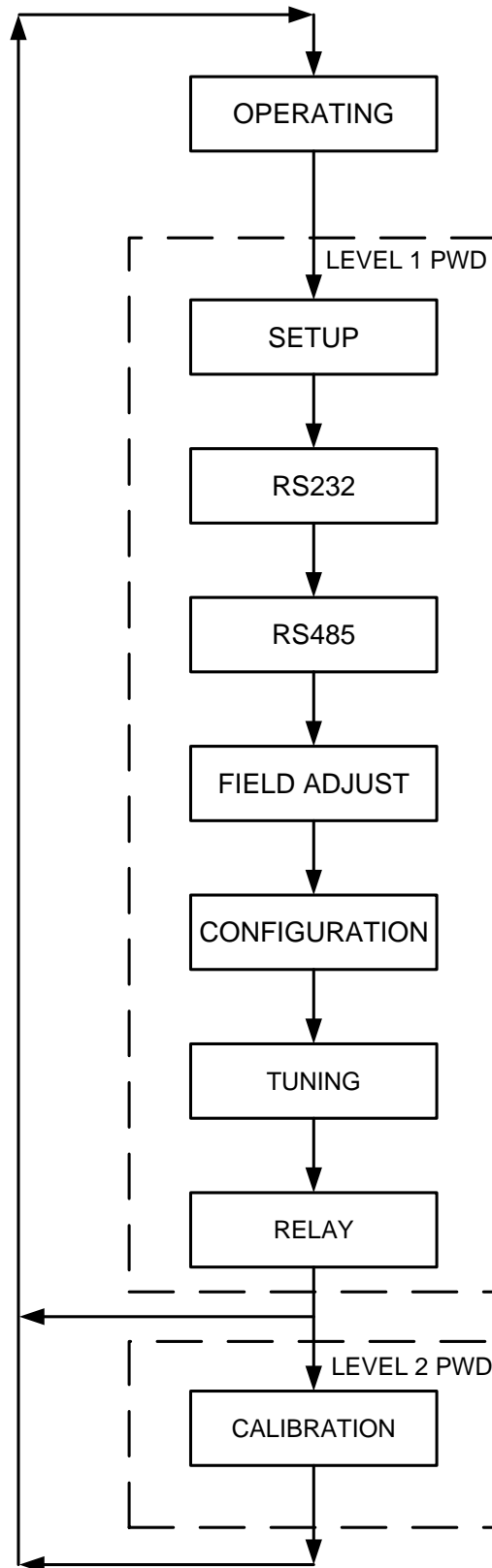
Figure 3-2: ACS Menu Structure

NOTE

The following sections provide detailed descriptions of the options contained in each of the menus shown in Figure 3-2. The menu options appear in the first line of the VFD display and the corresponding value or setting for the displayed option will appear in the second line of the display. See Appendix A for tabular summaries of all menu options showing the entry ranges and default values.

3.3 OPERATING MENU

The Operating Menu displays a number of key operating parameters for the ACS. These parameters include:

- *HEADER TEMP*

- *HEADER SETPOINT*

- *OUTSIDE AIR TEMP*

- *PERCENT OF LOAD*

- *I/O STATUS*

- *RETURN TEMP* (with optional Temperature Sensor)

All of the items in this menu are "Read-Only" and do not allow personnel to change or adjust any of the displayed parameters. Since this menu is "Read Only", it can be viewed at any time without entering a password. The Operating Menu options are described in the paragraphs which follow.

3.4.1 Header Temp and Percent of Load

The *HEADER TEMP* menu option displays the actual water temperature (°F) measured by the Header Sensor connected to HDR SEN terminals 4 and 5 of the ACS. If the Header Sensor is not installed, *HDR SENS ERROR* will appear in the first line of the display. The red FAULT indicator will also light. The Header Sensor **MUST** be installed for the ACS to operate properly.

The *PERCENT OF LOAD* option shows the percent level going from the ACS to each boiler in the boiler plant. It also shows the number of boiler units that are operating.

NOTE

The ACS will shut down the last boiler firing when the Percent Output Level goes below the BLR STOP LEVEL. The shutdown will be indicated by the second line of the default display flashing. By the same token, as the Percent Level Output rises from 0%, the second line of the default (Operating Menu) display will flash until it reaches the BLR START PERCENT and the Header temperature is below 'Setpoint - DEMAND OFFSET.

3.4.2 HEADER SETPOINT

This menu option is the setpoint temperature to which the control is set when operating in the Constant Setpoint, Remote Setpoint or Outdoor Reset Mode. When in the Constant Setpoint Mode, this value is equal to the Internal Setpoint setting in the Configuration Menu. When in the Remote Setpoint Mode, this value is the setpoint equivalent to the remote analog signal or Modbus value supplied to the unit. When in the Outdoor Reset Mode, this is the derived value from the charts in Appendix C.

11/22/2017
OMM-0081_0F

AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288

Page **47** of **139**
GF-131

3.4.3 OUTSIDE AIR TEMP

The *OUTSIDE AIR TEMP* option shows the outdoor air temperature (°F) measured by the Outdoor Air Sensor. This sensor is connected to OUT AIR SENS terminals 1 and 2 of the ACS. If the Sensor is not connected, the second line of the display will show *NOT CONNECTED*. The Outdoor Air Sensor MUST be connected when operating in the Outdoor Reset Mode.

3.4.4 I/O STATUS

I/O (Input/Output) *STATUS* is displayed as a hexadecimal number. The meaning of each bit is as indicated below. The higher 4 bits, or most significant digit (MSD), indicate which inputs are activated. The lower 4 bits, or least significant digit (LSD), indicate which relay outputs are activated. See Appendix B, Section B-6, for full list.

VALUE WHEN SET:

	MSD					LSD		
8	4	2	1		8	4	2	1
Bit 3	Bit 2	Bit 1	Bit 0		Bit 3	Bit 2	Bit 1	Bit 0

If MSD = **0**: All Inputs Open
If MSD = **1**: Setback Closed
If MSD = **2**: Interlock 2 Closed
If MSD = **3**: Setback and Interlock 2 Closed
If MSD = **4**: Interlock 1 Closed
If MSD = **5**: Setback and Interlock 1 Closed
If MSD = **6**: Interlock 1 and Interlock 2 Closed
If MSD = **7**: Setback, Interlock 2, & Interlock 2 Closed
If MSD = **8-16**: Not Valid

If LSD = **0**: All Relay Outputs Off
If LSD = **1**: Aux Relay On
If LSD = **2**: Fault Relay On
If LSD = **3**: Aux and Fault Relays On
If LSD = **4**: System Relay On
If LSD = **5**: System and Aux Relays On
If LSD = **6**: System and Fault Relays On
If LSD = **7**: Aux, Fault, and System Relays On
If LSD = **8-16**: Not Valid

3.4.5 RETURN TEMP

The *RETURN TEMP* (°F) option is displayed only if an optional Return Sensor is installed in the boiler water return line. When installed, it is connected to terminals 5 and 6 on the ACS. This optional sensor is used for monitoring purposes, as well as for Plant DT limit operation.

3.4.6 NETWORK BOILER OUTLET TEMPERATURE

When BLR CNTL SELECT is set to C-More or BCM, the outlet temperature of the boilers connected may be viewed here. Press the Change Key to view the other temperatures. Press Enter to stop at a particular boiler temperature.

3.4.7 NETWORK BOILER ERROR CODE

When BLR CNTL SELECT is set to C-More or BCM, the Status or Error Codes of the boiler may be viewed here. Press the Change Key and then, Up or Down keys to view the other temperatures. Press Enter to stop at a particular boiler code. See Appendix B for definition of codes.

3.4 SETUP MENU

The SETUP MENU permits the operator to set the unit password which is required to change any of the menu options. To prevent unauthorized use, a previously entered password entry will time-out after 1 hour. Therefore, the password must be re-entered when required. In addition to permitting password entries, the SETUP MENU is also used to enter the date and time. Descriptions of the SETUP MENU options follow.

3.5.1 ENTER PASSWORD

The *ENTER PASSWORD* option allows the Level 1 (**159**) or Level 2 (**6817**) to be entered.

Once the valid Level 1 password (**159**) is entered, options in all Menus, except the Calibration Menu, can be changed.

The Level 2 password (**6817**) must be entered to view or change options in the Calibration Menu. Only factory trained personnel should use this Menu.

To enter a password, press CHANGE, and then the UP or DOWN button to select each digit. Press Change after each digit is selected in order to advance to the next digit. Press Enter when the desired password is displayed

3.5.2 DATE AND TIME MENU OPTIONS

The Setup Menu options associated with date and time are as follows:

- *SET MONTH*   *01 -12*
- *SET DATE*   *01 – 31*
- *SET YEAR*   *00 – 99*
- *SET HOUR*   *00 -23*
- *SET MINUTE*   *00 – 59*
- *SET DAY OF WEEK   SUNDAY TO SATURDAY*

3.5 RS232 MENU

The *RS232 MENU* options permit the ACS to communicate with an external Energy Management System (EMS) or Computer via the RS232 Port wiring terminals labeled RXD, TXD, ISOGND on the ACS. The RS232 Menu options are used to select the RS232 Mode, Baud Rate, Modbus Address, Network Timeout period and Modbus Pass-Thru feature for the ACS.

3.6.1 RS232 MODE

The RS232 MODE option allows the selection of the type of communication desired at the RS232 port: NORMAL (dumb terminal) or MODBUS SLAVE (Modbus Protocol). When the ACS is being controlled by an external Energy Management System (EMS), via Modbus Protocol, set this option to MODBUS SLAVE (default). If the EMS being used contains only a RS485 port, a RS485-to-RS232 Converter is required.

3.6.2 RS232 BAUD RATE

The RS232 BAUDRATE option sets the communication Baud Rate between the ACS and the EMS. Available settings include 2400, 4800, 9600 (default), or 19200. Both the ACS and EMS MUST be set to the same baud rate to enable the communication link.

3.6.3 MODBUS ADDRESS

The *MODBUS ADDRESS* option sets the ACS address when operating as a Slave on a Modbus Network. The address can be set from 128 (default) to 247.

3.6.4 NETWORK TIMEOUT

When the ACS is operating in the Remote Setpt mode via Modbus, the *NETWORK TIMEOUT* option defines the maximum time (seconds) allowed before re-sending the setpoint information. If the information is not resent within this time period, the ACS will default to its Failsafe mode of operation set in the Configuration Menu and display "MODBUS TIMEOUT ERROR". The network timeout period is selectable from 005 to 240 seconds (Default = 060).

3.6.5 MODBUS PASS THRU

When enabled, the MODBUS PASS THRU option allows an EMS or computer, communicating from the RS232 port, to access information from the boilers connected on the RS485 port of the ACS. When enabled, it allows boiler monitoring and setup but not direct control of the boilers. To enable writing to the boiler control, you must go to the Calibration Menu and enable "PASSTHRU WRITE".

3.6 RS485 (MODBUS) MENU

The ACS communicates with the connected AERCO network boilers via its RS485 (Modbus) Port (485 B+ and 485 A-). Therefore, the RS485 Menu contains the options necessary to enable communication between the ACS and the connected network boiler slaves. Each network boiler on the Modbus network must be assigned a unique address to enable communication.

The RS485 Menu options are used to select the RS232 Baud Rate, Min./Max. Range of Slave Addresses, Total Number of Networked Boilers, Type of Modbus Control and the Unique Address for each Networked Boiler. Descriptions of these options follow.

The ACS can automatically detect boilers within the ""Min Slave Addr" and "Max Slave Addr" range, or you can program the boiler addresses in the order desired. AERCO recommends programming the addresses in the desired order. When programming the boiler addresses, set the "Min Slave Addr" and "Max Slave Addr" to zero.

3.7.1 RS485 BAUD RATE

The *RS485 BAUDRATE* option Sets the communication baud rate for the Modbus network between the ACS and the Boilers connected to the RS485 terminals [B(+), A(-)]. Available settings are 2400, 4800, 9600 (default), or 19200.

3.7.2 MIN SLAVE ADDR

The *MIN SLAVE ADDR* sets the Minimum Slave Address for the Boilers being controlled on the RS485 (Modbus) Network when automatic boiler detection is desired; otherwise, leave set to zero. Allowable entry range is 000 to 127 (default = 000).

3.7.3 MAX SLAVE ADDR

The *MAX SLAVE ADDR* Sets the Maximum Slave Address for the Boilers being controlled on the RS485 (Modbus) Network when automatic boiler detection is desired; otherwise, leave set to zero. Allowable entry range is 000 to 127 (default = 000).

3.7.4 NUMBER NETWK BLRS

This menu option sets the Number of Network Boilers connected to the ACS RS485 (Modbus)

Page **50** of **139**
GF-131

AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288

11/22/2017
OMM-0081_0F

terminals. Up to 32 Boilers can be connected to the Network (default = 02).

3.7.5 MODBUS CNTL TYPE

This menu option sets the Modbus Control Type to *ROUND ROBIN* or *BROADCAST*. Only *ROUND ROBIN* can be used at this time. When set to ROUND ROBIN, each networked boiler is addressed individually in sequence. *BROADCAST* is currently not used for the ACS.

3.7.6 NETW BOILER Xx ADDRESS=Yyy

Up to 32 Network Boilers can be accommodated on the Modbus Network (Where Xx = 01 – 32 and Yyy = 001 – 127). Each Boiler must be assigned a unique address on the network ranging from 001 to127. No addresses should be entered if automatic boiler detection is desired. Simply set the *MIN SLAVE ADDR* and *MAX SLAVE ADDR* to the minimum and maximum address range of the boilers. To program boiler addresses in the order you desire, enter them here and set the *MIN SLAVE ADDR* and *MAX SLAVE ADDR* to zero.

3.7 FIELD ADJUST MENU

The *FIELD ADJUST MENU* contains the most extensive list of options compared to the other 8 Menu categories. The options in this menu allow you to adjust important parameters to suit the specific needs of your ACS installation. Included are options to select the Header Mode and Temperature Limits, Internal Setpoint, Building Reference Temperature, Reset Ratio and Remote Signal. In addition, the Field Adjust Menu contains a series of options which can be used to set up a Header Setpoint Offset Schedule for an entire week. Descriptions of the Field Adjust Menu options:

3.8.1 HEADER SET MODE

The *HEADER SET MODE* option sets the Header Setpoint selection method for the ACS. Allowable selections are: CONSTANT SETPT, OUTDOOR RESET or REMOTE SETPT. (Default = CONSTANT SETPT).

3.8.2 HDR HIGH LIMIT

The *HDR HIGH LIMIT* option sets the maximum temperature setting allowed for the Header Setpoint. This setting also defines the 20 mA temperature equivalent when operating in the Remote Setpoint Mode using a 4 – 20 mA signal. The allowable setting range is from the *HDR LOW LIMIT* to 220°F. (Default = 200°F).

3.8.3 HDR LOW LIMIT

The *HDR LOW LIMIT* menu option sets the minimum temperature setting allowed for the Header Setpt. This setting also defines the 4 mA temperature equivalent when operating in the Remote Setpoint Mode using a 4 – 20 mA signal. The setting range is from 40°F to the *HDR HIGH LIMIT*. (Default = 40°F).

3.8.4 INTERNAL SETPT

The *INTERNAL SETPT* temperature is the *HEADER SETPT* used when *CONSTANT SETPT* is selected for the *HEADER SET MODE* or when the ACS operates in the Failsafe Mode and *CONSTANT SETPT* is selected as the FAIL SAFE MODE setting in the Configuration Menu.

11/22/2017
OMM-0081_0F

AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288

Page **51** of **139**
GF-131

3.8.5 RESET RATIO

This menu option is displayed only if the *HEADER SET MODE* is set to *OUTDOOR RESET.* *The RESET RATIO* option setting defines the ratio of the increase in Header temperature with respect to each degree decrease in Outdoor temperature starting from the Building Reference Temperature (*BLDG REF TEMP*).

The Reset Ratio is adjustable from 0.3 to 3.0. (Default = 1.2). The Reset Ratio Charts provided in Appendix C are suitable for most applications. However, if a special reset schedule is desired, the calculation method described in Appendix C must be used.

3.8.6 BLDG REF TEMP

The *BLDG REF TEMP* menu option is only displayed when the *HEADER SET MODE* is set to *OUTDOOR RESET.* This option is used to set the Building Reference Temperature *(BLDG REF TEMP)* to the desired value from 40°F to 220°F. (Default = 70°F).

3.8.7 REMOTE SIGNAL

The *REMOTE SIGNAL* menu option is only displayed when the *HEADER SET MODE* is set to *REMOTE SETPT.* When displayed, this option is used to select the controlling remote signal: to 4 – 20 mA or MODBUS. (Default = 4-20 mA).

3.8.8 OFFSET ENABLE

The *OFFSET ENABLE* menu option is used to turn ON, or turn OFF the Setpoint Temperature Offset feature. (Default = OFF)

3.8.9 OFFSET MENU OPTIONS

The Field Adjust Menu contains a series of menu options which permit an offset schedule to be set up for a 7-day period (Sunday through Saturday). For each day (Sunday – Saturday), these options include:

- *OFFS TEMP* **[Setpoint Offset Temperature (-50°F to +50°F)]**

- *ON HOUR* *(00 to 23)*

- *ON MINUTE* *(00 to 59)*

- *OFF HOUR* *(00 to 23)*

- *OFF MINUTE* *(00 to 59)*

Normally, if an Offset Schedule is used, it is controlled automatically using the set-up procedures described in the paragraph titled "Setting Up An Offset Reset Schedule" However, if desired, the header offset can be controlled manually by connecting a switch across the SET BACK wiring terminals 13 and 14 as shown in the wiring diagram in Appendix E. If a manual offset is used, refer to the paragraph titled "Manual Offset".

3.8.10 SETTING UP AN OFFSET SCHEDULE

The steps involved in setting up an automatic reset schedule consists first of selecting the temperature offset and then entering the start and stop times for which the offset will be in effect. Note that the ACS uses a 24-hour clock (00;00 to 23:59). The steps are outlined below. In this example, the setpoint temperature is being offset -15°F on Sunday from 12:01 AM (00:01) to 8:00 AM (08 hrs).

Setting up an Offset Schedule

1. Scroll through the *FIELD ADJUST MENU* and select *OFFSET ENABLE*. Set this option to *ON.*

2. Next, scroll to *SUN OFFS TEMP* and set the Offset Temperature to *-15°F*.

3. Press the ▲ arrow key. *SUN ON HOUR* will be displayed. Set the *HOUR* to *00.*

4. Press the ▲ arrow key again. *SUN ON MINUTE* will be displayed. Set the *MINUTE* to *01.*

5. Press the ▲ arrow key again. *SUN OFF HOUR* will be displayed. Set the *HOUR* to *08.*

6. Press the ▲ arrow key again. *SUN OFF MINUTE* will be displayed. Set the *MINUTE* to *00.*

7. Repeat steps 2 through 6 to set offset schedules for the remaining days of the week. Different offset temperatures and ON/OFF times can be set for each day if desired.

3.8.11 Setting up a Manual Offset Schedule

If a switch is connected across terminals 13 and 14 on the ACS, the offset temperature can be controlled manually. To set up a manual offset schedule, proceed as shown below.

Setting up a MANUAL Offset Schedule

1. Scroll through the FIELD ADJUST MENU and select OFFSET ENABLE. Set this option to ON

2. Next, scroll to SUN OFFS TEMP and set the desired Offset Temperature. A different Offset Temperature can be set for each day if desired.

3. Scroll through the remaining days of the week and set desired offset temperature for each day.

Once programmed as described above, closing the SET BACK switch will enable the programmed *OFFS TEMP* for that day. Opening the SET BACK switch will disable the *OFFSET* and the Header Setpoint will return the selected *INTERNAL SETPT* temperature.

3.8 CONFIGURATION MENU

The Configuration Menu contains options which set the Boiler operating modes start/stop levels and maximum allowable power input. In addition, it contains a Fail Safe Mode feature which is used to select the default mode when the controlling input source is lost.

3.9.1 BLR CNTL SELECT

You can select the type of boiler control being connected to the ACS (C-More or BCM) in order for the ACS to read its Outlet Temp and Error Code in the Operating Menu. Otherwise, select NONE to disable these displays in the Operating Menu.

3.9.2 BOILER OP MODE

The *BOILER OP MODE* menu option sets the control operation method for the ACS to either *SEQUENTIAL* or *PARALLEL MODE.*

3.9.3 PARALLEL MODE

When *PARALLEL MODE* is selected, all boilers are simultaneously started by the ACS. The *BLR START LEVEL* and *BLR STOP LEVEL* set in the Configuration Menu (see below) have no effect when in this mode. Regardless of the number of Boilers in the plant, the turn-down ratio in the Parallel Mode is fixed at 20:1 for KC1000 Series Boilers (except 11:1 for KC Low NOx). For Benchmark Series Boilers, the turn-down ratio is fixed at 20:1 for BMK2.0, 2.0LN, and 1.5LN Boilers. However, for BMK3.0LN Boilers the turn-down ratio is fixed at 15:1.

3.9.4 SEQUENTIAL

When *SEQUENTIAL MODE* is selected it provides a greater turn-down ratio than the *PARALLEL MODE.* This is due to the fact that the turn-down ratio in the Sequential Mode is equal to the number of Boilers multiplied by the 20 for KC1000 Series and Benchmark Series units.

In Sequential Mode, each boiler is started one at a time based on the load and start/stop levels programmed in the ACS. The ACS will start a single Modulex boiler when there is a load demand or a Benchmark or KC1000 boiler when the boiler start level is reached. Once the first boiler reaches twice the start level, a second boiler will be started and the load will be distributed evenly between the two boilers.

For instance, if a start level of 25% is chosen, when the first boiler reaches 50% a second boiler will start (after a 30 second delay), and the ACS will distribute the load 25% for each boiler. If the firing rate of both boilers reach a combined value equal to 3 times the start level, a third boiler is started by the ACS (after a 30 second delay), and the load will be distributed across all three boilers. This sequence will continue based on load demand and the number of boilers connected to the ACS.

3.9.5 SYS INTLK CONFIG

This option selects when the System Start Interlock takes effect. The available choices are *START ENABLED* (default) and *ALWAYS ENABLED.* If *START ENABLED* is selected, the ACS will wait 30 seconds after the System Start Relay is activated before looking for a closure across the System Start Interlock selected. (See *SYS START INTLK* in the RELAY MENU). If no closure is seen after 30 seconds, the ACS will stop the boilers and display a fault message and activate the fault relay. ALWAYS ENABLED will cause a fault whenever the interlocks are opened.

NOTE
The *BLR START LEVEL* and *BLR STOP LEVEL* must be programmed in the ACS by the user. Refer to Appendix I for additional information on *START/STOP LEVELS.*

3.9.6 BLR START LEVEL

The Boiler Start Level (*BLR START LEVEL*) sets the percentage level at which the Boilers connected to the ACS will start. The allowable entry range is from 1% to 100% (default = 20%). See important note below.

3.9.7 BLR STOP LEVEL

The Boiler Stop Level (*BLR STOP LEVEL)* menu option set the percentage level below which the Boilers connected to the ACS will stop. The allowable entry range is from 1% to 40% (default = 16%). See important note below.

NOTE
For best efficiency, the Boiler Start Level (*BLR START LEVEL*) and Boiler Stop Level (*BLR STOP LEVEL) of the ACS must be the same values as all of the C-More Controls in the heating plant, i.e. if the boilers are set to 20%/16% (Start/Stop levels), then the ACS must be set to 20%/16%. These values must NEVER be set lower than the values at the boilers.*

3.9.8 MAX POWER INPUT

The Maximum Power Input (*MAX POWER INPUT)* sets the maximum Percent Level that the ACS can ramp up the boilers to. This may be useful in an over-sized boiler plant. The allowable entry range is from 50 % to 100% (default = 100%).

3.9.9 FAIL SAFE MODE

Selects the desired operating mode of the ACS if it loses its Outdoor Air Sensor when operating in the Outdoor Reset mode, or loses its Remote Signal when operating in the Remote Setpoint mode. If CONSTANT SETPT is selected as the FAIL SAFE MODE, the ACS will operate the boilers to achieve a Header Setpt equal to the programmed Internal Setpt. If SHUTDOWN is selected, it will shut down all the boilers.

NOTE
If the Header Sensor is lost, the ACS will shut down all the boilers.

3.9.10 LEAD BLR SELECT (Lead Boiler Selection)

The LEAD BLR SELECT option is used to select NETW BOILER 1 as the only lead boiler. This boiler will be the first one fired and the last one shut down on the boiler plant. This boiler will not be included in the rotation scheme. Be sure that the address of the boiler being selected is programmed as NETW BOILER 1. The default selection for this option is NONE.

3.9.11 LAST BLR SELECT (Last Boiler Selection)

The LAST BLR SELECT option selects the boiler that is to be the last one fired and only after all the others have reached the maximum percent output. this boiler might be an older one that must only be fired when absolutely needed. This boiler will not be included in the rotation scheme. The default selection for this option is NONE.

3.9.12 ROTATE TIME

The boilers will normally rotate on a first-on, first-off basis. This option allows a timed rotation of the boilers. At the selected time, the first-on, first-off rotation will take place. The default time is set for 168 hours (1 week).

3.9.13 RET SENSOR MODE (Return Sensor Mode)

This option defines the use of the sensor connected to the Return Sensor input. When set to NORMAL, it is sensing the return temperature of the boiler plant and therefore all the functions that relate to this - PLANT DT LIMIT would now be active. When set to DHW/TANK TEMP, the input is monitoring the domestic hot water temperature. When set to OFF (default), this input is ignored.

3.9.14 PLANT DT LIMIT (Plant Delta-Temperature Limit)

This feature is active if the RET SENSOR MODE is set to NORMAL. This value defines the maximum temperature difference allowed between the Header temperature and the Return

temperature. If we exceed this value by 18°, the ACS will shut down the boiler plant. When the temperature difference gets below the PLANT DT LIMIT, the boiler plant will be activated again. The Return TC must be installed for this function to operate.

3.9.15 BOILER DELAY

The BOILER DELAY is the minimum wait time after firing one boiler before firing the next one. It can be set from 10 seconds to 999 seconds. The default is 30 seconds.

3.9.16 DHW OPTION (Domestic Hot Water Option)

There are four DHW selections to choose from: NO OPTION, OPTION 1, OPTION 2, and OPTION 3. Option 1 and 2 do NOT apply to Modulex boilers.

- **NO OPTION** - The default, NO OPTION, disable all options and allows the ACS to function strictly for building heating.

- **OPTION 1** - This option is selected when the ACS is to control a boiler plant containing up to 8 combination boilers that are Domestic Hot Water Priority (DHW PRIORITY) boilers, along with building heat (BLDG HEAT) boilers, and using one hydronic isolation valve in the main header between the BLDG HEAT boilers and the DHW PRIORITY boilers. When this option is selected, the AUX Relay will act as the DHW valve open contact and the SYS Relay will act as the DHW valve close contact (unless the SYS relay is programmed otherwise by the SYS relay option setting), the interlock 2 will act as the Valve End Switch input, and Setback will be used as the Aquastat input. When this option is selected, there are three other settings that will be displayed - NUMBER DHW BLRS, DHW SIGNAL, and SYS RELAY OPTION. These will be defined later.

- **OPTION 2** - This option is selected when the ACS is to control a boiler plant containing up to 8 combination boilers that are divided up into Building Priority (BLDG PRIORITY) boilers and Domestic Hot Water Priority (DHW PRIORITY) boilers, along with building heat (BLDG HEAT) boilers, and using two hydronic isolation valves in the main header, one between the BLDG HEAT and BLDG PRIORITY boilers, and the other between the BLDG PRIORITY and the DHW PRIORITY boilers. When this option is selected, the ACS Relay Panel must be used in conjunction with the ACS. See sections 2.14 to 2.18 for wiring and operation. When this option is selected, there are three other settings that will be displayed - NUMBER DHW BLRS, DHW SIGNAL, and NUM DHW PRIORITY. These will be defined later.

- **OPTION 3** - This option is selected when the ACS is to boost the setpoint temperature of the whole boiler plant when the domestic system is calling for heat. Boost is activated by closing Interlock 2 and deactivated by opening the Interlock. When this option is selected, three other settings are displayed - BOOST TEMP, RET TMP BST DIS, and BOOST MAX TIMER. These will be defined later.

See section 2.15 for wiring any of these options. The extra settings are defined below:

3.9.17 NUMBER DHW BLRS (Number of Domestic Hot Water Boilers)

Selects the total number of boilers being used to help supply domestic hot water. If these are C-More controls, their Boiler Mode would be programmed as Combination. This selection applies to OPTION 1 and OPTION 2. For OPTION 1 they would all be DHW PRIORITY boilers. For OPTION 2 they would be the total of DHW PRIORITY boilers and BLDG PRIORITY boilers. NUM DHW PRIORITY differentiates between the two types.

These boilers begin from NETW BOILER 32 and backward. If 3 is entered, then NETW BOILER 30, NETW BOILER 31, and NETW BOILER 32 would be combination boilers.

3.9.18 DHW SIGNAL (Domestic Hot Water Signal)

NOTE
This function apples only to the C-More Controller, although it
is not currently implemented at this time.

This setting tells the ACS the type of signal to send to the combination (DHW) boilers in order to allow them to do domestic water heating. If NO SIGNAL is selected, the ACS will just stop sending the Modbus fire ra te (percent level) signal to the boiler during this time. If SPECIAL SIGNAL is selected, the ACS will send an AERCO-defined signal that the boiler control will recognize as the signal to do domestic hot water heating. The default is NO SIGNAL.

3.9.19 NUM DHW PRIORITY (Number of DHW Priority Boilers)

This shows for OPTION 2 only. It selects the amount of boilers from the previously selected NUMBER DHW BOILERS that are to be used as DHW PRIORITY boilers.

3.9.20 VALVE WAIT STATES

This setting tells the ACS whether to keep a fired boiler running while waiting for the valve to transition or to shut it down. Select ON to keep it running and OFF to shut it down.

3.9.21 SYS RELAY OPTION (System Relay Option)

This selection will only show when OPTION 1 is selected for DHW OPTION. It allows one to choose whether the SYS RELAY output from the ACS will be acting as the DHW valve close contact or will be operating normally as the contact to indicate when the boiler plant system is enabled. The default is DHW VALVE CLOSE in which case the ACS will use the SYS RELAY as the valve closure contact and the AUX RELAY output as the valve open contact. If the hydronic valve being controlled has a spring-return closure or other non-powered closure, one would select NORMAL since the SYS RELAY contact would not be needed to close the valve.

3.9 BOOST TEMP

This option only shows when OPTION 3 is selected for DHW OPTION. The BOOST TEMP tells the minimum water temperature desired in the primary loop or heat exchanger of the domestic heating system in order to heat the water to the desired temperature. This temperature would normally be at least 10 degrees above the desired DHW setpoint. The default setting is 140°F.

If the current setpoint is below the set BOOST TEMP, the BOOST TEMP will be used as the new setpoint. If the ACS's setpoint is above the BOOST TEMP setting, no change will be made to the setpoint while the domestic system is calling for heat. When the domestic system stops calling, the setpoint will go back to normal.

3.10.1 RET TEMP BST DIS (RETURN TEMPERATURE BOOST DISABLE)

This setting defines a return temperature above which the Boost will be disabled. If the return temperature exceeds the RET TMP BST DIS setting, the boost will be deactivated and the fault message will be displayed. The fault may be cleared by cycling the boost input (Interlock 2) or by pressing the "Clear" key. The default setting is OFF.

3.10.2 BOOST MAX TIMER

This setting is the maximum amount of time that the boost input should be continually activated. It should be assumed that the switch is broken if the boost input remains activated longer than the time entered in this setting.

If Interlock 2 remains activated for longer than the BOOST MAX TIMER setting, the boost will be de-activated and the fault message "BOOST DISABLED" will be displayed and the fault relay activated. The fault message may be cleared by cycling the boost input (Interlock 2) or by pressing the "clear" key. The default setting for this is OFF.

3.10 TUNING MENU

The *TUNING MENU* options are used to select PID (Proportional Integral Derivative) control functions incorporated in the ACS. These functions govern temperature control and response of the 'ACS to the boiler system. Since each system is different, these PID controls can tune the ACS to the characteristics of your specific installation. The factory defaults preset by AERCO work well for most applications. In instances when there is a large error between the setpoint and the actual supply water temperature, the ACS may appear to require PID tuning. However, it is best to observe ACS operation over a period of time prior to making any PID changes. Contact AERCO, or an AERCO representative, prior to making any PID setting changes.

The *TUNING MENU* options include Proportional Bandwidth, Integral Gain, Derivative Gain and Header Temperature Deadband.

3.11.1 PROPORTIONAL BND

The Proportional Bandwidth (degrees) represents the immediate response to a setpoint error. This value is the temperature deviation from setpoint for which a 100% output change is desired. This is a part of the PID output calculation in the ACS.

For instance, proportional band of 50°F is chosen. The header temperature setpoint is 180°F and the actual incoming supply water temperature is 130°F. This is a 50°error and the following is true:

$$\frac{\text{Temp. Error}}{\text{Prop. Bandwidth}}$$

$\frac{\text{Temp. Error}}{\text{Prop Bandwidth}}$ **X 100 = Firing Rate in %**

THEREFORE:

$\frac{50}{50}$ **X 100% = Firing Rate**

1 X 100 = 100 % Firing Rate

With an error of 30° and a bandwidth of 50, the following would be true:

30/50 X 100 = .6 X 100 = 60% Firing Rate.

3.11.2 INTEGRAL GAIN

The Integral Gain (repeats/min) responds to the setpoint error over time. Integral references the proportional band error signal and sums itself with respect to the period of time the error exists. Based on the previous example, if the integral gain is 0.15 repeats/minute at a firing rate of 60% and a temperature error exists for one minute, then the following is true:

(0.15 reps/min.) x (60% firing rate) = 9% actual firing rate

60% firing rate +9% firing rate = 69% firing rate

If the error continues and is present for another minute, another 9% correction factor will be added:

69% firing rate +9% firing rate = 78% firing rate

If, after a load change, the supply water temperature stabilizes at a temperature above or below the setpoint, the integral gain should be increased. If, after a load change, the supply water temperature overshoots and oscillates excessively, integral gain should be reduced.

3.11.3 DERIVATIVE GAIN

Derivative Gain is a function of time. It senses and responds to the rate of change of the setpoint error. A slow rate of change will yield a small amount of derivative gain. Conversely, a fast rate of change will yield a large derivative gain. Too high a derivative gain setting will produce a large output for a short time. This can result in overshoot of the setpoint. Too low a derivative gain setting will have the opposite effect, producing a small output for a longer period, and may result in slow system response or the system undershooting the setpoint.

3.11.4 Decreasing Boiler Cycles

The five settings below - HI_DB_SETPT_EN, DEADBAND HIGH, DEADBAND LOW, SETPT DOWN RATE, and DEMAND OFFSET - are meant to decrease boiler cycles. They each will be defined and then their inter-operation will be explained.

3.11.5 HI_DB_SETPT_EN (High Deadband Setpoint Enable)

This value sets the percent level output at which the setpoint will be changed to its maximum limit - Setpoint + DEADBAND HIGH. The effect will be that as we approach the shutdown limit, we aim for the highest setpoint value allowed thereby delaying the shutdown of the boilers. If we go back above this value after making the setpoint adjustment, the SETPT DOWN RATE will define the rate at which to decrease the adjusted setpoint (Setpoint + DEADBAND HIGH) back down to the normal setpoint. This value defaults to the BLR STOP LEVEL.

3.11.6 DEADBAND HIGH

This defines how many degrees above setpoint we can allow the temperature to drift without changing the percent level output value. This is also the value that is added to the setpoint when doing the HI_DB_SETPT_EN adjustment. The default is set to 3°.

3.11.7 DEADBAND LOW

This defines how many degrees below setpoint we can allow the temperature to drift without changing the percent level output value. The default is set to 3°.

3.11.8 SETPT DOWN RATE (Setpoint Down (descending) Rate

If we go back above the HI_DB_SETPT_EN value, after first going below it and adjusting to 'Setpoint + DEADBAND HIGH', this defines the rate at which to decrease 'Setpoint + DEADBAND HIGH' back down to Setpoint. The default is set to 100° per minute.

3.11.9 DEMAND OFFSET

This setting defines an offset to the Active Setpoint such that when the ACS shuts down the whole boiler plant, it will not allow any boiler to fire again until both the Header Temperature < Active Setpoint - DEMAND OFFSET, and the Percent Level Output >= the BLR START LEVEL. During the time that the output is being kept at 0%, the ACS will flash the second line of its default display. The default value here is 10°F.

NOTE

In the Revision C firmware and later, the BMSII will shut down the last boiler firing when the Percent Output Level goes below the BLR STOP LEVEL. The shutdown will be indicated by the second line of the default display flashing. By the same token, as the Percent Level Output rises from 0%, the second line of the default (Operating Menu) display will flash until it reaches the BLR START PERCENT and the Header temperature is below 'Setpoint - DEMAND OFFSET'.

3.11 RELAY MENU

As the name implies, the *RELAY MENU* contains the options necessary to select the actions performed by the System Start (SYS START*),* Fault Alarm (FLT ALARM) and Auxiliary (AUX) Relays in the ACS.

3.12.1 SYS START TEMP

If an Outdoor Air Sensor is installed, this menu option is used to select the Outdoor Temperature below which the System Start Relay is allowed to activate (close), provided that the SYS START OPTION conditions specified below are satisfied. The percent level will always remain at 0% until the System Start Relay is activated The System Start Relay will open if the Outdoor temperature is above the value set for this option.

3.12.2 SYS START OPTION

The *SYS START OPTION* can be set to *TEMP ONLY* or *TEMP AND LOAD.* Selecting *TEMP ONLY* means the System Start Relay will be active whenever the Outdoor Temperature falls below the System Start Temperature (SYS START TEMP).

Selecting *TEMP AND LOAD* will cause the System Start Relay to activate if the Outdoor Temperature falls below the System Start Temperature and the Percent of Load (Operating Menu) is at or above the *LOAD START PCT* (Calibration Menu*).* It will deactivate (open) the System Start Relay when the Percent of Load goes below the *LOAD START PCT.*

3.12.3 SYS START INTLK

The *SYS START INTLK* selects the Interlock associated with the System Start Relay activation when *SYS INTLK CONFIG* is set for *START ENABLED.* Available settings include*, INTERLOCK 1 (default), INTERLOCK 2,* or *INTERLOCK 1&2.*

3.12.4 AUX RELAY OPEN

The *AUX RELAY OPEN* setting is the Percent Level output below which the AUX Relay will open if it was closed due to the conditions described by the AUX RELAY CLOSE setting.

3.12.5 AUX RELAY CLOSE

This determines the condition for which the AUX relay will close. If 100% FIRE RATE is selected, the AUX relay will close when all available boilers are firing at 100%. If 100% AND OFF (default) is selected, it will close when all available boilers are firing at 100% as well as when no boilers are available and the boiler plant is below setpoint. This relay can trigger emergency heat in the latter case.

3.12.6 FAULT ALRM RELAY

This setting tells the ACS which faults should activate the fault alarm relay. The default is *ALL FAULTS*. If *NO INTERLOCK* is selected, the Fault Alarm Relay will not activate when the interlocks are opened, however the ACS will still shut down all boilers. If *INTERLOCK 2* is selected, the Fault Alarm Relay will only activate when Interlock 2 is opened and not when Interlock 1 is opened. Similarly, when *INTERLOCK 1* is selected, the fault alarm relay will only activate when Interlock 1 is opened and not when Interlock 2 is opened.

3.12.7 FAULT ALARM BLRS

This selection tells the ACS whether to activate the fault alarm relay if a boiler connected to it is faulted.

3.12.8 FAULT ALRM CLEAR

Selecting MANUAL will latch the fault alarm relay if a fault condition occurs and goes away. The CLEAR key must be pushed to deactivate the relay. If set to AUTOMATIC, the fault relay will open when the fault condition goes away.

3.12 CALIBRATION MENU

The options contained in this Menu should only be used by factory-trained personnel, since it contains options that could adversely affect system operation if incorrectly set.

NOTE
The Level 2 Password (**6817**) must be entered in order to view or change options in the Calibration Menu.

3.13.1 HDR SENS OFFSET

This option sets the offset temperature value that is added to the displayed Header Sensor temperature in the event that it is different from a trusted reference Header temperature reading and needs calibration. Be sure the Header Sensor is properly installed <u>before</u> adjusting this offset value. The allowable offset range is ±10°F

3.13.2 OUTD SENS OFFSET

This offset value is added to the Outdoor Sensor temperature displayed in case it is different from a trusted reference outdoor temperature reading and needs calibration. Be sure the Outdoor sensor is properly installed before adjusting this value. The allowable offset range is ±10°F.

3.13.3 4 - 20 MA OFFSET

This offset value is added to the 4 – 20 mA Remote signal input to the ACS in the event that calibration is needed. The allowable offset range is ±1.0 mA.

3.13.4 RETN SENS OFFSET

This offset value is added to the Return Sensor temperature displayed in case it is different from a trusted reference return temperature reading and needs calibration. Be sure the Return Sensor is properly installed before adjusting this value. The allowable offset range is ±10°F

3.13.5 RAMP UP % / MIN

This sets the maximum Percent Level ramp up rate for the ACS. The Percent Level output will follow the PID output if it is slower than this rate. The default setting is 20% per minute. Refer to the following example:

Ramp Up % / Min.	Time Required To Go From 0% To 100%
20	5 Minutes
40	2.5 Minutes
50	2 Minutes

NOTE
TO TURN OFF THE RAMP UP %/MIN FUNCTION, SET THE VALUE TO ZERO (0).

3.13.6 RAMP DOWN % / MIN

This sets the maximum Percent Level ramp down rate for the ACS. The Percent Level output will follow the PID output if it is slower than this rate. The default setting is 200% per minute. Refer to the following example:

Ramp Down % / Min.	Time Required To Go From 100% To 0%
200	30 Seconds
300	20 Seconds
100	1 Minute

NOTE
To turn off the RAMP DOWN %/MIN function, set the value to zero (0).

3.13.7 RESET DEFAULTS

This option is used to set the ACS to its factory default values. Make sure that you want to reset all options before activating.

Page **62** of **139**
GF-131

AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288

11/22/2017
OMM-0081_0F

3.13.8 PASSTHRU WRITE

This is the enable/disable for the write functionality when MODBUS PASSTHRU is enabled in the RS232 menu. When set to the default value, DISABLED, it will allow only reading of values but no writing of values. To allow writing of any values, this must be set to ENABLED.

3.13.9 VALVE WAIT TIME

This value tells how long to wait for the hydronic valve to transition between open and closed. The Valve End Switch status is not correct after this time expires, a fault message will be displayed - VALVE POS ISSUE (Valve Position Issue).

3.13.10 SYSTEM OVERRIDE (Modbus Enable/Disable)

This is a Modbus Enable/Disable feature. It can only be accessed via the Modbus slave port (RS232 port) on the ACS. It basically mimics the pressing of the On/Off front panel button. This setting is located at Modbus Address 0x00A0 or 160. To override the system Off, you must write 204 to that address. To override the system On, you must write 51 to that address. Writing any other number will be ignored.

The front panel switch would have top priority so that if it is switched Off by the front panel button, it cannot be switched On by the modbus command. But if it is switched On by the front panel button, it can be switched On and Off by the modbus command. Reading the status would show "1" for On, "2" for Modbus Off, and "0" for Front Panel Off.

3.13 ACS QUICK-START GUIDE MENU

NOTE
The "Quick Start" procedures in this section (3.14) assume that the user fully understands the ACS menu structure and is able to navigate through these menus to display and change menu options. Refer to paragraph 3.3 for menus and menu processing procedures.

The following procedure assumes that you are programming a new ACS that has the "Factory Default" settings currently stored in memory.

If you wish to restore a "Field-Programmed" ACS to the "Factory Default" values, go to the CALIBRATION MENU and select the *RESET DEFAULTS* option. ALL SETTINGS, EXCEPT TIME AND DATE, WILL RETURN TO THEIR FACTOR DEFAULTS.

This paragraph provides the instructions to quickly start up and operate the ACS in some of the most commonly used modes. The ranges and default values of the Menu Options used in the following instructions are summarized in Appendix A.

3.14.1 CONSTANT SETPT MODE (Default):

Constant Setpoint Mode Programming	
Menu & Option	**Action**
SETUP MENU	
↓	
ENTER PASSWORD	Enter 159
↓	
RS485 MENU	Enter this menu if there are more than 2 boilers (default), otherwise go to step 3
↓	
NUMBER NETW BOILERS	This setting is preset to 2. If more than 2 Boilers (default), enter number (03, 04, etc)
↓	
NETW BOILER 01 ADDRESS= 001	Address 001 and 002 are preset. Enter other Network Addresses if required (003, 004, 005, etc.)
↓	
FIELD ADJUST MENU	If Setpt is other than 160°F (default), enter this menu; otherwise go to step 4
↓	
INTERNAL SETPT	Enter Setpoint temperature
↓	
CONFIGURATION MENU	If *BLR START LEVEL=20% & BLR STOP LEVEL=16%,* skip this menu.
↓	
BLR START LEVEL	Enter Boiler Start Level Percent (default = 20%). See Appendix I.
↓	
BLR STOP LEVEL	Enter Boiler Stop Level Percent (default = 16%). See Appendix I.

Page **64** of **139**
GF-131
AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288
11/22/2017
OMM-0081_0F

3.14.2 REMOTE SETPT MODE:

Perform the procedure described for the CONSTANT SETPT MODE and then continue with the steps described below:

Remote Setpoint Mode Programming	
Menu & Option	**Action**
FIELD ADJUST MENU	
↓	
HEADER SET MODE	Set to *REMOTE SETPT*
↓	
HDR HIGH LIMIT	Enter the maximum temperature for the Remote Setpoint input (this will be the temperature equivalent to a 20 mA input) Default = 200°F
↓	
HDR LOW LIMIT	Enter the minimum temperature for the Remote Setpoint input (this will be the temperature equivalent to a 4 mA input) Default = 40°F
↓	
REMOTE SIGNAL	Select 4-20 mA (default) or MODBUS
↓	
CONFIGURATION MENU	
↓	
FAIL SAFE MODE	Set to *CONSTANT SETPT* if you want to maintain a Constant Setpoint temperature in the event that the Remote signal is lost. (Default = *SHUTDOWN)*

11/22/2017
OMM-0081_0F

AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288

Page **65** of **139**
GF-131

3.14.3 OUTDOOR RESET MODE

Perform the procedure described for the CONSTANT SETPT MODE and then continue with the steps described below:

Outdoor Reset Mode Programming	
Menu & Option	**Action**
FIELDADJUST MENU	
↓	
HEADER SET MODE	Set to *OUTDOOR RESET*
↓	
RESET RATIO	Enter a different value, if required (default = 1.2). Refer to Appendix C.
↓	
BLDG REF TEMP	Enter the desired Building Reference Temperature. Default = 70°F (Refer to Appendix C).
↓	
CONFIGURATION MENU	
↓	
FAIL SAFE MODE	Set to *CONSTANT SETPT* if you want to maintain a Constant Setpointt temperature in the event that the Outdoor Sensor signal is lost. (Default = *SHUTDOWN)*
↓	
RELAY MENU	
↓	
SYS START TEMP	Enter the outdoor temperature below which the system will be activated.

After completing the "Quick Start" procedure for any of the modes described above, check to ensure that the "ON" LED is lit. If it is not, press the **ON/OFF** key to activate the ACS.

For further programming details, refer to **Chapter 4**.

CHAPTER 4: PROGRAMMING ACS OPERATING MODES

4.1 INTRODUCTION

Prior to programming, the ACS must be mounted and all required wiring completed. In addition, all connections should be checked for accuracy. Once these items are completed, the ACS is ready to be programmed for the desired mode of operation for the boiler plant. The steps for programming will vary somewhat, depending on whether the Outdoor Reset, Remote Setpoint or Constant Setpoint operating mode is selected.

NOTE

The Level 1 Password (**159**) must be entered prior to programming the ACS for operation in any of the modes described in **paragraphs 4.2** through **4.4**. Refer to **Chapter 3** for instructions on password entry and basic menu processing procedures.

4.2 OUTDOOR RESET MODE

The Outdoor Reset mode operates based on outside air temperature. In this mode, the header supply water temperature will vary up or down in accordance with outside air temperature. Therefore, in order to set up and operate in this mode, an outdoor air sensor MUST be installed. This mode requires entries to be made in the Field Adjust Menu, Configuration Menu and Relay Menu. For Modulex installations an entry will also be required in +the Calibration Menu. The required entries are as follows:

- **FIELD ADJUST MENU**
    - o HEADER SET MODE
    - o RESET RATIO
    - o BLDG REF TEMP

- **CONFIGURATION MENU**
    - o BOILER OPERATING MODE
    - o BLR START LEVEL
    - o BLR STOP LEVEL

- **RELAY MENU**
    - o SYSTEM START RELAY TEMP

- **CALIBRATION MENU (Required Only For Modulex Installations)**
    - o LOAD START PCT

The programming set-up instructions for the above menu options are provided in paragraphs which follow.

11/22/2017
OMM-0081_0F

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Page **67** of **139**
GF-131

4.2.1 Selecting Outdoor Reset Mode

The Outdoor Reset Mode is selected using the Header Set Mode option in the Field Adjust Menu as shown below:

Selecting Outdoor Reset Mode

1. Using the keypad on the ACS, press the **MENU** key, until *FIELD ADJUST MENU* appears in the display.

2. Using the ▲ or ▼ arrow key on the keypad, scroll through the menu until *HEADER SET MODE* is displayed in first line of the VFD display. The second line of display will show the currently selected Header Set Mode (*CONSTANT SETPOINT, OUTDOOR RESET or REMOTE SETPOINT*).

3. If *OUTDOOR RESET* is not displayed in the second line of the display, press the **CHANGE** key. The VFD display will switch to a reverse video format indicating that a change is in process.

4. Using the ▲ or ▼ arrow key, select *OUTDOOR RESET.*

5. Press the **ENTER** key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory. While still in the Field Adjust Menu, proceed to the next paragraph and continue the set-up procedure.

4.2.2 Determining Reset Schedule

There are two variables that must be considered when determining Reset Schedule: Reset Ratio and Building Reference Temperature. There are two methods for determining the Reset Ratio. The first method utilizes the Reset Ratio Charts provided in Appendix C. This method is suitable for most installations. However, if a special Reset Schedule is desired for reheat or other purposes, the calculation method must be used. When using this method, both Reset Ratio and Building reference Temperature must be calculated. Refer to Appendix C for further instructions concerning both of these methods.

Once the Reset Ratio and Building Reference Temperature have been determined, proceed to the next paragraph and enter these options.

Page **68** of **139**
GF-131
AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288
11/22/2017
OMM-0081_0F

4.2.3 Entering Reset Ratio and Building Reference Temperature

The Reset Ratio and Building Reference Temperature (*BLDG REF TEMP*) are also entered using options contained in the Field Adjust Menu. These parameters are entered as shown below:

Entering Reset Ratio and Building Reference Temperature

1. To enter the required Reset Ratio, scroll through the Field Adjust Menu and select *RESET RATIO.*

2. If the desired ratio is not displayed, press the **CHANGE** key. The display will switch to a reverse video format indicating that a change is in process.

3. Select the required Reset Ratio using the ▲ or ▼ arrow key.

4. Press the **ENTER** key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory.

5. Next, scroll through the Field Adjust Menu and select *BLDG REF TEMP*.

6. If the desired *BLDG REF TEMP* is not displayed, press the **CHANGE** key. The display will switch to a reverse video format.

7. Select the required *BLDG REF TEMP* using the ▲ or ▼ arrow key.

8. Press the **ENTER** key to store the change. The reverse video display will revert to the normal VFD display format.

9. This completes the required entries in the Field Adjust Menu. Proceed to the next paragraph and select the Boiler Operating Mode.

4.2.4 SELECTING BOILER OPERATING MODE

The Boiler Plant can be set for either Parallel or Sequential Mode operation. The Boiler Operating Mode is selected in the Configuration Menu as shown below:

Selecting Boiler Operating Mode

1. Using the keypad on the ACS, press the MENU key, until CONFIGURATION MENU appears in the display.

2. On the keypad, press the ▲ arrow key once. BOILER OP MODE will be displayed in the first line of the VFD display. The second line of the display will show the currently selected Boiler Operating Mode. (SEQUENTIAL MODE or PARALLEL MODE). The default setting is SEQUENTIAL MODE.

3. If the desired Operating Mode is not displayed in the second line of the display, press the CHANGE key. The VFD display will switch to a reverse video format indicating that a change is in process.

4. Using the ▲ or ▼ arrow key, toggle the display to the desired setting.

5. Press the ENTER key to store the change. The reverse video display will revert to the normal display format indicating that the change has been stored in memory.

4.2.5 Entering System Start Temperature

In order to set up the Outdoor Reset Mode, the System Start Temperature must be entered. The System Start Temperature is the outside air temperature at which the boiler plant begins to operate. The factory default value for the System Start Temperature (*SYS START TEMP*) is 70°F. However, temperatures from 32°F to 120°F can be selected using the ▲ and ▼ arrow keys on the ACS keypad. Proceed as shown below:

<div style="border:1px solid #1a3c6e;">

Entering System Start Temperature

1. Using the ▲ or ▼ arrow key on the keypad, scroll through the Configuration Menu until *BLR START LEVEL* is displayed along with the current setting (default = 20%).

2. If the desired Boiler Start Level is not displayed, press the **CHANGE** key. The display will switch to to a reverse video format.

3. Select the desired Boiler Start Level using the ▲ or ▼ arrow key.

4. Press the **ENTER** key to store the changed Start Level.. The reverse video display will revert to the normal VFD display format.

5. Next, scroll through the menu until the *BLR STOP LEVEL* is displayed along with the current setting (default = 16%).

6. If the desired Boiler Stop Level is not displayed, repeat steps 2, 3 and 4 above and enter the desired Stop Level.

</div>

4.2.6 Entering Boiler Start and Boiler Stop Levels

The Boiler (BLR) Start and Boiler Stop Levels are also entered in the Configuration Menu. Refer to Appendix I to determine the correct Start and Stop levels for your installation. Enter the appropriate values in the Configuration Menu as shown below:

<div style="border:1px solid #1a3c6e;">

Entering Boiler Start & Boiler Stop Levels

1. Press the **MENU** key until *RELAY MENU* appears in the display.

2. Press the ▲ arrow key once. *SYS START TEMP* will be displayed along with the current setting for the System Start Temperature.

3. Press the **CHANGE** key to change the displayed temperature. The display will switch to a reverse video format.

4. Select the desired System Start temperature using the ▲ or ▼ arrow key.

5. Press the **ENTER** key to store the changed temperature. The reverse video display will revert to the normal VFD display format.

</div>

4.3 REMOTE SETPOINT MODE

In order to set up the ACS to operate in this mode, a Modbus communication line or a 4-to-20 mA input line with a floating ground from an Energy Management System (EMS) is required. In addition, a ACS header sensor is required. This mode may be used with or without an outdoor air temperature sensor installed. Entries in this mode are required for the following menu items:

- **FIELD ADJUST MENU**
  - HEADER SET MODE
  - HEADER HIGH LIMIT
  - HEADER LOW LIMIT
  - REMOTE SIGNAL
- **CONFIGURATION MENU**
  - BOILER OPERATING MODE
  - BLR START LEVEL
  - BLR STOP LEVEL

The programming set-up instructions for the above menu options are provided in paragraphs which follow.

4.3.1 Selecting Remote Setpoint Mode

The Remote Setpoint Mode is selected using the Header Set Mode option in the Field Adjust Menu as shown below:

Selecting Remote Setpoint Mode

1. Using the keypad on the ACS, press the **MENU** key, until *FIELD ADJUST MENU* appears in the display.

2. Using the ▲ or ▼ arrow key on the keypad, scroll through the menu until *HEADER SET MODE* is displayed in the first line of the VFD display. The second line of the display will show the currently selected Header Set Mode (*CONSTANT SETPOINT, OUTDOOR RESET or REMOTE SETPOINT*).

3. If *REMOTE SETPOINT* is not displayed in the second line of the display, press the CHANGE key. The VFD display will switch to a reverse video format indicating that a change is in process.

4. Using the ▲ or ▼ arrow key, select *REMOTE SETPOINT.*

5. Press the **ENTER** key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory. With the ACS still in the *FIELD ADJUST MENU,* proceed to the next paragraph and continue the set-up procedure.

4.3.2 Entering Header High Limit and Low Limit Temperatures

The Header High Limit and Header Low Limit are also selected using options in the *Field Adjust Menu* as shown below:

Entering Header High Limit and Low Limit Temperatures

1. Using the ▲ or ▼ arrow key on the keypad, scroll through the menu until HDR HIGH LIMIT is displayed in the first line of the VFD display. The second line of the display will show the currently selected Header High Limit temperature (default = 200°F).

2. If the required HDR HIGH LIMIT is not displayed in the second line of the display, press the CHANGE key. The VFD display will switch to a reverse video format indicating that a change is in process.

3. Using the ▲ or ▼ arrow key, select required HDR HIGH LIMIT temperature.

4. Press the ENTER key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory.

5. Next, scroll through the FIELD ADJUST MENU until HDR LOW LIMIT is displayed in the first line of the VFD display. The second line of the display will show the currently selected Header Low Limit temperature (default = 040°F).

6. If the required HDR LOW LIMIT is not displayed, press the CHANGE key.

7. Using the ▲ or ▼ arrow key, select required HDR LOW LIMIT temperature. Press the ENTER key to store the change.

8. With the ACS still in the *FIELD ADJUST MENU*, proceed to the next paragraph and continue the set-up procedure.

NOTE

If the Remote Signal is set to 4 – 20 mA, the *HDR HIGH LIMIT* temperature defines the 20 mA value and the *HDR LOW LIMIT* temperature defines the 4 mA value.

Page 72 of 139

GF-131

AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913

Phone: 800-526-0288

11/22/2017

OMM-0081_0F

4.3.3 Selecting Remote Signal Type

The boilers connected to the ACS can be controlled by either a 4-to-20 mA signal or a Modbus signal from an Energy Management System (EMS). Remote Signal type is selected in the Field Adjust Menu as shown below:

Selecting Remote Signal Type

1. Using the ▲ or ▼ arrow key on the keypad, scroll through the menu until *REMOTE SIGNAL* is displayed in the first line of the VFD display. The second line of the display will show the currently selected Remote Signal (*4-20 mA* or *MODBUS*). The default is *4-20 mA*.

2. If the required *REMOTE SIGNAL* is not displayed in the second line of the display, press the **CHANGE** key. The VFD display will switch to a reverse video format indicating that a change is in process.

3. Using the ▲ or ▼ arrow key, toggle the display to the required signal type*.*

4. Press the **ENTER** key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory.

5. This completes all required entries in the Field Adjust Menu. To complete Remote Setpoint Mode setup, select the Boiler Operating Mode option as shown at right.

4.3.4 Selecting Boiler Operating Mode

The Boiler Plant can be set for either Parallel or Sequential Mode operation. The Boiler Operating Mode is selected in the Configuration Menu as shown below:

Selecting Boiler Operating Mode

1. Using the keypad on the ACS, press the **MENU** key, until *CONFIGURATION MENU* appears in the display.

2. On the keypad, press the ▲ arrow key once. *BOILER OP MODE* will be displayed in the first line of the VFD display. The second line of the display will show the currently selected Boiler Operating Mode. (*SEQUENTIAL MODE or PARALLEL MODE*). The default setting is *SEQUENTIAL MODE.*

3. If the desired Operating Mode is not displayed in the second line of the display, press the **CHANGE** key. The VFD display will switch to a reverse video format indicating that a change is in process.

4. Using the ▲ or ▼ arrow key, toggle the display to the desired setting*.*

5. Press the **ENTER** key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory.

6. The ACS is now programmed for operation in Remote Setpoint Mode.

4.3.5 Entering Boiler Start & Stop Levels

The Boiler (BLR) Start and Boiler Stop Levels are also entered in the Configuration Menu. Refer to Appendix I to determine the correct Start and Stop levels for your installation. Enter the appropriate values in the Configuration Menu as shown below:

Entering Boiler Start & Stop Levels

1. Using the ▲ or ▼ arrow key on the keypad, scroll through the Configuration Menu until *BLR START LEVEL* is displayed along with the current setting (default = 20%).

2. If the desired Boiler Start Level is not displayed, press the **CHANGE** key. The display will switch to a reverse video format.

3. Select the desired Boiler Start Level using the ▲ or ▼ arrow key.

4. Press the **ENTER** key to store the changed Start Level.. The reverse video display will revert to the normal VFD display format.

5. Next, scroll through the menu until the *BLR STOP LEVEL* is displayed along with the current setting (default = 16%).

6. If the desired Boiler Stop Level is not displayed, repeat steps 2, 3 and 4 above for the desired Stop Level.

4.4 CONSTANT SETPOINT MODE

In the Constant Setpoint Mode of operation, only a header sensor is required. Entries in this mode are required for the following items:

- **FIELD ADJUST MENU**
  - HEADER SET MODE
  - INTERNAL SETPOINT

- **CONFIGURATION MENU**
  - BOILER OPERATING MODE
  - BLR START LEVEL
  - BLR STOP LEVEL

The set-up instructions for the above menu options are provided in paragraphs which follow.

Page **74** of **139**

GF-131

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11/22/2017

OMM-0081_0F

4.4.1 Selecting Constant Setpoint Mode

The Constant Setpoint Mode is selected using the Header Set Mode option in the Field Adjust Menu as shown below:

Selecting Constant Setpoint Mode

1. Using the keypad on the ACS, press the **MENU** key, until *FIELD ADJUST MENU* appears in the display.

2. Using the ▲ or ▼ arrow key on the keypad, scroll through the menu until *HEADER SET MODE* is displayed in the first line of the VFD display. The second line of the display will show the currently selected Header Set Mode (*CONSTANT SETPOINT, OUTDOOR RESET or REMOTE SETPOINT*).

3. If *CONSTANT SETPOINT* <u>is not</u> displayed in the second line of the display, press the **CHANGE** key. The VFD display will switch to a reverse video format indicating that a change is in process.

4. Using the ▲ or ▼ arrow key, select *CONSTANT SETPOINT.*

5. Press the ENTER key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory. With the ACS still in the *FIELD ADJUST MENU,* proceed to next paragraph to select the Internal Setpoint Temperature.

4.4.2 Selecting Internal Setpoint Temperature

The Internal Setpoint Temperature is selected using in the Field Adjust Menu below:

Selecting Internal Setpoint Temperature

1. Using the ▲ or ▼ arrow key on the keypad, scroll through the menu until *INTERNAL SETPT* is displayed in the first line of the VFD display. The second line of the display will show the currently selected Internal Setpoint temperature (default = 160°F). If the required *INTERNAL SETPT* <u>is not</u> displayed in the second line of the display, press the **CHANGE** key. The VFD display will switch to a reverse video format indicating that a change is in process.

2. Using the ▲ or ▼ arrow key, select required *INTERNAL SETPT* temperature*.*

3. Press the **ENTER** key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory.

4. This completes the required entries in the Field Adjust Menu. To complete the Constant Setpoint Mode set-up, select the Boiler Operating Mode as described below.

4.4.3 Selecting Boiler Operating Mode

The Boiler Plant can be set for either Parallel or Sequential Mode operation. The Boiler Operating Mode is selected in the Configuration Menu as shown below:

Selecting Boiler Operating Mode

1. Using the keypad on the ACS, press the **MENU** key, until *CONFIGURATION MENU* appears in the display.

2. On the keypad, press the ▲ arrow key once. *BOILER OP MODE* will be displayed in the first line of the VFD display. The second line of the display will show the currently selected Boiler Operating Mode. (*SEQUENTIAL MODE or PARALLEL MODE*). The default setting is *SEQUENTIAL MODE.*

3. If the desired Operating Mode <u>is not</u> displayed in the second line of the display, press the **CHANGE** key. The VFD display will switch to a reverse video format indicating that a change is in process.

4. Using the ▲ or ▼ arrow key, toggle the display to the desired setting.

5. Press the **ENTER** key to store the change. The reverse video display will revert to the normal display format indicating that the change has been store in memory.

6. The ACS is now programmed for operation in the Constant Setpoint Mode.

4.4.4 Entering Boiler Start and Boiler Stop Levels

The Boiler (BLR) Start and Boiler Stop Levels are also entered in the Configuration Menu. Refer to Appendix I to determine the correct Start and Stop levels for your installation. Enter the appropriate values in the Configuration Menu as shown below:

Entering Boiler Start and Boiler Stop Levels

1. Using the ▲ or ▼ arrow key on the keypad, scroll through the Configuration Menu until *BLR START LEVEL* is displayed along with the current setting (default = 20%).

2. If the desired Boiler Start Level is not displayed, press the **CHANGE** key. The display will switch to a reverse video format.

3. Select the desired Boiler Start Level using the ▲ or ▼ arrow key.

4. Press the **ENTER** key to store the changed Start Level.. The reverse video display will revert to the normal VFD display format.

5. Next, scroll through the menu until the *BLR STOP LEVEL* is displayed along with the current setting (default = 16%).

6. If the desired Boiler Stop Level is not displayed, repeat steps 2, 3 and 4 above for the desired Stop Level.

Page **76** of **139**
GF-131

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11/22/2017
OMM-0081_0F

4.5 "Temp and Load" Option

The boiler plant, and the System Start Relay, can be programmed to start based on either, or both, an outdoor temperature and/or load demand criteria. When the *SYS START OPTION* is set to *TEMP ONLY*, the outdoor temperature is the only criteria used to activate the system. In this case the system, and the System Start Relay, will activate when the outdoor temperature falls below the *SYS START TEMP* setting. If no outdoor sensor is installed, the system (and the System Start Relay) will always be activated in this case. The system will shut down and the System Start Relay deactivated when the outdoor temperature rises above the *SYS START TEMP* setting.

If the SYS START OPTION is set to *TEMP AND LOAD*, the system (and the System Start Relay) will start when the outdoor temperature is below the *SYS START TEMP* setting and the load demand (*PERCENT OF LOAD*) is at or above the *LOAD START PCT* (in Calibration Menu). The *PERCENT OF LOAD* display in the Operating Menu will show 0% until both of these criteria are satisfied. The system will shut down and the System Start Relay deactivated if either the outdoor temperature rises above the *SYS START TEMP* or the *PERCENT OF LOAD* falls below the *LOAD STOP PCT*. If no outdoor sensor is installed, the system (and the System Start Relay) will activate when the *PERCENT OF LOAD* is at or above the *LOAD START PCT*. The system will shut down when the *PERCENT OF LOAD* falls below the *LOAD STOP PCT*.

4.6 "START ENABLED" OPTION

The ACS can be used to turn on and prove a device such as a fresh air damper, gas booster or the flow of a local pump before ramping up the output. With *SYS INTLK CONFIG* (Configuration Menu) set to *START ENABLED*, the ACS will allow 30 seconds after it activates the System Start Relay before proving the selected interlock (such as *SYS START INTLK*) and ramping up the output. The System Start Relay can activate the device and the dry-contact proving switch of the device, or devices can be wired to one or both interlocks.

4.7 SYSTEM INITIALIZATION AND POLLING

In order for the ACS to recognize the boilers connected to the RS485 Network, Initialization and polling must be accomplished by performing the steps shown below:

Performing System Initialization and Polling

1. Set the **ON/OFF** switch on each boiler control panel to **ON**.

2. Turn on the ACS by pressing the **ON** key. The ACS will automatically poll (recognize) each boiler at prescribed intervals.

3. Check the yellow **REMOTE** (**REM**) LED on each boiler control panel to ensure it is ON. This indicates that the boiler is now being controlled by the ACS. On the BCM of the Modulex boilers, the yellow LED should be on and NOT flashing.

4. If any of the boiler **REMOTE** LEDs are off, check to ensure that:
   - Boiler AC power is not turned off
   - Boiler is not shut down due to a fault.
   - The RS485 Network connection is not broken.
   - Each C-More or BCM is set to a unique address.
   - The ACS is programmed with the correct C-More or BCM addresses.

The ACS will continuously poll the boilers at prescribed intervals. Therefore, if a boiler is placed off-line and then placed back on-line, it will again be recognized by the ACS during the next polling cycle.

4.8 TESTING THE SYSTEM USING THE C-MORE CONTROLS

The following procedure places a load on the system and will begin firing the boilers. At this point it is very important to make sure the system pumps are running. After system has been initialized as described in **paragraph 4.5**, proceed as shown in **Instruction 4.8** on next page:

IMPORTANT!

Prior to performing these tests, view and record the PRESENT settings stored in the ACS for *HEADER SET MODE* and *INTERNAL SETPT*. These settings are located in the Field Adjust Menu and MUST be restored to these values upon completion of following tests.

NOTE

On a cold start up, if the system is designed with a return temperature sensor with the intent to activate the plant Delta-Temperature (Delta-T) Limit function, consider disabling the return sensor. During a cold start, the cold water may be cold enough to trip the High Delta-T alarm and shut down the plant. In this case you can set the Return Sensor Mode to OFF to temporarily disable the Plant Delta-T function and then set it to NORMAL after the return water has warmed up.

Testing the System Using the C-More Controls

1. Turn off the ACS by pressing the ON/OFF key. The ON LED will turn off.

2. Using the MENU key, select the *FIELD ADJUST MENU* and scroll to the *HEADER SET MODE* option, The second line of the display will show the current setting stored in memory (*CONSTANT SETPT, OUTDOOR RESET,* or *REMOTE SETPT).*

3. If *CONSTANT SETPT* is not currently selected, press the CHANGE key. Select the *CONSTANT SETPT* mode using the ▲ or ▼ arrow key. When selected, store the change by pressing the ENTER key.

4. Next, scroll to the *INTERNAL SETPT* menu option. The second line of the display will show the current Internal Setpoint temperature (°F) stored in memory.

5. Press the CHANGE key. Set the *INTERNAL SETPT* temperature to 180°F using the ▲ and ▼ arrow keys. When set, store the change by pressing the ENTER key.

6. Turn on the ACS by pressing the ON/OFF key. The ON indicator will light and the boiler plant will start to operate.

7. Using the MENU key on the ACS, scroll to the OPERATING MENU. The first line of the display will show the Header Temperature. The second line of the display will show the Firing Rate % and the number of Units (boilers) firing.

8. When all boilers have reached at least a 55% firing rate, any boilers that have not started have not been identified by the ACS. (Cont.)

Testing the System Using the C-More Controls

9. Remember that in the Sequential mode, the ACS turns boilers on in 30-second intervals. Therefore, in a 6-boiler plant, with five boilers operating at 55% capacity, a boiler that has not started after 3 minutes has not been recognized. In parallel mode, all boilers will start at the same time.

10. This completes the System Test. Return the *HEADER SET MODE* and *INTERNAL SETPT* settings to their previously stored values.

11. If the System Test is not completed successfully, refer to the troubleshooting procedures in this manual (**Chapter 5**) and the applicable O & M Manuals for the boilers included in the boiler plant. If the problem can still not be resolved, contact **AERCO** at **1-800-526-0288**.

CAUTION!

Monitor the HDR TEMP reading to ensure it is not ramping up too high. If it is, press the ON/OFF key of the ACS to shut down the boilers. Remember that the boiler outlet temperature may be higher than the ACS header temperature.

NOTE

When a Building Automation System (BAS) is connected to monitor the ACS, ensure that the RS232 Menu is configured properly.

If the boilers connected to the ACS are to be monitored by the BAS, ensure that the MODBUS PASS THRU option in the RS232 Menu is enabled.

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Page **80** of **139**

GF-131

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11/22/2017

OMM-0081_0F

CHAPTER 5: TROUBLESHOOTING

5.1 FAULT MESSAGES AND COMMON PROBLEMS

When a fault occurs in the boiler plant, the ACS flashes fault messages at 2-second intervals and the Fault Alarm (FLT ALARM) relay contacts are closed. The red **FAULT** indicator on the front panel will also light. To cancel the alarm (open relay contacts), press the **CLEAR** key on the ACS keypad. The **FAULT** indicator will turn off, however the fault message will continue to be displayed.

The fault messages shown in Table 5-1 can appear when the ACS is operating in any of the three basic modes (Constant Setpoint, Outdoor Reset, or Remote Setpoint).

Table 5-2 lists some common problems that may occur during ACS operation and provide Probable Causes and Corrective Action for each listed Probable Cause.

TABLE 5-1: Fault Messages	
Fault Message	**Description & Possible Cause**
OUTSIDE AIR TEMP NOT CONNECTED	• Open outside air temp. sensor: resistance greater than 240K ohms (less than -40°F) • Shorted outside air temp. sensor: resistance less than 1K ohms (greater than 200°F) No sensor connected Note: Displays only in Remote Setpt and Constant Setpoint modes. I
OUTSIDE AIR TEMP SENSOR ERROR	When in Outdoor Reset Mode, the outside air temperature sensor is either open, shorted, or not connected.
HEADER SENSOR ERROR	• Open header sensor: resistance greater than 240K ohms (less than -40°F) • Shorted header sensor: resistance less than 240 ohms (over 300°F) Sensor not installed
INTERLOCK 1 ERROR	Interlock 1 is open
INTERLOCK 2 ERROR	Interlock 2 is open
HIGH DT (next to **RETURN TEMP** reading)	The Delta-T range has been exceeded by 18°F. The system must cool down to below "Header Temp + Delta-T" before the BMS will return to normal operation. **NOTE** If upon startup, the system is locked out because the Header temperature is more than "Delta-T + 18°F" above the return temperature, first set the RETURN SENSOR MODE to OFF and allow the system to warm up before setting it back to NORMAL. This will prevent the boilers from cycling too much at cold startup.

TABLE 5-1: Fault Messages	
Fault Message	**Description & Possible Cause**
CURRENT LOOP ERROR	The 4-to-20-mA remote input signal has dropped below 3 mA, or the signal is not present at the ACS.
FAIL SAFE MODE ACTIVATED	This message indicates that the ACS is operating in the Fail Safe (Constant Setpoint) mode.due to sensor loss or signal loss.
MODBUS TIMEOUT ERROR	Displayed during Modbus Remote Setpoint operation when the ACS is functioning as a Slave to an EMS Master. Error indicates that the Network Timeout has expired.
NETWORK DISABLED MODBUS LISTEN	Displayed during Modbus operation when the "FORCE LISTEN ONLY" Modbus diagnostic command is sent to the ACS Slave by the controlling Master, thereby disabling normal Modbus Network communication. It indicates that the ACS is listening for the "RESTART COMMUNICATIONS OPTIONS" diagnostic command required to restart normal Modbus communication. The ACS will operate in the Fail Safe mode during this period.
VALVE POSITION ISSUE ERROR	For Option 1 or Option 2, the motorized valve has not reached its expected position on time. Valve wait time has been exceeded.
FAULT ALARM BOILER ERROR	A boiler connected to the ACS is in fault.

TABLE 5-2: Common Problems		
Problem	**Possible Causes**	**Solution**
Boiler plant not started by ACS	• ACS not turned ON. • Outside air temperature higher than system's start temperature • Configuration not correct. • System must be initialized • Wiring between boilers and ACS not correct	• Press ON/OFF button and ensure that the LED lights • Check outside air temperature and system start temperature. System start temperature should be higher than outside air temperature for boilers to run. Check *SYS START TEMP* setting in RELAY MENU (paragraph 3.11). • Check *SYS START OPTION* in RELAY MENU. Load *START PCT* and *STOP PCT* in CALIBRATION MENU paragraphs 3.11, 3.12). • Initialize and test system (para. 4.7 and 4.8). • Check wiring. (See Chapter 2 & Appendix E)
BMK or KC Boiler with C-More Control Box not being recognized by ACS.	• C-More Box not configured correctly. • C-More Box not enabled. Front panel switch is off. • Incorrect wiring between ACS and Boiler. • Alarm condition present on C-More Control Box.	• Ensure that the C-More Boiler is configured for Direct Drive (see Chapter 5 of correct BMK or KC1000 O & M Manual for required menu settings). • Check ON/OFF switch. • See Chapter 2 for correct wiring connections • Clear alarm condition.
Modulex Boiler with BCM Control not being recognized by ACS.	• BCM not configured correctly. • 3-position switch on boiler not in correct position. • BCM Control is in alarm. • Incorrect wiring between ACS and BCM Control.	• Ensure that last boiler has termination activated (see GF-114, GF-115-C). • Ensure that the 3-position switch is in the 0 (zero) position. • Clear alarm condition. • Refer to Chapter 2 for correct wiring connections.
EMS cannot see ACS	• Incorrect address • Incorrect Baud Rate • Faulty wiring between EMS and ACS.	• See RS232 MENU (paragraph 3.6). • See RS232 MENU (paragraph 3.6). • See Chapter 2. Check wiring polarity and connections.
Boiler *RAMP UP* or *RAMP DOWN* too slow or too fast	• *RAMP UP* or *RAMP DOWN* time needs adjustment. • PID requires adjustment.	• Refer to CALIBRATION MENU (paragraph 3.12) and check the *RAMP UP %/MIN* or *RAMP DOWN %/MIN* • Refer to TUNING MENU (para. 3.10).

TABLE 5-2: Common Problems

Problem	Possible Causes	Solution
HEADER TEMPERA-TURE not reaching Setpoint	• Deadband requires adjustment • PID requires adjustment	• Check *HDR TEMP DEADBND* in TUNING MENU (paragraph 3.10). Default = 5°. • See TUNING MENU (paragraph 3.10).
Need to restore Factory Default Settings.	• Too many setting changes.	• Go to *RESET DEFAULTS* option in CALIBRATION MENU (paragraph 3.12)
Boilers over-shooting setpoint or tripping aquastat	• Header sensor not installed correctly • PID setting require adjustment • Adjustable aquastat set too low • System pumps are shut down and not controlled by or interlocked with the ACS	• Check header sensor connections and installation. • Adjust PID settingsin TUNING MENU (paragraph 3.10). • If aquastat is set lower than 200°F, reset it to 220°F. • If system pumps are shut down, check start and stop temperatures on energy management system. They should correspond to those set in the ACS. In addition, interlock wiring can be run between the ACS and energy management system to disable the ACS pumps when pumps are not running.
Modbus Network faults encountered. Boiler plant not operating	• ACS or boilers not properly configured for Modbus communication. • Bias and/or termination not activated.	• Refer to Modbus Communication Manual GF-114 for C-More control or GF-115-C for BCM control on Modulex boilers. Check all wiring connections and software menu settings. • Activate termination in last boiler. Activate bias on ACS for BCM control or in last C-More control.
Percent of Load starts to rise and suddenly drops to zero.	• Bias Switch and/or termination resister not activated at either the boiler or the ACS.	• Refer to section 2.6 to 2.9 in this manual.

APPENDIX A: ACS MENUS

TABLE A-1: ACS Menus			
Menu Level & Option	**Available Choices Or Limits**		**Default**
	Minimum	**Maximum**	
OPERATING MENU			
HEADER TEMP	40	280	N/A
HEADER SET TEMP	40	220	N/A
OUTSIDE AIR TEMP	-60	180	N/A
PERCENT OF LOAD	0	100	N/A
I/O STATUS	LSD: Bit 0 = AUX Relay Bit 1 = Fault Relay Bit 2 = Sys Start Relay Bit 3 = Empty **See Appendix B**	MSD: Bit 0 = Setback Bit 1 = Interlock 2 Bit 2 = Interlock 1 Bit 3 = Empty	
RETURN TEMP (Displayed Only If RETURN SENSOR MODE = NORMAL or DHW/TANK TEMP)	40	280	N/A
OUTLET TEMP (Displayed Only If BOILER CONTROL SELECT = CMORE or BCM)	40	280	N/A
ERROR/STATUS CODE (Displayed Only If BOILER CONTROL SELECT = CMORE or BCM)	See App. B	See App. B	N/A
SETUP MENU			
ENTER PASSWORD (Level 1 = 159) (Level 2 = 6817)	0	32000	0
SET MONTH	01	12	
SET DATE	01	31	
SET YEAR	00	99	
SET HOUR	00	23	
SET MINUTE	00	59	
SET DAY OF WEEK	SUNDAY TO SATURDAY		
RS232 MENU			

11/22/2017
OMM-0081_0F

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Page 85 of 139
GF-131

TABLE A-1: ACS Menus			
Menu Level & Option	**Available Choices Or Limits**		**Default**
	Minimum	**Maximum**	
RS232 MODE	MODBUS SLAVE, NORMAL		MODBUS SLAVE
RS232 BAUDRATE	2400, 4800, 9600, 19200		9600
MODBUS ADDRESS	128	247	128
NETWORK TIMEOUT (Seconds)	005	240	060
MODBUS PASS THRU	DISABLED, ENABLED		DISABLED
RS485 MENU			
RS485 BAUDRATE	2400, 4800, 9600, 19200		9600
MIN SLAVE ADDR	000	127	000
MIN SLAVE ADDR	000	127	000
NUMBER NETW BLRS	00	32	02
MODBUS CNTL TYPE	ROUND ROBIN, BROADCAST		ROUND ROBIN
NETW BOILER 01 ADDRESS =	000	127	001
NETW BOILER 02 ADDRESS =	000	127	002
NETW BOILER 03 ADDRESS =	000	127	000
Etc., Up To:			
FIELD ADJUST MENU			
HEADER SET MODE	CONSTANT SETPOINT, OUTDOOR RESET, REMOTE SETPOINT		CONSTANT SETPOINT
HDR HIGH LIMIT	040°F	220°F	200°F
HDR LOW LIMIT	040°F	220°F	040°F
INTERNAL SETPT	040°F	220°F	160°F
RESET RATIO (Displayed Only if HDR SET MODE = OUTDOOR RESET)	0.3	3.0	1.2
BLDG REF TEMP (Displayed Only If HDR SET MODE = OUTDOOR RESET)	40°F	220°F	70°F
REMOTE SIGNAL (Displayed Only If HDR SET MODE = REMOTE SETPT)	4 – 20 mA, MODBUS		4 - 20 mA
OFFSET ENABLE	OFF, ON		OFF

TABLE A-1: ACS Menus

Menu Level & Option	Available Choices Or Limits		Default
	Minimum	**Maximum**	
SUN OFFS TEMP	-50.0°F	50.0°F	00.0
SUN ON HOUR	00	23	00
SUN ON MINUTE	00	59	00
SUN OFF HOUR	00	23	00
SUN OFF MINUTE	00	59	00
Etc., Up To:			
SAT OFF MINUTE	00	59	00
OFFSET ENABLE	OFF, ON		OFF
SUN OFFS TEMP	-50.0°F	50.0°F	00.0
SUN ON HOUR	00	23	00
SUN ON MINUTE	00	59	00
SUN OFF HOUR	00	23	00
SUN OFF MINUTE	00	59	00
Etc., Up To:			
SAT OFF MINUTE	00	59	00
CONFIGURATION MENU			
BOILER CONTROL SELECT	OFF, CMORE, BCM		OFF
BOILER OP MODE	SEQUENTIAL MODE, PARALLEL MODE		SEQUENTIAL MODE
SYS INTLK CONFIG	START ENABLED, ALWAYS ENABLED		START ENABLED
BLR START LEVEL	001%	100%	020%
BLR STOP LEVEL	001%	040%	016%
MAX POWER INPUT	050%	100%	100%
FAIL SAFE MODE	SHUTDOWN, CONSTANT SETPOINT		SHUTDOWN
LEAD BOILER SELECT	NONE, NETW BOILER 1		NONE
LAST BOILER SELECT	NONE, NETW BOILER 1, NETW BOILER 2, Etc., Up To: NETW BOILER 32		NONE
ROTATE TIME	0 to 999 HOURS		168 HOURS
RETURN SENSOR MODE	OFF, NORMAL, DHW/TANK TEMP		OFF
PLANT DELTA-T LIMIT	10°F TO 100°F		40°F

11/22/2017
OMM-0081_0F

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Page **87** of **139**
GF-131

TABLE A-1: ACS Menus

Menu Level & Option	Available Choices Or Limits		Default
	Minimum	**Maximum**	
BOILER DELAY	10 TO 999 SEC		30 SEC
DHW OPTION	OPTION 1, OPTION 2, OPTION 3, NO OPTION		NO OPTION
NUMBER OF DHW BOILERS (Displayed Only if DHW OPTION = 1 or 2)	0 to 8		1
DHW SIGNAL (Displayed Only if DHW OPTION = 1 or 2)	NO SIGNAL, SPECIAL SIGNAL		NO SIGNAL
VALVE WAIT STATE (Displayed Only if DHW OPTION = 1 or 2)	OFF, ON		OFF
SYSTEM RELAY OPTION (Displayed Only if DHW OPTION = 1)	NORMAL, DHW VALVE 1		DHW VALVE 1
NUMBER OF DHW PRIORITY BLRS (Displayed Only if DHW OPTION = 2)	0 TO (NUM DHW BLRS – 1)		0
BOOST TEMP (Displayed Only if DHW OPTION = 3)	40°F TO 200°F		140°F
RETURN TEMP BOOST DISABLE	-10°F TO 10°F		0°F
TUNING MENU			
PROPORTIONAL BND	005°F	120°F	070°F
INTEGRAL GAIN	0.00 REP/MIN	9.99 REP/MIN	0.15 REP/MIN
DERIVATIVE GAIN	-2.00 MIN.	2.00 MIN.	0.15 MIN.
HIGH DB SETPT ENABLE	BLR STOP PCT	100%	16%
DEADBND HIGH	001°F	025°F	001°F
DEADBND LOW	001°F	015°F	001°F
SETPOINT DOWN RATE	1° PER MIN	240° PER MIN	100° PER MIN
DEMAND OFFSET	0°F	25°F	0°F
RELAY MENU			
SYS START TEMP	032°F	120°F	070°F
SYS START OPTION	TEMP ONLY, TEMP AND LOAD		TEMP ONLY
SYS START INTLK	DISABLED INTERLOCK 1 INTERLOCK 2 INTERELOCK 1&2		INTERLOCK 1
AUX RELAY OPEN	000%	099%	045%
AUX RELAY CLOSE	100% FIRE RATE, 100% AND OFF		100% AND OFF

Menu Level & Option	Available Choices Or Limits		Default
	Minimum	**Maximum**	
TABLE A-1: ACS Menus			
FAULT ALRM RELAY	ALL FAULTS, NO INTERLOCK, INTERLOCK 2, INTERLOCK 1		ALL FAULTS
FAULT ALARM BLRS	NO BLR FAULTS, ALL BLR FAULTS		NO BLR FAULTS
FAULT ALRM CLEAR	AUTOMATIC, MANUAL RESET		AUTOMATIC
CALIBRATION MENU			
HDR SENS OFFSET	-10.0°	10.0°	00.0°
OUTD SENS OFFSET	-10.0°	10.0°	00.0°
4 – 20 MA OFFSET	-10.0	10.0	00.0
RET SENS OFFSET	-10.0°	10.0°	00.0
RAMP UP %/MIN	000	300	020
RAMP DOWN %/MIN	000	300	200
RESET DEFAULTS	NO, YES (DONE If Selected)		NO
PASSTHRU WRITE?	DISABLED, ENABLED		DISABLED
VALVE WAIT TIME	1 TO 500 SEC		120 SEC

11/22/2017
OMM-0081_0F

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Page **89** of **139**
GF-131

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Page **90** of **139**

GF-131

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11/22/2017

OMM-0081_0F

APPENDIX B: STATUS AND FAULT MESSAGES

B.1 ACS STATUS AND FAULT MESSAGES

TABLE B-1: ACS Status And Fault Messages	
Display Messages	**Description**
STATUS MESSAGES:	
FAIL SAFE MODE ACTIVATED	The system is running in the Constant Setpt mode due to loss of the Remote signal or Outdoor Air sensor input.
NETWORK DISABLED MODBUS LISTEN	"Forced Listen Only Mode" has been activated. All Modbus commands except "restart Communications Options" will be ignored. The ACS will operate in the Fail Safe Mode.
OUTSIDE AIR TEMP NOT CONNECTED	The Outdoor Air Temperature Sensor is not installed and connected.
RETURN TEMP NOT INSTALLED	The Boiler Return Temperature Sensor is not installed.
FAULT MESSAGES	
OUTDOOR SENSOR ERROR	The Outdoor Air Temperature Sensor signal is out of range.
HEADER SENSOR ERROR	The Header Temperature Sensor signal is out of range or disconnected.
RETURN SENSOR ERROR	The Return Temperature Sensor signal is out of range.
INTERLOCK 1 ERROR	Interlock 1 input is open.
INTERLOCK 2 ERROR	Interlock 2 input is open.
4 – 20 mA INPUT ERROR	The 4 – 20 mA Remote Input signal is lost.
MODBUS TIMEOUT ERROR	The Modbus remote input information was not received within the network timeout period.

B.2 C-MORE STATUS AND FAULT MESSAGES

TABLE B-2: C-More Status and Fault Messages		
Code	**Message**	**Description**
1	DISABLED HH:MM pm MM/DD/YY	Displayed if ON/OFF switch is set to OFF. The display also shows the time and date that the unit was disabled.
2	STANDBY	Displayed when ON/OFF switch is in the ON position, but there is no demand for heat. The time and date are also displayed.
3	DEMAND DELAY XX sec	Displayed if Demand Delay is active.
4	PURGING XX sec	Displayed during the purge cycle during startup. The duration of the purge cycle counts up in seconds.
5	IGNITION TRIAL XX sec	Displayed during ignition trial of startup sequence. The duration of cycle counts up in seconds.
6	FLAME PROVEN	Displayed after flame has been detected for a period of 2 seconds. Initially, the flame strength is shown in %. After 5 seconds has elapsed, the time and date are shown in place of flame strength.
7	WARMUP XX sec	Displayed for 2 minutes during the initial warm-up only.
8	HIGH WATER TEMP SWITCH OPEN	The High Water Temperature Limit Switch is open.
9	LOW WATER LEVEL	The Water Level Control board is indicating low water level.
10	LOW GAS PRESSURE	The Low Gas Pressure Limit Switch is open.
11	HIGH GAS PRESSURE	The High Gas Pressure Limit Switch is open.
12	INTERLOCK OPEN	The Remote Interlock is open.
13	DELAYED INTERLOCK OPEN	The Delayed Interlock is open.
14	AIRFLOW FAULT DURING PURGE	The Blower Proof Switch opened during purge.
15	SSOV FAULT DURING PURGE	The SSOV switch opened during purge.

Page **92** of **139**
GF-131

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11/22/2017
OMM-0081_0F

Code	Message	Description
16	PRG SWTCH OPEN DURING PURGE	The Purge Position Limit switch on the Air/Fuel valve opened during purge.
17	IGN SWTCH OPEN DURING IGNITION	The Ignition Position Limit switch on the Air/Fuel valve opened during ignition.
18	AIRFLOW FAULT DURING IGN	The Blower Proof Switch opened during ignition.
19	AIRFLOW FAULT DURING RUN	The Blower Proof Switch opened during run.
20	SSOV FAULT DURING IGN	The SSOV switch closed or failed to open during ignition.
21	SSOV FAULT DURING RUN	The SSOV switch closed for more than 15 seconds during run.
22	FLAME LOSS DURING IGN	The Flame signal was not seen during ignition or lost within 5 seconds after ignition.
23	FLAME LOSS DURING RUN	The Flame signal was lost during run.
24	HIGH EXHAUST TEMPERATURE	The High Exhaust Temperature Limit Switch is closed.
25	LOSS OF POWER	A power loss occurred. The time and date when power was restored is displayed.
26	LOSS OF SENSOR	Not Currently Used
27	LOSS OF SIGNAL	Not Currently Used
28	HIGH O2 LEVEL	Not Currently Used
29	LOW O2 LEVEL	Not Currently Used
30	HIGH CO LEVEL	Not Currently Used
31	SSOV RELAY FAILURE	A failure has been detected in one of the relays that control the SSOV.
32	RESIDUAL FLAME	The Flame signal was seen for more than 60 seconds during standby.
33	HEAT DEMAND FAILURE	The Heat Demand Relays on the Ignition board failed to activate when commanded.
34	IGN SWTCH CLOSED DURING PURGE	The Ignition Position Limit switch on the Air/Fuel valve closed during purge.
35	PRG SWTCH CLOSED DURING IGNITION	The Purge Position Limit switch on the Air/Fuel valve closed during ignition.
36	SSOV SWITCH OPEN	The SSOV switch opened during standby.

TABLE B-2: C-More Status and Fault Messages

Code	Message	Description
	TABLE B-2: C-More Status and Fault Messages	
37	IGNITION BOARD COMM FAULT	Communication fault between the Ignition board and the CPU board.
39	DIRECT DRIVE SIGNAL FAULT	The direct drive signal is not present or is out of range.
40	REMOTE SETPT SIGNAL FAULT	The remote setpoint signal is not present or is out of range.
41	OUTDOOR TEMP SENSOR FAULT	The temperature measured by the Outdoor Air Sensor is out of range.
42	OUTLET TEMP SENSOR FAULT	The temperature measured by the Outlet Sensor is out of range.
43	FFWD TEMP SENSOR FAULT	The temperature measured by the FFWD Sensor is out of range.
44	HIGH WATER TEMPERATURE	The temperature measured by the Outlet Sensor exceeded the Temp Hi Limit setting.
45	LINE VOLTAGE OUT OF PHASE	The High AC voltage is out of phase from the low AC voltage.
46	STEPPER MOTOR FAILURE	The stepper motor failed to move the valve to the desired position.
47	SETPT LIMITING ACTIVE	Setpoint temperature has exceeded the maximum allowable setting.
48	MODBUS COMM FAULT	The RS485 (Modbus) network information is not present or is corrupted.
49	BOILER_RETRY_WAIT_ MESSAGE	
50	BOILER_FAULT_PURGE_ MESSAGE,	
51	BOILER_RETRY_PAUSE_ MESSAGE	
52	EXHAUST_TEMP_SENSOR_ SHORT_MESSAGE	
53	EXHAUST_TEMP_SENSOR_ OPEN_MESSAGE	
54	EXHAUST_TEMP_HIGH_ WARNING_MESSAGE	
55	EXHAUST_TEMP_HIGH_ FAULT_MESSAGE	
56	INLET_TEMP_SENSOR_ SHORT_MESSAGE	

TABLE B-2: C-More Status and Fault Messages		
Code	Message	Description
57	INLET_TEMP_SENSOR_ OPEN_MESSAGE	
58	INLET_TEMP_HIGH_ WARNING_MESSAGE	
59	INLET_TEMP_LOW_ WARNING_MESSAGE	
60	INLET_GAS_PRESSURE_ SENSOR_OPEN_MESSAGE	
61	GAS_PLATE_DP_SENSOR_ OPEN_MESSAGE	
62	INLET_WATER_FLOW_ SENSOR_OPEN_MESSAGE	
63	INLET_WATER_FLOW_ LOW_WARNING_MESSAGE	
64	INLET_WATER_FLOW_ HIGH_WARNING_MESSAGE	

B.3 CONVERSION EQUATIONS FOR TEMPERATURE VARIABLES

TABLE B-3: Conversion Equations for Temp. Variables – Variable Counts to Temp		
Register Variable Type	**Degrees Fahrenheit (°F)**	**Degrees Celsius (°C)**
DEGREES_1	$Temp(F) = \left[\dfrac{(RegVar)*(230)+500}{1000}\right] + 20$	$Temp(C) = \left[\dfrac{(RegVar)*(128)+500}{1000}\right] - 7$
DEGREES_2	$Temp(F) = \left[\dfrac{(RegVar)*(220)+500}{1000}\right] - 80$	$Temp(C) = \left[\dfrac{(RegVar)*(183)+500}{1000}\right] - 62$
DEGREES_3	$Temp(F) = \left[\dfrac{(RegVar)*(520)+500}{1000}\right] + 40$	$Temp(C) = \left[\dfrac{(RegVar)*(289)+500}{1000}\right] - 4$

ABS_DEG_1	For (RegVar≥0): $Temp(F) = \left[\dfrac{(RegVar)*(230)+500}{1000}\right]$
	
	 For (RegVar<0): $Temp(F) = \left[\dfrac{(RegVar)*(230)-500}{1000}\right]$
		For (RegVar≥0): $Temp(C) = \left[\dfrac{(RegVar)*(128)+500}{1000}\right]$
		
		 For (RegVar<0): $Temp(C) = \left[\dfrac{(RegVar)*(128)-500}{1000}\right]$

TABLE B-3: Conversion Equations for Temp. Variables – Temp to Variable Counts		
Register Variable Type	**Degrees Fahrenheit (°F)**	**Degrees Celsius (°C)**
DEGREES_1	$RegVar = \left[\dfrac{(degF-20)*(1000)+115}{230}\right]$	$RegVar = \left[\dfrac{(degC+7)*(1000)+64}{128}\right]$
DEGREES_2	$RegVar = \left[\dfrac{(degF-80)*(1000)+110}{220}\right]$	$RegVar = \left[\dfrac{(degC+62)*(1000)+91.5}{183}\right]$
DEGREES_3	$RegVar = \left[\dfrac{(degF+40)*(1000)+300}{600}\right]$	$RegVar = \left[\dfrac{(degC-4)*(1000)+144.5}{289}\right]$

TABLE B-3: Conversion Equations for Temp. Variables – Temp to Variable Counts		
Register Variable Type	**Degrees Fahrenheit (°F)**	**Degrees Celsius (°C)**
ABS_DEG_1	For (degF≥0): $$RegVar = \left[\frac{(degF)*(1000)+115}{230}\right]$$ For (degF<0): $$RegVar = \left[\frac{(degF)*(1000)-115}{230}\right]$$	For (degC≥0): $$RegVar = \left[\frac{(degC)*(1000)-115}{128}\right]$$ For (degC<0): $$RegVar = \left[\frac{(degC)*(1000)-64}{128}\right]$$

B.4 INTERPRETING BCM FAULT CODES (MODULEX)

NOTE

In order to properly interpret a Fault Code for the BCM (Boiler Communication Module), use the table below to determine the actual Fault Code in which to look up in tables B-5 and B-6.

Formula for Interpreting BCM Fault Codes (Modulex)		
Displayed Number Between:	**Fault Name**	**Fault Code Formula**
0	No Fault	None
1 and **255**	BMM #0 Fault	Displayed Number = BMM Fault Code in Table B-6
256 and **511**	BMM #1 Fault	Subtract 256 from Displayed Number = BMM Fault Code in Table B-6
512 and **767**	BMM #2 Fault	Subtract 512 from Displayed Number = BMM Fault Code in Table B -6
768 and **1023**	BMM #3 Fault	Subtract 768 from Displayed Number = BMM Fault Code in Table B -6
1024 and **1279**	BMM #4 Fault	Subtract 1024 from Displayed Number = BMM Fault Code in Table B -6
1280 and **1535**	BMM #5 Fault	Subtract 1280 from Displayed Number = BMM Fault Code in Table B -6
1536 and **1791**	BMM #6 Fault	Subtract 1536 from Displayed Number = BMM Fault Code in Table B -6
1792 and **2047**	BMM #7 Fault	Subtract 1792 from Displayed Number = BMM Fault Code in Table B -6
2048 and **65279**	Invalid Codes	None
Above **65280**	BCM Fault	Subtract 65280 from Displayed Number = BCM Fault Code in Table B -5

Example:

A displayed number of "261" means the fault occurred on BMM #1, and after subtracting 256 from 261 (261 – 256 = 5), the actual Fault Code is 5, which, according to Table B-6 means "Flame Loss During Run".

B.5 BCM (BOILER COMMUNICATION MODULE) FAULT CODES

Code	Description	Effect	Correction	Reset
TABLE B-5: BCM (Boiler Control Module) Fault Codes				
17	Boiler Pipe is frozen. FlowSensor temp. is 36°F or less.	Ignition is inhibited. Pump runs for 5 min at max speed.	Carefully defrost boiler	AUTOMATIC - when FlowSensor is greater than 41°F.
18	Maximum Δ-temperature protection. Flow temperature - Return Temperature > Water Δ-Temp Protection + 50°F	All burners turned OFF and Pump ON at maximum speed.	Check the system installation.	AUTOMATIC - when Δ-temperature < Water Δ-Temp Protection.
19	High outlet temperature. FlowSensor temperature > 203°F.	All burners turned OFF and Pump ON at maximum speed.	Check Flow Sensor or system pump	AUTOMATIC - when FlowSensor < 176°F.
38	Settings Corrupted	Ignition is inhibited. Pump runs for 5 min at max speed.	Re-program the settings. Contact Factory	MANUAL - push reset switch or cycle power.
50	Internal Failure	Ignition is inhibited.	Contact Factory for new BCM.	MANUAL - cycle the power.
58	FlowSensor fault.	All burners turned OFF.	Check flow sensor or wiring.	AUTOMATIC
97	Standby. No remote control detected and Request input is open.	Ignition is inhibited.	Close Request input for Manual operation.	MANUAL - push reset switch or cycle power.
98	No BMM detected.	Ignition is not possible.	Check the BMM eBus wiring.	MANUAL - push reset switch or cycle power.

B.6 BMM (BURNER MANAGEMENT MODULE) FAULT CODES

Code	Description	Effect	Correction	Reset
TABLE B-6: BMM (Boiler Management Module) Fault Codes				
1	High Limit (STB) Thermostat activated	All burners turned OFF and Pump ON at maximum speed.	Check FlowSensor thermal connection to boiler.	MANUAL - push reset switch when temperature goes below limit.
2	Low Gas Pressure	All burners turned OFF .	Check gas pressure or gas pressure switch.	AUTOMATIC - when gas pressure switch closes.
4	No flame detected at burner start	Burner control lockout.	Check flame rod or combustion.	MANUAL - push reset switch or cycle power.
5	Flame loss during run.	Ignition retry.	Check combustion and wiring.	MANUAL - push reset switch or cycle power.
6	High outlet temperature. FlowSensor temperature > 203°F.	All burners turned OFF and Pump ON at maximum speed.	Check Flow Sensor or system pump	AUTOMATIC - when FlowSensor < 176°F.
10	Internal Failure	Ignition is inhibited.	Contact Factory for new BCM.	MANUAL - cycle the power.
11	Flame signal detected before ignition.	Ignition is inhibited.	Disconnect flame rod wire from BMM. If problem goes away change flame rod and/or wire. If problem does not go away change BMM.	MANUAL - push reset switch or cycle power.
12	FlowSensor fault.	All burners turned OFF.	Check flow sensor or wiring.	AUTOMATIC
14	Return Sensor fault	All burners turned OFF.	Check return sensor or wiring.	AUTOMATIC
15	Maximum Δ-temperature protection. Flow temperature - Return Temperature > Water Δ-Temp Protection + 50°F	All burners turned OFF and Pump ON at maximum speed.	Check the system installation.	AUTOMATIC - when Δ-temperature < Water Δ-Temp Protection.

TABLE B-6: BMM (Boiler Management Module) Fault Codes				
Code	**Description**	**Effect**	**Correction**	**Reset**
16	Boiler Pipe is frozen. FlowSensor temperature is 36°F or less.	Ignition is inhibited. Pump runs for 5 min at max speed.	Carefully defrost boiler	AUTOMATIC - when FlowSensor is greater than 41°F.
20	Flame signal detected after burner is OFF.	Ignition is inhibited.	Disconnect gas valve wire from BMM. If failure goes away, check wiring or change BMM. If failure remains check or change gas valve.	MANUAL - push reset switch or cycle power.
22	No air flow at burner after fan started for 30 seconds.	Ignition retry after 60 second delay and failure remains until we have a successful burner operation.	If fan is stopped, check supply voltage and fan wiring. If OK try another fan. If still not working change the BMM. If fan is not stopped, check the exhaust gas outlet for blockage. If OK then check the air pressure switch wiring. If still not working try another air pressure switch. If still not working, change the BMM.	AUTOMATIC/MANUAL
23	The air pressure switch doesn't switch off.	Ignition is inhibited.	Disconnect the air proving switch. If problem goes away install a new switch. If not, check the wiring. If wiring OK then change BMM.	AUTOMATIC
24	Fan speed out of control: It doesn't reach pre-purge speed within 30 seconds.	Ignition retry after 60 second delay and failure remains until we have a successful burner operation.	Check fan wiring.	AUTOMATIC/MANUAL
26	Fan speed out of control: It doesn't stop within 30 seconds after turned OFF.	Ignition is inhibited.	Check fan wiring.	AUTOMATIC

TABLE B-6: BMM (Boiler Management Module) Fault Codes				
Code	**Description**	**Effect**	**Correction**	**Reset**
27	Air flow failure during ignition.	Restart pre-purge timer. The failure remains until we have a successful burner operation.	Check fan and wiring. Check air proving switch and wiring.	AUTOMATIC
30	Settings Corrupted	Ignition is inhibited. Pump runs for 5 min at max speed.	Re-program the settings. Contact Factory	MANUAL - cycle the power or send reset message.
32	Line voltage too low. (<96 VAC)	Wait for proper line voltage. (>102 VAC)	Check input voltage else try another BMM.	AUTOMATIC
40	Low Water Flow. Low water flow switch activated.	Burners turned OFF.	Check water flow or check switch.	AUTOMATIC

B.7 ACS (AERCO CONTROL SYSTEM) I/O STATUS

TABLE B-7: ACS I/O Status							
(MSD = Most Significant Digit; LSD = Least Significant Digit)							
I/O Status	(MSD Bit 3)	Inter-Lock (MSD Bit 2)	Inter-Lock 2 (MSD Bit 1)	Setback (MSD Bit 0)	(Lsd Bit 3)	Sys Strt Relay (LSD Bit 2)	Fault Relay (LSD Bit 1)	Aux Relay (LSD Bit 0)
00	N/A	OFF	OFF	OFF	N/A	OFF	OFF	OFF
01	N/A	OFF	OFF	OFF	N/A	OFF	OFF	ON
02	N/A	OFF	OFF	OFF	N/A	OFF	ON	OFF
03	N/A	OFF	OFF	OFF	N/A	OFF	ON	ON
04	N/A	OFF	OFF	OFF	N/A	ON	OFF	OFF
05	N/A	OFF	OFF	OFF	N/A	ON	OFF	ON
06	N/A	OFF	OFF	OFF	N/A	ON	ON	OFF
07	N/A	OFF	OFF	OFF	N/A	ON	ON	ON
08 - 09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	OFF	OFF	ON	N/A	OFF	OFF	OFF
11	N/A	OFF	OFF	ON	N/A	OFF	OFF	ON
12	N/A	OFF	OFF	ON	N/A	OFF	ON	OFF
13	N/A	OFF	OFF	ON	N/A	OFF	ON	ON
14	N/A	OFF	OFF	ON	N/A	ON	OFF	OFF
15	N/A	OFF	OFF	ON	N/A	ON	OFF	ON
16	N/A	OFF	OFF	ON	N/A	ON	ON	OFF
17	N/A	OFF	OFF	ON	N/A	ON	ON	ON
18 - 19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	N/A	OFF	ON	OFF	N/A	OFF	OFF	OFF
21	N/A	OFF	ON	OFF	N/A	OFF	OFF	ON
22	N/A	OFF	ON	OFF	N/A	OFF	ON	OFF
23	N/A	OFF	ON	OFF	N/A	OFF	ON	ON
24	N/A	OFF	ON	OFF	N/A	ON	OFF	OFF
25	N/A	OFF	ON	OFF	N/A	ON	OFF	ON
26	N/A	OFF	ON	OFF	N/A	ON	ON	OFF
27	N/A	OFF	ON	OFF	N/A	ON	ON	ON
28 - 29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	OFF	ON	ON	N/A	OFF	OFF	OFF
31	N/A	OFF	ON	ON	N/A	OFF	OFF	ON
32	N/A	OFF	ON	ON	N/A	OFF	ON	OFF
33	N/A	OFF	ON	ON	N/A	OFF	ON	ON
34	N/A	OFF	ON	ON	N/A	ON	OFF	OFF

Page **102** of 139
GF-131
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TABLE B-7: ACS I/O Status

				(MSD = Most Significant Digit; LSD = Least Significant Digit)				
I/O Status	(MSD Bit 3)	Inter-Lock (MSD Bit 2)	Inter-Lock 2 (MSD Bit 1)	Setback (MSD Bit 0)	(Lsd Bit 3)	Sys Strt Relay (LSD Bit 2)	Fault Relay (LSD Bit 1)	Aux Relay (LSD Bit 0)
35	N/A	OFF	ON	ON	N/A	ON	OFF	ON
36	N/A	OFF	ON	ON	N/A	ON	ON	OFF
37	N/A	OFF	ON	ON	N/A	ON	ON	ON
38 - 39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
40	N/A	ON	OFF	OFF	N/A	OFF	OFF	OFF
41	N/A	ON	OFF	OFF	N/A	OFF	OFF	ON
42	N/A	ON	OFF	OFF	N/A	OFF	ON	OFF
43	N/A	ON	OFF	OFF	N/A	OFF	ON	ON
44	N/A	ON	OFF	OFF	N/A	ON	OFF	OFF
45	N/A	ON	OFF	OFF	N/A	ON	OFF	ON
46	N/A	ON	OFF	OFF	N/A	ON	ON	OFF
47	N/A	ON	OFF	OFF	N/A	ON	ON	ON
48 - 49	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50	N/A	ON	OFF	ON	N/A	OFF	OFF	OFF
51	N/A	ON	OFF	ON	N/A	OFF	OFF	ON
52	N/A	ON	OFF	ON	N/A	OFF	ON	OFF
53	N/A	ON	OFF	ON	N/A	OFF	ON	ON
54	N/A	ON	OFF	ON	N/A	ON	OFF	OFF
55	N/A	ON	OFF	ON	N/A	ON	OFF	ON
56	N/A	ON	OFF	ON	N/A	ON	ON	OFF
57	N/A	ON	OFF	ON	N/A	ON	ON	ON
58 - 59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
60	N/A	ON	ON	OFF	N/A	OFF	OFF	OFF
61	N/A	ON	ON	OFF	N/A	OFF	OFF	ON
62	N/A	ON	ON	OFF	N/A	OFF	ON	OFF
63	N/A	ON	ON	OFF	N/A	OFF	ON	ON
64	N/A	ON	ON	OFF	N/A	ON	OFF	OFF
65	N/A	ON	ON	OFF	N/A	ON	OFF	ON
66	N/A	ON	ON	OFF	N/A	ON	ON	OFF
67	N/A	ON	ON	OFF	N/A	ON	ON	ON
68 - 69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
70	N/A	ON	ON	ON	N/A	OFF	OFF	OFF
71	N/A	ON	ON	ON	N/A	OFF	OFF	ON
72	N/A	ON	ON	ON	N/A	OFF	ON	OFF

11/22/2017
OMM-0081_0F

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Page **103** of **139**
GF-131

TABLE B-7: ACS I/O Status

	(MSD = Most Significant Digit; LSD = Least Significant Digit)						
I/O Status	(MSD Bit 3)	Inter-Lock (MSD Bit 2)	Inter-Lock 2 (MSD Bit 1)	Setback (MSD Bit 0)	(Lsd Bit 3)	Sys Strt Relay (LSD Bit 2)	Fault Relay (LSD Bit 1)	Aux Relay (LSD Bit 0)
73	N/A	ON	ON	ON	N/A	OFF	ON	ON
74	N/A	ON	ON	ON	N/A	ON	OFF	OFF
75	N/A	ON	ON	ON	N/A	ON	OFF	ON
76	N/A	ON	ON	ON	N/A	ON	ON	OFF
77	N/A	ON	ON	ON	N/A	ON	ON	ON
78 - 79	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

APPENDIX C: RESET SCHEDULE AND OUTDOOR RESET RATIO CHARTS

C.1 USING THE CHARTS TO DETERMINE RESET SCHEDULE

Each table in this appendix provides data for a specific building reference temperature. On the vertical axis of each table are degree day temperatures. These are the average lowest temperatures likely to be encountered. The engineer of your system should have this number for your area. The reset ratio is shown across the top. The data in the tables is header temperature. To determine the reset ratio for your installation, follow these steps:

- On the vertical axis, find the degree day for your area.

- Select the temperature that should be maintained in the header to maintain the building at the desired temperature. The system engineer should have this information.

- The proper reset ratio is the value found above the two selected points. For example, for a degree day of 15°F and a header temperature of 125°F, the reset ratio is 1.4.

C.2 DETERMINING RESET SCHEDULE BY FORMULA

There are two steps required to determine reset schedule with this method. The first is to determine the reset ratio by dividing the range of outside temperatures by the range of header temperatures:

$T_{header}/T_{outside}$ = Reset Ratio.

for example, If $T_{outside}$ varies from -10 to +95°F (105° range), and T_{header} varies from 125 to 200°F (75° range), then the reset ratio equals

75°F/105°F = 0.714.

Once the reset ratio is determined, this number and the lowest or highest header temperature and corresponding lowest or highest air temperature, are input to the following equation to yield the building reference temperature:

T_{header} = RR (TR-TO)+TR, where:

RR is the reset ratio

TR is the building reference temperature

TO is the minimum outside temperature, and

T_{header} is the maximum heating system

Temperature desired at the minimum outside air temperature.

So in this example:

T_{header} = 200°F

200°F = 0.714 [TR-(-10°F)] +TR

200°F = 1.714TR + 7.14°F

Solving for TR:

TR = (200°F-7.14°F)/1.714

TR = 192.86°F/1.714

TR = 112.5°F

Therefore, use a reset ratio of 0.7 (closest to 0.714) and a building reference temperature of 113 (closest to 112.5).

11/22/2017
OMM-0081_0F

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Page **105** of **139**
GF-131

TABLE C-1: Header Temperature for a Building Reference Temperature of 50°F

Air Temp	RESET RATIO									
	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
50°F	50°F	50°F	50°F	50°F	50°F	50°F	50°F	50°F	50°F	50°F
45°F	53°F	54°F	55°F	56°F	57°F	58°F	59°F	60°F	60°F	62°F
40°F	56°F	58°F	60°F	62°F	64°F	66°F	68°F	70°F	72°F	74°F
35°F	59°F	62°F	65°F	68°F	71°F	74°F	77°F	80°F	83°F	86°F
30°F	62°F	66°F	70°F	74°F	78°F	82°F	86°F	90°F	94°F	98°F
25°F	65°F	70°F	75°F	80°F	85°F	90°F	95°F	100°F	105°F	110°F
20°F	68°F	74°F	80°F	86°F	92°F	98°F	104°F	110°F	116°F	122°F
15°F	71°F	78°F	85°F	92°F	99°F	106°F	113°F	120°F	127°F	134°F
10°F	74°F	82°F	90°F	98°F	106°F	114°F	122°F	130°F	138°F	146°F
5°F	77°F	86°F	95°F	104°F	113°F	122°F	131°F	140°F	149°F	158°F
0°F	80°F	90°F	100°F	110°F	120°F	130°F	140°F	150°F	160°F	170°F
-5°F	83°F	94°F	105°F	116°F	127°F	138°F	149°F	160°F	171°F	182°F
-10°F	86°F	98°F	110°F	122°F	134°F	146°F	158°F	170°F	182°F	194°F
-15°F	89°F	102°F	115°F	128°F	141°F	154°F	167°F	180°F	193°F	206°F
-20°F	92°F	106°F	120°F	134°F	148°F	162°F	176°F	190°F	204°F	218°F

TABLE C-2: Header Temperature for a Building Reference Temperature of 60°F

Air Temp	RESET RATIO									
	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
60°F	60°F	60°F	60°F	60°F	60°F	60°F	60°F	60°F	60°F	60°F
55°F	63°F	64°F	65°F	66°F	67°F	68°F	69°F	70°F	71°F	72°F
50°F	66°F	68°F	70°F	72°F	74°F	76°F	78°F	80°F	82°F	84°F
45°F	69°F	72°F	75°F	78°F	81°F	84°F	87°F	90°F	93°F	96°F
40°F	72°F	76°F	80°F	84°F	88°F	92°F	96°F	100°F	104°F	108°F
35°F	75°F	80°F	85°F	90°F	95°F	100°F	105°F	110°F	115°F	120°F
30°F	78°F	84°F	90°F	96°F	102°F	108°F	114°F	120°F	126°F	132°F
25°F	81°F	88°F	95°F	102°F	109°F	116°F	123°F	130°F	137°F	144°F
20°F	84°F	92°F	100°F	108°F	116°F	124°F	132°F	140°F	148°F	156°F
15°F	87°F	96°F	105°F	114°F	123°F	132°F	141°F	150°F	159°F	168°F
10°F	90°F	100°F	110°F	120°F	130°F	140°F	150°F	160°F	170°F	180°F
5°F	93°F	104°F	115°F	126°F	137°F	148°F	159°F	170°F	181°F	192°F
0°F	96°F	108°F	120°F	132°F	144°F	156°F	168°F	180°F	192°F	204°F
-5°F	99°F	112°F	125°F	138°F	151°F	164°F	177°F	190°F	203°F	216°F
-10°F	102°F	116°F	130°F	144°F	158°F	172°F	186°F	200°F	214°F	
-15°F	105°F	120°F	135°F	150°F	165°F	180°F	195°F	210°F		
-20°F	108°F	124°F	140°F	156°F	172°F	188°F	204°F			

TABLE C-3: Header Temperature for a Building Reference Temperature of 65°F

Air Temp	RESET RATIO									
	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
65°F	65°F	65°F	65°F	65°F	65°F	65°F	65°F	65°F	65°F	65°F
60°F	68°F	69°F	70°F	71°F	72°F	73°F	74°F	75°F	76°F	77°F
55°F	71°F	73°F	75°F	77°F	79°F	81°F	83°F	85°F	87°F	89°F
50°F	74°F	77°F	80°F	83°F	86°F	89°F	92°F	95°F	98°F	101°F
45°F	77°F	81°F	85°F	89°F	93°F	97°F	101°F	105°F	109°F	113°F
40°F	80°F	85°F	90°F	95°F	100°F	105°F	110°F	115°F	120°F	125°F
35°F	83°F	89°F	95°F	101°F	107°F	113°F	119°F	125°F	131°F	137°F
30°F	86°F	93°F	100°F	107°F	114°F	121°F	128°F	135°F	142°F	149°F
25°F	89°F	97°F	105°F	113°F	121°F	129°F	137°F	145°F	153°F	161°F
20°F	92°F	101°F	110°F	119°F	128°F	137°F	146°F	155°F	164°F	173°F
15°F	95°F	105°F	115°F	125°F	135°F	145°F	155°F	165°F	175°F	185°F
10°F	98°F	109°F	120°F	131°F	142°F	153°F	164°F	175°F	186°F	197°F
5°F	101°F	113°F	125°F	137°F	149°F	161°F	173°F	185°F	197°F	209°F
0°F	104°F	117°F	130°F	143°F	156°F	169°F	182°F	195°F	208°F	
-5°F	107°F	121°F	135°F	149°F	163°F	177°F	191°F	205°F	219°F	
-10°F	110°F	125°F	140°F	155°F	170°F	185°F	200°F°	215°F		
-15°F	113°F	129°F	145°F	161°F	177°F	193°F	209°F			

TABLE C-4: Header Temperature for a Building Reference Temperature of 70°F

Air Temp	RESET RATIO									
	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
70°F	70°F	70°F	70°F	70°F	70°F	70°F	70°F	70°F	70°F	70°F
65°F	73°F	74°F	75°F	76°F	77°F	78°F	79°F	80°F	81°F	82°F
60°F	76°F	78°F	80°F	82°F	84°F	86°F	88°F	90°F	92°F	94°F
55°F	79°F	82°F	85°F	88°F	91°F	94°F	97°F	100°F	103°F	106°F
50°F	82°F	86°F	90°F	94°F	98°F	102°F	106°F	110°F	114°F	118°F
45°F	85°F	90°F	95°F	100°F	105°F	110°F	115°F	120°F	125°F	130°F
40°F	88°F	94°F	100°F	106°F	112°F	118°F	124°F	130°F	136°F	142°F
35°F	91°F	98°F	105°F	112°F	119°F	126°F	133°F	140°F	147°F	154°F
30°F	94°F	102°F	110°F	118°F	126°F	134°F	142°F	150°F	158°F	166°F
25°F	97°F	106°F	115°F	124°F	133°F	142°F	151°F	160°F	169°F	178°F
20°F	100°F	110°F	120°F	130°F	140°F	150°F	160°F	170°F	180°F	190°F
15°F	103°F	114°F	125°F	136°F	147°F	158°F	169°F	180°F	191°F	202°F
10°F	106°F	118°F	130°F	142°F	154°F	166°F	178°F	190°F	202°F	214°F
5°F	109°F	122°F	135°F	148°F	161°F	174°F	187°F	200°F	213°F	
0°F	112°F	126°F	140°F	154°F	168°F	182°F	196°F	210°F		
-5°F	115°F	130°F	145°F	160°F	175°F	190°F	205°F			
-10°F	118°F	134°F	150°F	166°F	182°F	198°F	214°F			
-15°F	121°F	138°F	155°F	172°F	189°F	206°F				
-20°F	124°F	142°F	160°F	178°F	196°F	214°F				

11/22/2017
OMM-0081_0F
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Phone: 800-526-0288
Page **107** of **139**
GF-131

TABLE C-5: Header Temperature for a Building Reference Temperature of 75°F

Air Temp	RESET RATIO									
	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
75°F	75°F	75°F	75°F	75°F	75°F	75°F	75°F	75°F	75°F	75°F
70°F	78°F	79°F	80°F	81°F	82°F	83°F	84°F	85°F	86°F	87°F
65°F	81°F	83°F	85°F	87°F	89°F	91°F	93°F	95°F	97°F	99°F
60°F	84°F	87°F	90°F	93°F	96°F	99°F	102°F	105°F	108°F	111°F
55°F	87°F	91°F	95°F	99°F	103°F	107°F	111°F	115°F	119°F	123°F
50°F	90°F	95°F	100°F	105°F	110°F	115°F	120°F	125°F	130°F	135°F
45°F	93°F	99°F	105°F	111°F	117°F	123°F	129°F	135°F	141°F	17°F
40°F	96°F	103°F	110°F	117°F	124°F	131°F	138°F	145°F	152°F	159°F
35°F	99°F	107°F	115°F	123°F	131°F	139°F	147°F	155°F	163°F	171°F
30°F	102°F	111°F	120°F	129°F	138°F	147°F	156°F	165°F	174°F	183°F
25°F	105°F	115°F	125°F	135°F	145°F	155°F	165°F	175°F	185°F	195°F
20°F	108°F	119°F	130°F	141°F	152°F	163°F	174°F	185°F	196°F	207°F
15°F	111°F	123°F	135°F	147°F	159°F	171°F	183°F	195°F	207°F	219°F
10°F	114°F	127°F	140°F	153°F	166°F	179°F	192°F	205°F	218°F	
5°F	117°F	131°F	145°F	159°F	173°F	187°F	201°F	215°F		
0°F	120°F	135°F	150°F	165°F	180°F	195°F	210°F			
-5°F	123°F	139°F	155°F	171°F	187°F	203°F	219°F			
-10°F	126°F	143°F	160°F	177°F	194°F	211°F				
-15°F	129°F	147°F	165°F	183°F	201°F	219°F				

TABLE C-6: Header Temperature for a Building Reference Temperature of 80°F

Air Temp	RESET RATIO									
	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
80°F	80°F	80°F	80°F	80°F	80°F	80°F	80°F	80°F	80°F	80°F
75°F	83°F	84°F	85°F	86°F	87°F	88°F	89°F	90°F	91°F	92°F
70°F	86°F	88°F	90°F	92°F	94°F	96°F	98°F	100°F	102°F	104°F
65°F	89°F	92°F	95°F	98°F	101°F	104°F	107°F	110°F	113°F	116°F
60°F	92°F	96°F	100°F	104°F	108°F	112°F	116°F	120°F	124°F	128°F
55°F	95°F	100°F	105°F	110°F	115°F	120°F	125°F	130°F	135°F	140°F
50°F	98°F	104°F	110°F	116°F	122°F	128°F	134°F	140°F	146°F	152°F
45°F	101°F	108°F	115°F	122°F	129°F	136°F	143°F	150°F	157°F	164°F
40°F	104°F	112°F	120°F	128°F	136°F	144°F	152°F	160°F	168°F	176°F
35°F	107°F	116°F	125°F	134°F	143°F	152°F	161°F	170°F	179°F	188°F
30°F	110°F	120°F	130°F	140°F	150°F	160°F	170°F	180°F	190°F	200°F
25°F	113°F	124°F	135°F	146°F	157°F	168°F	174°F	190°F	201°F	212°F
20°F	116°F	128°F	140°F	152°F	164°F	176°F	188°F	200°F	212°F	
15°F	119°F	132°F	145°F	158°F	171°F	184°F	197°F	210°F		
10°F	122°F	136°F	150°F	164°F	178°F	192°F	206°F			
5°F	125°F	140°F	155°F	170°F	185°F	200°F	215°F			
0°F	128°F	144°F	160°F	176°F	192°F	208°F				
-5°F	131°F	148°F	165°F	182°F	199°F	216°F				
-10°F	134°F	152°F	170°F	188°F	206°F					

Air Temp	RESET RATIO									
	0.6	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
90°F	90°F	90°F	90°F	90°F	90°F	90°F	90°F	90°F	90°F	90°F
85°F	93°F	94°F	95°F	96°F	97°F	98°F	99°F	100°F	101°F	102°F
80°F	96°F	98°F	100°F	102°F	104°F	106°F	108°F	110°F	112°F	114°F
75°F	99°F	102°F	105°F	108°F	111°F	114°F	117°F	120°F	123°F	126°F
70°F	102°F	106°F	110°F	114°F	118°F	122°F	126°F	130°F	134°F	138°F
65°F	105°F	110°F	115°F	120°F	125°F	130°F	135°F	140°F	145°F	150°F
60°F	108°F	114°F	120°F	126°F	132°F	138°F	144°F	150°F	156°F	162°F
55°F	111°F	118°F	125°F	132°F	139°F	146°F	153°F	160°F	167°F	174°F
50°F	114°F	122°F	130°F	138°F	146°F	154°F	162°F	170°F	178°F	186°F
45°F	117°F	126°F	135°F	144°F	153°F	162°F	171°F	180°F	189°F	198°F
40°F	120°F	130°F	140°F	150°F	160°F	170°F	180°F	190°F	200°F	210°F
35°F	123°F	134°F	145°F	156°F	167°F	178°F	189°F	200°F		
30°F	126°F	138°F	150°F	162°F	174°F	186°F	198°F	210°F		
25°F	129°F	142°F	155°F	168°F	181°F	194°F	207°F			
20°F	132°F	146°F	160°F	174°F	188°F	202°F	216°F			
15°F	135°F	150°F	165°F	180°F	195°F	210°F				
10°F	138°F	154°F	170°F	186°F	202°F	218°F				
5°F	141°F	158°F	175°F	192°F	209°F					
0°F	144°F	162°F	180°F	198°F	216°F					

TABLE C-7: Header Temperature for a Building Reference Temperature of 90°F

11/22/2017
OMM-0081_0F

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Page **109** of **139**
GF-131

APPENDIX D: NTC TEMPERATURE SENSOR RESISTANCE

NTC Temperature Sensor Resistance Chart			
Temperature (°F)	**Resistance (ohms)**	**Temperature (°F)**	**Resistance (ohms)**
-40	239,571	180	1,362
-30	173,530	190	1,155
-20	127,088	200	984
-10	94,059	210	842
0	70,314	220	723
10	53,068	230	623
20	40,418	240	539
30	31,053	250	468
40	24,057	260	408
50	18,787	270	357
60	14,783	280	313
70	11,717	290	276
80	9,353	300	243
90	7,516	310	
100	6,078	320	
110	4,946	330	
120	4,049	340	
130	3,333	350	
140	2,759	360	
150	2,296	370	
160	1,920	380	
170	1,613	390	

NOTE

This Temperature Chart is applicable to Header Sensor (and Return Sensor), P/N **64038** and Outside Air Sensor, P/N **GP-122662**

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Page **110** of 139
GF-131

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11/22/2017
OMM-0081_0F

APPENDIX E: ACS WIRING DIAGRAM

11/22/2017
OMM-0081_0F

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Page **111** of 139
GF-131

APPENDIX F: ACS PARTS AND ACCESSORIES

ACS Parts and Accessories List		
Part Number	**Description**	**Comments**
64053	ACS II (ACS)	Complete ACS
GP-123043	12 VAC, 5A, 2AG Subminiature, Fast-Acting Fuse (Littlefuse 225005)	For System-Start, Fault Alarm, and Auxiliary Relays
69091	4 – 20 mA Fuse	63 microamp fuse for current loop
GP-122662	Outside Air Temperature Sensor	Sensor Only
GM-122781	Outside Air Temperature Sensor Kit	Includes Sensor (GP-122662) and Mounting Bracket
64038	Header Temperature Sensor	Sensor Only
GP-122758	Thermowell for Header Temperature Sensor	Thermowell Only
GM-122790	Header Temperature Sensor Kit	Includes 64038 and GP-122758
GM-122791	Outdoor Reset Kit	Includes GM-122781 and GM-122790
62017	Low Voltage Terminal Block (14 pin)	
62018	High Voltage Terminal Block (9 pin)	
62019	RS485 Terminal Block (3 pin)	
62020	RS232 Terminal Block (4 pin)	

Page 112 of 139
GF-131
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Phone: 800-526-0288
11/22/2017
OMM-0081_0F

APPENDIX G: PROGRAMMING USING RS232 COMMUNICATION

G.1 INTRODUCTION

The RS-232 communication feature allows the ACS to be easily programmed to your installation requirements using a listing of entry commands.

The RS-232 port located in the wiring compartment area of the ACS can be used to program the ACS using a laptop computer or other suitable terminal. Connection to a laptop or other terminal device is made by wiring to the RXD, TXD and GND connections (see paragraph 2.9 and Figure 2-12 for pinout information when wiring from a DB9 connector). Communication can be accomplished using any "Dumb Terminal" emulation, such as "PuTTY" which is not included with Microsoft Windows, but can be downloaded for free on the internet. Source and instructions for using Putty are provided here:

G.2 AQUIRING THE PuTTY APPLICATION

Download the **putty.exe** program to your desktop from:

www.chiark.greenend.org.uk/~sgtatham/putty/download.html

You can use PuTTY to logon to remote computers as well as run a single command on a remote server. PuTTY does not need to be installed, so just clicking the downloaded executable will start it.

G.2.1 Logging on to a Remote Machine Using PuTTY

To use **PuTTY** to logon to a remote machine, bring up the PuTTY application by double-clicking its icon. You will see the main window as shown in left image of Figure 9-1.
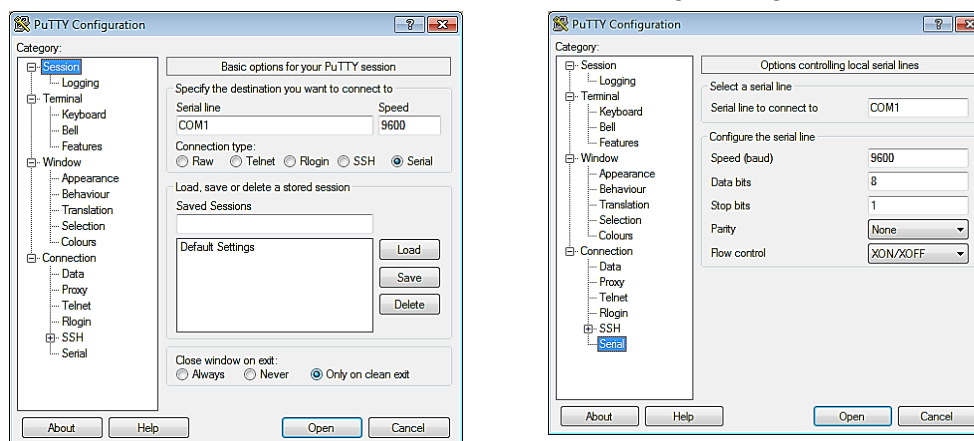
Figure 9-1: PuTTY GUI: Basic Serial Session (L) and Serial Options (R)

In Serial mode, text typed into the PuTTY window will be sent straight out of your computer's serial port, and data received through that port will be displayed in the PuTTY window.

To create a Serial connection, click the radio button labeled Serial. The Serial line and Speed fields will then be automatically filled in as shown in *left* image of Figure 9-1, but will allow you to specify the serial line to use (if your computer has more than one) and what speed (baud rate) to use when transferring data. For further configuration options (data bits, stop bits, parity, flow

control), you can use the Serial Configuration panel (*right* image in Figure 9-1) by selecting "Serial" in the left navigation pane.

Now, to connect to the remote server, simply click the Open button at the bottom of the dialog box. A new terminal window will pop up and ask you to log in.

So that you don't have to enter this information every time you wish to connect to your server, you can save this configuration by typing an appropriate *name* in the Saved Sessions text box in the PuTTY "Basic Options" window (left image of Figure 9-1) and then clicking the Save button. In the future, you can select the *name* you chose in the list box and click the Load button to initialize this particular configuration.

G.2.2 Running a Command on a Remote Machine Using PuTTY

PuTTY may also be used to run some command residing on the remote server. After specifying the command line you want to run, you will be asked for your account name and password, and then the command you specified will execute. When it completes, your session will terminate, and your window will either close or remain open depending on how you configure the session. Here are the steps:

<div style="border:1px solid">

Running a Command on a Remote Machine Using PuTTY

1. Bring up the PuTTY application and select the server you wish to connect to.

2. At the bottom of the Basic Options dialog box (left image of Figure 9-1) in the section titled: **Close window on exit**, select the **Never** radio button. This will keep the window open after the command has finished executing so that you can see any results in the terminal window.

3. In the menu bar along the left side of the dialog box, click the **SSH** menu near the bottom. The following screen will be presented:
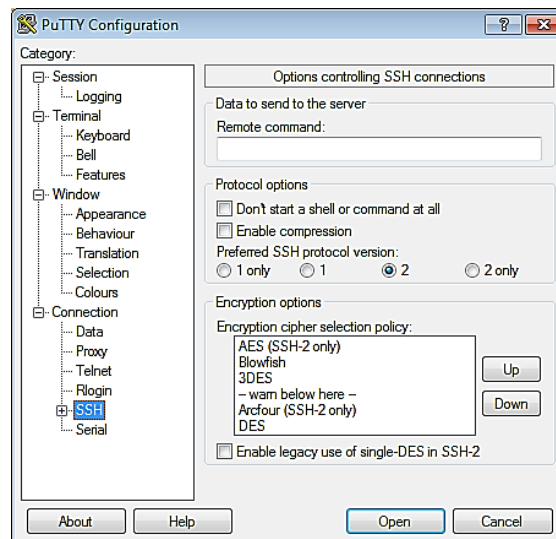
4. Into the textbox titled, **Remote command** type the full command line you wish to have executed on the remote machine.
5. You are now ready to execute this command on the remote machine, simply click the **Open** button at the bottom of the dialog.
6. You will have to provide an account name and password in the terminal window to complete the process.

</div>

G.3 RS232 COMMUNICATION SET-UP

Regardless of the terminal emulation utilized, the following guidelines must be adhered to when interfacing the ACS to the Terminal device:

RS232 Communication Set-Up

1. Connect cable leads to the RS-232 connector in the wiring area of the ACS.

2. Connect the free end of the cable to the COM 1 or COM 2 port on your laptop, or other suitable terminal device.

3. Set up the emulator communication link as follows:

    a. Set the baud rate to 9600.

    b. Set the data format to 8 bits, 1 stop bit, no parity and either Xon/Xoff or No Flow Control.

4. Turn on the ACS by pressing the ON/OFF key. Verify that the ON LED lights.

5. Press the MENU key. Go to the SETUP MENU and enter a valid PASSWORD.

6. Press the MENU key and go to the RS232 MENU.

7. Press the ▲ arrow key to display the *RS232 MODE* option.

8. Press the ▲ or ▼ arrow key to display *NORMAL*. Press the ENTER key to store the *NORMAL* selection

9. Start the emulator software program.

10. At the command prompt, enter the password EXACTLY as follows (case-sensitive):
    P=gobms

11. Press Return (<Rtn>) on your terminal.

12. The setup is now complete. You are ready to begin viewing or changing ACS functions.

G.4 PROGRAMMING PROCEDURE

ACS functions which can be viewed or changed are listed in **Table G-1** along with their corresponding command numbers. Functions which can only be viewed (such as actual sensor readings) are marked "Read Only". Viewing or changing function values is accomplished as follows:

Programming Procedure

1. Select the number of the desired command from Table J-1.

2. To view a parameter, type **?**, followed by the command number and then press return (<Rtn>). For example, to view command no. 00 (HEADER TEMPERATURE), enter:

    ?00<Rtn>

    The header temperature reading will be displayed. All temperature readings are in °F.

3. To program (set) a ACS parameter, type @, followed by the command number, an equal sign, the parameter value and a trailing zero. For example, to set command 05 (SYSTEM OUTSIDE AIR START TEMPERATURE) to 65°F, enter:

    @05=650<Rtn>

Use the above steps to view and/or program the desired ACS functions listed in **Table G-1**.

No.	Command	Entry Range	Factory Default
**TABLE G-1: ACS Commands**			
00	Header Temperature (°F)	40 to 220	Read Only
01	Outside Air Temperature (°F)	-60 to 80	Read Only
02	Return Sensor (°F)	40 to 160	Read Only
03	Percent of Load (%)	0 to 100	Read Only
04	Header Set Temperature (°F)	40 to 220	Read Only
05	System Start Temperature (°F)	32 to 120	70
06	System Start Mode	0 = Temp Only 1 = Temp and Load	0 = Temp Only
07	Internal Setpt (°F)	40 to 220	160
08	Bldg Reference Temperature (°F)	40 to 220	70°F
09	Not Used		
10	Not Used		
11	Reset Ratio	0.3 to 3.0 (0.1 increments)	1.2
12	Maximum Header Temperature (°F)	40 to 220	220
13	Minimum Header Temperature (°F)	40 to 220	40
14	Boiler Start Percent	25 to 100	20
15	Boiler Stop Percent	10 to 45	16
16	Integral Gain (Rep./Min)	0.00 to 9.99 (0.01 increments)	0.15
17	Header Set Mode	0 = Constant Setpt 1 = Indr/Outdr Reset 2 = Remote Settemp	0 = Constant Setpt
18	Derivative Gain	-2.00 to 2.00 (0.01 increments)	0.15
19	Proportional Band (°F)	5 to 100	70
20	Aux Relay Open	0 to 99	45
21	Aux Relay Close	0 = 100% Fire Rate 1 = 100% and OFF	1 = 100% AND OFF
22	Failsafe Mode	0 = Shutdown 1 = Switch Inputs	0 = Shutdown
23	Fault Relay Mode	0 = All Faults 1 = No Interlock 2 = Interlock 2 3 = Interlock 1	0 = All Faults
24	Alarm Clear Method	0 = Automatic 1 = Manual	0 = Automatic
25	Boiler Operation Mode	0 = Parallel 1 = Sequential 2 = Combination	1 = Sequential
00	Header Temperature (°F)	40 to 220	Read Only
01	Outside Air Temperature (°F)	-60 to 80	Read Only
02	Return Sensor (°F)	40 to 160	Read Only
03	Percent of Load (%)	0 to 100	Read Only
04	Header Set Temperature (°F)	40 to 220	Read Only
05	System Start Temperature (°F)	32 to 120	70

Page **116** of **139**

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GF-131

Phone: 800-526-0288

11/22/2017

OMM-0081_0F

TABLE G-1: ACS Commands

No.	Command	Entry Range	Factory Default
06	System Start Mode	0 = Temp Only 1 = Temp and Load	0 = Temp Only
07	Internal Setpt (°F)	40 to 220	160
08	Bldg Reference Temperature (°F)	40 to 220	70°F
09	Not Used		
10	Not Used		
11	Reset Ratio	0.3 to 3.0 (0.1 increments)	1.2
12	Maximum Header Temperature (°F)	40 to 220	220
13	Minimum Header Temperature (°F)	40 to 220	40
14	Boiler Start Percent	25 to 100	20
15	Boiler Stop Percent	10 to 45	16
16	Integral Gain (Rep./Min)	0.00 to 9.99 (0.01 increments)	0.15
17	Header Set Mode	0 = Constant Setpt 1 = Indr/Outdr Reset 2 = Remote Settemp	0 = Constant Setpt
18	Derivative Gain	-2.00 to 2.00 (0.01 increments)	0.15
19	Proportional Band (°F)	5 to 100	70
20	Aux Relay Open	0 to 99	45
21	Aux Relay Close	0 = 100% Fire Rate 1 = 100% and OFF	1 = 100% AND OFF
22	Failsafe Mode	0 = Shutdown 1 = Switch Inputs	0 = Shutdown
23	Fault Relay Mode	0 = All Faults 1 = No Interlock 2 = Interlock 2 3 = Interlock 1	0 = All Faults
24	Alarm Clear Method	0 = Automatic 1 = Manual	0 = Automatic
25	Boiler Operation Mode	0 = Parallel 1 = Sequential 2 = Combination	1 = Sequential
26	Not Used		
27 28 29	Reserved		
30	Maximum Power Input	50 to 100	100
31	System Interlock Configuration	0 = Always Enabled 1 = Start Enabled	1 = Start Enabled
32	Real Time Clock - Minutes	00 to 59	Present Time
33	Real Time Clock - Hours	00 to 23	Present Time
34	Real Time Clock - Day Of Week	1 to 7	Present Day
35	Real Time Clock - Year	00 to 99	Present Year
36	Real Time Clock - Day Of Month	00 to 31	Present Day
37	Real Time Clock - Month	00 to 12	Present Month

No.	Command	Entry Range	Factory Default
38 Thru 44	(Day 1 – Sun.) Offset Temperatures (Day 1-7) (Day 7 – Sat.)	-50 to +50°F	All Set To 0°F
45 Thru 51	(Sun.) Offset ON Time – Minutes (Sun.-Sat.) (Sat.)	00 to 59	All Set to Zero
52 Thru 58	(Sun.) Offset ON Time – Hours (Sun.-Sat.) (Sat.)	00 to 23	All Set To Zero
59	Offset Enable	0 = Disabled 1 = Enabled	0 = Disabled
60	Header Temp Offset (°F)	-10°F to 10°F	0
61	System Start Interlock	1 = Intlk 1 Opens Start Relay 2 = Intlk 2 Opens Start Relay 3 = Either Intlk Opens Start Relay	1 = Intlk 1
70 Thru 76	(Sun.) Offset OFF Time – Minutes (Sun.-Sat.) Sat.)	00 to 59	All Set To Zero
77 Thru 83	(Day 1) Offset OFF Time – Hours (Day 1-7) (Day 7)	0 to 23	All Set To Zero
84	(Reserved)		
85	Not Used	0 or 1	
86	Remote Signal	0 or 1 0 = 4 - 20 mA 1 = Modbus	0 = 4 - 20 mA
87	RS232 Mode	0 or 1 0 = Normal 1 = Modbus	1 = Modbus
88	RS232 Baud Rate	0=2400, 1=4800, 2=9600, 3=14400, 4=19200	2 = 9600
89	Number Of Network Boilers	0 to 32	2
90	Min Slave Address	0 to 127	0
91	Max Slave Address	0 to 127	0
92	Net Boiler 1 Address	Address for Network Boiler 1	001
93	Net Boiler 2 Address	Address for Network Boiler 2	002
94	Net Boiler 3 Address	Address for Network Boiler 3	000

TABLE G-1: ACS Commands

TABLE G-1: ACS Commands

No.	Command	Entry Range	Factory Default
95	Net Boiler 4 Address	Address for Network Boiler 4	000
96	Net Boiler 5 Address	Address for Network Boiler 5	000
97	Net Boiler 6 Address	Address for Network Boiler 6	000
98	Net Boiler 7 Address	Address for Network Boiler 7	000
99	Net Boiler 8 Address	Address for Network Boiler 8	000
100	Net Boiler 9 Address	Address for Network Boiler 9	000
101	Net Boiler 10 Address	Address for Network Boiler 10	000
102	Net Boiler 11 Address	Address for Network Boiler 11	000
103	Net Boiler 12 Address	Address for Network Boiler 12	000
104	Net Boiler 13 Address	Address for Network Boiler 13	000
105	Net Boiler 14 Address	Address for Network Boiler 14	000
106	Net Boiler 15 Address	Address for Network Boiler 15	000
107	Net Boiler 16 Address	Address for Network Boiler 16	000
108	Net Boiler 17 Address	Address for Network Boiler 17	000
109	Net Boiler 18 Address	Address for Network Boiler 18	000
110	Net Boiler 19 Address	Address for Network Boiler 19	000
111	Net Boiler 20 Address	Address for Network Boiler 20	000
112	Net Boiler 21 Address	Address for Network Boiler 21	000
113	Net Boiler 22 Address	Address for Network Boiler 22	000
114	Net Boiler 23 Address	Address for Network Boiler 23	000
115	Net Boiler 24 Address	Address for Network Boiler 24	000
116	Net Boiler 25 Address	Address for Network Boiler 25	000
117	Net Boiler 26 Address	Address for Network Boiler 26	000

No.	Command	Entry Range	Factory Default
118	Net Boiler 27 Address	Address for Network Boiler 27	000
119	Net Boiler 28 Address	Address for Network Boiler 28	000
120	Net Boiler 29 Address	Address for Network Boiler 29	000
121	Net Boiler 30 Address	Address for Network Boiler 30	000
122	Net Boiler 31 Address	Address for Network Boiler 31	000
123	Net Boiler 32 Address	Address for Network Boiler 32	000
124	Network Baud	0=2400, 1=4800, 2=9600, 3=14400, 4=19200	2 = 9600
125	Network Timeout	5 to 240 sec	60 sec.
126	Password Lo	0 to 255	0
127	Password Hi	0 to 255	0
128	Modbus Control Type	0 = Round-Robin 1 = Broadcast	0 = Round Robin
129	Modbus Pass-Thru	0 = Disabled 1 = Enabled	0 = Disabled
130	Header Temp Deadband	01 to 15°F	05°F
131	Outside Temp Sensor Offset	-10.0°F to 10.0°F	0.0°F
132	Ramp Up %/Min	000 to 300	20
133	Ramp Down %/Min	000 to 300	200
134	Fault Alarm Boilers	No Blr Faults All Blr faults	No Blr Faults
135	4-20 mA Offset	-1.00 to 1.00 mA	0.0 mA
136	Return Sensor Offset	-10.0 to 10.0°F	0.0°F
137	Load Start Pct	000 to 100	1
138	Load Stop Pct	000 to 100	0
150	I/O Status	00 to 255	Bit 0 = AUX Relay Bit 1 = Fault Relay Bit 2 = Sys Start Relay Bit 3 = Empty Bit 4 = Setback Bit 5 = Interlock 2 Bit 6 = Interlock 1 Bit 7 = Empty
151 & Up	(Reserved For Future Expansion)	Undefined	

TABLE G-1: ACS Commands

APPENDIX H: ACS MODBUS ADDRESS ASSIGNMENTS

IMPORTANT!

All Modbus addresses specified in this manual are written generically in hexadecimal format. However, many Building Automation Systems utilize another form of addressing where:

40001 is added to the generic address for a Holding Register address.

AND

30001 is added to the generic address for an Input Register address.

Be sure to check the addressing scheme being used by the BAS that is being interfaced to the ACS.

H.1 ACS CONTROLLER STANDARD INPUT REGISTER ASSIGNMENTS

The Read Only Input Register assignments for the ACS are listed in Table H-1 which follows:

TABLE H-1: ACS Standard Input Register Address Mapping

Modbus Data Address Decimal (Hex)	Menu Item	Units and Range	Default/ Comments
0 (0x0000)	(Reserved)		
1 (0x0001)	Header Temperature	40 to 220°F	
2 (0x0002)	Outside Air Temperature	-60 to 120°F	
3 (0x0003)	Indoor Air/Return Temperature	40 to 220°F	
4 (0x0004)	Fire Rate Out	0 to 100% (out to boilers)	
5 (0x0005)	Header Set Temperature	40 to 220°F	
6 (0x0006)	Network Address	128 to 247	Default = 128
7 (0x0007)	Total Boilers Fired	0 to 32 (for ACS)	
8 (0x0008)	Total Boilers On Line	0 to 32	
9 (0x0009)	(Reserved)		
10 (0x000A)	Fault/Message Code	0 to 65535 <u>Bit</u>: 0 = Outside Air Sensor 1 = Header Sensor Error 2 = Interlock 1 Error 3 = Interlock 2 Error 4 = Indoor Air Sensor Error/ Return Sensor Error 5 = 4-20mA Input Error	

TABLE H-1: ACS Standard Input Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
11 (0x000B) thru 15 (0x000F)	(Reserved)		
16 (0x0010)	Lead Boiler Number	1 to 32	
17 (0x0011) Thru 24 (0x0018)	Not Applicable		Used for 8 ACS Legacy (PWM) Boilers Only
25 (0x0019)	Boiler 1 Status (Net Boiler 1)	119 = Not On-Line 120 = On-Line But Not Fired 1–40 = Fired & Sequence 121 = On-Line But Disabled 122 = On-Line But Faulted	ACS has only Network Boilers so Net Boiler 1 = Boiler 1, etc.
26 (0x001A)	Boiler 2 Status (Net Boiler 2)	Same As Above	
27 (0x001B)	Boiler 3 Status (Net Boiler 3)	Same As Above	
28 (0x001C)	Boiler 4 Status (Net Boiler 4)	Same As Above	
29 (0x001D)	Boiler 5 Status (Net Boiler 5)	Same As Above	
30 (0x001E)	Boiler 6 Status (Net Boiler 6)	Same As Above	
31 (0x001F)	Boiler 7 Status (Net Boiler 7)	Same As Above	
32 (0x0020)	Boiler 8 Status (Net Boiler 8)	Same As Above	
33 (0x0021)	Boiler 9 Status (Net Boiler 9)	Same As Above	
34 (0x0022)	Boiler 10 Status (Net Boiler 10)	Same As Above	
35 (0x0023)	Boiler 11 Status (Net Boiler 11)	Same As Above	
36 (0x0024)	Boiler 12 Status (Net Boiler 12)	Same As Above	
37 (0x0025)	Boiler 13 Status (Net Boiler 13)	Same As Above	

Page **122** of **139**
GF-131
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11/22/2017
OMM-0081_0F

TABLE H-1: ACS Standard Input Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
38 (0x0026)	Boiler 14 Status (Net Boiler 14)	Same As Above	
39 (0x0027)	Boiler 15 Status (Net Boiler 15)	119 = Not On-Line 120 = On-Line But Not Fired 1–40 = Fired & Sequence 121 = On-Line But Disabled 122 = On-Line But Faulted	
40 (0x0028)	Boiler 16 Status (Net Boiler 16)	Same As Above	
41 (0x0029)	Boiler 17 Status (Net Boiler 17)	Same As Above	
42 (0x002A)	Boiler 18 Status (Net Boiler 18)	Same As Above	
43 (0x002B)	Boiler 19 Status (Net Boiler 19)	Same As Above	
44 (0x002C)	Boiler 20 Status (Net Boiler 20)	Same As Above	
45 (0x002D)	Boiler 21 Status (Net Boiler 21)	Same As Above	
46 (0x002E)	Boiler 22 Status (Net Boiler 22)	Same As Above	
47 (0x002F)	Boiler 23 Status (Net Boiler 23)	Same As Above	
48 (0x0030)	Boiler 24 Status (Net Boiler 24)	Same As Above	
49 (0x0031)	Boiler 25 Status (Net Boiler 25)	Same As Above	
50 (0x0032)	Boiler 26 Status (Net Boiler 26)	Same As Above	
51 (0x0033)	Boiler 27 Status (Net Boiler 27)	Same As Above	
52 (0x0034)	Boiler 28 Status (Net Boiler 28)	Same As Above	
53 (0x0035)	Boiler 29 Status (Net Boiler 29)	Same As Above	

11/22/2017
OMM-0081_0F

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Phone: 800-526-0288

Page **123** of **139**
GF-131

TABLE H-1: ACS Standard Input Register Address Mapping

Modbus Data Address Decimal (Hex)	Menu Item	Units and Range	Default/ Comments
54 (0x0036)	Boiler 30 Status (Net Boiler 30)	Same As Above	
55 (0x0037)	Boiler 31 Status (Net Boiler 31)	119 = Not On-Line 120 = On-Line But Not Fired 1–40 = Fired & Sequence 121 = On-Line But Disabled 122 = On-Line But Faulted	
56 (0x0038)	Boiler 32 Status (Net Boiler 32)	Same As Above	
57 (0x0039)	I/O Status	00 to 255	Bit map of Input/Output Status: LSD: Bit 0 = AUX Relay Bit 1 = Fault Relay Bit 2 = Sys Start Relay Bit 3 = Empty MSD: Bit 4 = Setback Bt 5 = Interlock 2 Bit 6 = Interlock 1 Bit 7 = Empty See Appendix A, Table A-7.
58 (0x003A)	Return Sensor Temp	40°F to 220°F	When Ret Sensor Mode = Normal
59 (0x003B)	Net Blr 1 Outlet Temp	40°F to 220°F	When Blr Cntl Type = 1 or 2
60 (0x003C)	Net Blr 2 Outlet Temp	40°F to 220°F	
61 (0x003D)	Net Blr 3 Outlet Temp	40°F to 220°F	
62 (0x003E)	Net Blr 4 Outlet Temp	40°F to 220°F	
63 (0x003F)	Net Blr 5 Outlet Temp	40°F to 220°F	
64 (0x0040)	Net Blr 6 Outlet Temp	40°F to 220°F	
65 (0x0041)	Net Blr 7 Outlet Temp	40°F to 220°F	
66 (0x0042)	Net Blr 8 Outlet Temp	40°F to 220°F	

Page 124 of 139
GF-131

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Phone: 800-526-0288

11/22/2017
OMM-0081_0F

TABLE H-1: ACS Standard Input Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
67 (0x0043)	Net Blr 9 Outlet Temp	40°F to 220°F	
68 (0x0044)	Net Blr 10 Outlet Temp	40°F to 220°F	
69 (0x0045)	Net Blr 11 Outlet Temp	40°F to 220°F	
70 (0x0046)	Net Blr 12 Outlet Temp	40°F to 220°F	
71 (0x0047)	Net Blr 13 Outlet Temp	40°F to 220°F	
72 (0x0048)	Net Blr 14 Outlet Temp	40°F to 220°F	
73 (0x0049)	Net Blr 15 Outlet Temp	40°F to 220°F	
74 (0x004A)	Net Blr 16 Outlet Temp	40°F to 220°F	
75 (0x004B)	Net Blr 17 Outlet Temp	40°F to 220°F	
76 (0x004C)	Net Blr 18 Outlet Temp	40°F to 220°F	
77 (0x004D)	Net Blr 19 Outlet Temp	40°F to 220°F	
78 (0x004E)	Net Blr 20 Outlet Temp	40°F to 220°F	
79 (0x004F)	Net Blr 21 Outlet Temp	40°F to 220°F	
80 (0x0050)	Net Blr 22 Outlet Temp	40°F to 220°F	
81 (0x0051)	Net Blr 23 Outlet Temp	40°F to 220°F	
82 (0x0052)	Net Blr 24 Outlet Temp	40°F to 220°F	
83 (0x0053)	Net Blr 25 Outlet Temp	40°F to 220°F	
84 (0x0054)	Net Blr 26 Outlet Temp	40°F to 220°F	
85 (0x0055)	Net Blr 27 Outlet Temp	40°F to 220°F	
86 (0x0056)	Net Blr 28 Outlet Temp	40°F to 220°F	
87 (0x0057)	Net Blr 29 Outlet Temp	40°F to 220°F	
88 (0x0058)	Net Blr 30 Outlet Temp	40°F to 220°F	
89 (0x0059)	Net Blr 31 Outlet Temp	40°F to 220°F	
90 (0x005A)	Net Blr 32 Outlet Temp	40°F to 220°F	
91 (0x005B)	PLANT DT STATUS	10°F to 100°F	When Return Sensor Mode = NORMAL
92 (0x005C)	Net Blr 1 Code	0 to 64 for C-more; 0 to 65535 for MLX (BCM)	See Appendix A, Tables A-2, A-5, and A-6.
93 (0x005D)	Net Blr 2 Code	Same as Above	"

11/22/2017
OMM-0081_0F

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Phone: 800-526-0288

Page **125** of **139**
GF-131

TABLE H-1: ACS Standard Input Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
94 (0x005E)	Net Blr 3 Code	Same as Above	
95 (0x005F)	Net Blr 4 Code	Same as Above	
96 (0x0060)	Net Blr 5 Code	Same as Above	
97 (0x0061)	Net Blr 6 Code	Same as Above	
98 (0x0062)	Net Blr 7 Code	Same as Above	
99 (0x0063)	Net Blr 8 Code	Same as Above	
100 (0x0064)	Net Blr 9 Code	Same as Above	
101 (0x0065)	Net Blr 10 Code	Same as Above	
102 (0x0066)	Net Blr 11 Code	Same as Above	
103 (0x0067)	Net Blr 12 Code	Same as Above	
104 (0x0068)	Net Blr 13 Code	Same as Above	
105 (0x0069)	Net Blr 14 Code	Same as Above	
106 (0x006A)	Net Blr 15 Code	Same as Above	
107 (0x006B)	Net Blr 16 Code	Same as Above	
108 (0x006C)	Net Blr 17 Code	Same as Above	
109 (0x006D)	Net Blr 18 Code	Same as Above	
110 (0x006E)	Net Blr 19 Code	Same as Above	
111 (0x006F)	Net Blr 20 Code	Same as Above	
112 (0x0070)	Net Blr 21 Code	Same as Above	
113 (0x0071)	Net Blr 22 Code	Same as Above	
114 (0x0072)	Net Blr 23 Code	Same as Above	
115 (0x0073)	Net Blr 24 Code	Same as Above	
116 (0x0074)	Net Blr 25 Code	Same as Above	
117 (0x0075)	Net Blr 26 Code	Same as Above	
118 (0x0076)	Net Blr 27 Code	Same as Above	
119 (0x0077)	Net Blr 28 Code	Same as Above	
120 (0x0078)	Net Blr 29 Code	Same as Above	
121 (0x0079)	Net Blr 30 Code	Same as Above	

Page 126 of 139
GF-131

AERCO International, Inc. • 100 Oritani Dr. • Blauvelt, New York 10913
Phone: 800-526-0288

11/22/2017
OMM-0081_0F

TABLE H-1: ACS Standard Input Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
122 (0x007A)	Net Blr 31 Code	Same as Above	
123 (0x007B)	Net Blr 32 Code	Same as Above	
124 (0x007C) Thru 65535 (0xFFFF)	(Reserved for future expansion)	(Not defined)	

H.2 ACS CONTROLLER STANDARD HOLDING REGISTER ASSIGNMENTS

The Holding Register address assignments for the ACS are listed in Table H-2 which follows. Unless otherwise specified, all Holding Register Menu items are Read/Write (R/W).

TABLE H2: ACS Standard Holding Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
0 (0x0000) thru 3 (0x0003)	(Reserved)		
4 (0x0004)	Net Header Set Temp	40 to 220°F	Valid when Hdr Set Mode=Remote Setpt and Remote Signal = Network
5 (0x0005)	System Start Temp	32 to 120°F	Default = 70°F
6 (0x0006)	System Start Option	0 or 1 0 = Temp Only, 1 = Temp and Load	Default = 0
7 (0x0007)	Manual Hdr Set Temp/Internal Setpt	40 to 220°F	Default = 160°F
8 (0x0008)	Bldg Ref Temp	40 to 220°F	Default = 70°F
9 (0x0009)	Not Applicable		
10 (0x000A)	Not Applicable		
11 (0x000B)	Reset Ratio	0.3 to 3.0 (0.1 increments),	Default = 1.2 (Value x 10)
12 (0x000C)	Max Header Temp	40 to 220°F	Default = 200°F
13 (0x000D)	Min Header Temp	40 to 220°F	Default = 40°F
14 (0x000E)	Start Percent	25 to 100%	Default = 20%
15 (0x000F)	Stop Percent	10 to 45%	Default = 16%
16 (0x0010)	Integral Gain	0.00 to 9.99 Rep/Min (in 0.01 increments	Default = 0.15 Rep/Min (Value x 100)
17 (0x0011)	Header Set Mode	0, 1, or 2 0 = Constant Setpt 1 = In/Outdoor Reset 2 = Remote Setpt	Default = 0 (Constant Setpt))
18 (0x0012)	Derivative Gain	-2.00 to 2.00 (0.00 increments)	Default = 0.15 (Value x 100)
19 (0x0013)	Header Temp Bandwidth	5 to 120°F	Default = 70°F

Page **128** of **139**
GF-131

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Phone: 800-526-0288

11/22/2017
OMM-0081_0F

TABLE H2: ACS Standard Holding Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
20 (0x0014)	Aux Relay Open	0 to 99%	Default = 45%
21 (0x0015)	Aux Relay Mode	0 or 1 0 = 100% Fire Rate 1 = 100% Fire Rate and Off	Default = 1 (100% Fire Rate & Off)
22 (0x0016)	Failsafe Mode	0 or 1 0 = Shutdown 1 = Constant Setpt	Default = 0 (Shutdown)
23 (0x0017)	Fault Alarm Relay Mode	0, 1, 2, 3 0 = All Faults, 1 = No Interlock 2 = Interlock 1 3 = Interlock 2	Default = 0 (All Faults)
24 (0x0018)	Fault Alarm Clear Method	0 or 1 0 = Automatic 1 = Manual	Default = 0 (Automatic)
25 (0x0019)	Boiler Operation Mode	0, 1 or 2 0 = Parallel 1 = Sequential 2 = Combination	Default = 1 (Sequential)
26 (0x001A)	Not Applicable		
27 (0x001B)	(Reserved)		
28 (0x001C)	(Reserved)		
29 (0x001D)	(Reserved)		
30 (0x001E)	Max Power Input	50 to 100%	Default = 100% (Fire Rate)
31 (0x001F)	Sys Intlk Config	0 or 1 0 = Always Enabled 1 = Start Enabled	Default = 1 (Start Enabled)
32 (0x0020)	Real Time Clock Minutes	00 to 59	Present Time
33 (0x0021)	Real Time Clock Hours	00 to 23 Hours	Present Time
34 (0x0022)	Real Time Clock Day of Week	1 to 7	Present Day
35 (0x0023)	Real Time Clock Year	00 to 99	Present Year

TABLE H2: ACS Standard Holding Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
36 (0x0024)	Real Time Clock Day of Month	01 to 31	Present Day of Month
37 (0x0025)	Real Time Clock Month	01 to 12	Present Month
38 (0x0026)	Offset Temp Sun.	-50 to 50°F	Default = 0°F
39 (0x0027)	Offset Temp Mon.	-50 to 50°F	Default = 0°F
40 (0x0028)	Offset Temp Tue.	-50 to 50°F	Default = 0°F
41 (0x0029)	Offset Temp Wed.	-50 to 50°F	Default = 0°F
42 (0x002A)	Offset Temp Thu.	-50 to 50°F	Default = 0°F
43 (0x002B)	Offset Temp Fri.	-50 to 50°F	Default = 0°F
44 (0x002C)	Offset Temp Sat.	-50 to 50°F	Default = 0°F
45 (0x002D)	Offset On Time Day 1 – Minutes	00 to 59 Minutes	Default = o
46 (0x002E)	Offset On Time Day 2 – Minutes	00 to 59 Minutes	Default = 0
47 (0x002F)	Offset On Time Day 3 – Minutes	00 to 59 Minutes	Default = 0
48 (0x0030)	Offset On Time Day 4 – Minutes	00 to 59 Minutes	Default = 0
49 (0x0031)	Offset On Time Day 5 – Minutes	00 to 59 Minutes	Default = 0
50 (0x0032)	Offset On Time Day 6 – Minutes	00 to 59 Minutes	Default = 0
51 (0x0033)	Offset On Time Day 7 – Minutes	00 to 59 Minutes	Default = 0
52 (0x0034)	Offset On Time Day 1 – Hours	00 to 23 Hours	Default = 0
53 (0x0035)	Offset On Time Day 2 – Hours	00 to 23 Hours	Default = 0
54 (0x0036)	Offset On Time Day 3 – Hours	00 to 23 Hours	Default = 0
55 (0x0037)	Offset On Time Day 4 – Hours	00 to 23 Hours	Default = 0
56 (0x0038)	Offset On Time Day 5 – Hours	00 to 23 Hours	Default = 0
57 (0x0039)	Offset On Time Day 6 – Hours	00 to 23 Hours	Default = 0
58 (0x003A)	Offset On Time Day 7 – Hours	00 to 23 Hours	Default = 0

Page 130 of 139
GF-131

AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288

11/22/2017
OMM-0081_0F

Modbus Data Address Decimal (Hex)	Menu Item	Units and Range	Default/ Comments
59 (0x003B)	Offset Enable	0 or 1 0 = Disabled 1 = Enabled	Default = 0 (Disabled)
60 (0x003C)	Header Temp Offset	-10 to 10°F	Default = 0°F
61 (0x003D)	System Start Interlock	1, 2 or 3 1 = Intlk1 Opens Start Relay 2 = Intlk2 Opens Start Relay 3 = Either Intlk Opens Start Relay	Default = 1 (Intlk 1)
62 (0x003E) Thru 69 (0x0045)	(Reserved)		
70 (0x0046)	Offset Off Time Sun. – Minutes	0 to 59 Minutes	Default = 0
71 (0x0047)	Offset Off Time Mon. – Minutes	0 to 59 Minutes	Default = 0
72 (0x0048)	Offset Off Time Tue.– Minutes	0 to 59 Minutes	Default = 0
73 (0x0049)	Offset Off Time Wed.– Minutes	0 to 59 Minutes	Default = 0
74 (0x004A)	Offset Off Time Thu – Minutes	0 to 59 Minutes	Default = 0
75 (0x004B)	Offset Off Time Fri. – Minutes	0 to 59 Minutes	Default = 0
76 (0x004C)	Offset Off Time Sat. – Minutes	0 to 59 Minutes	Default = 0
77 (0x004D)	Offset Off Time Sun. – Hours	0 to 23 Hours	Default = 0
78 (0x004E)	Offset Off Time Mon. – Hours	0 to 23 Hours	Default = 0
79 (0x004F)	Offset Off Time Tue. – Hours	0 to 23 Hours	Default = 0
80 (0x0050)	Offset Off Time Wed. – Hours	0 to 23 Hours	Default = 0
81 (0x0051)	Offset Off Time Thu. – Hours	0 to 23 Hours	Default = 0
82 (0x0052)	Offset Off Time Fri. – Hours	0 to 23 Hours	Default = 0
83 (0x0053)	Offset Off Time Sat. – Hours	0 to 23 Hours	Default = 0
84 (0x0054)	(Reserved)		

TABLE H2: ACS Standard Holding Register Address Mapping

11/22/2017
OMM-0081_0F
AERCO International, Inc. • 100 Oritani Dr. • Blauvelt, New York 10913
Phone: 800-526-0288
Page **131** of 139
GF-131

TABLE H2: ACS Standard Holding Register Address Mapping

Modbus Data Address Decimal (Hex)	Menu Item	Units and Range	Default/ Comments
85 (0x0055)	Not Applicable		
86 (0x0056)	Remote Signal	0 or 1 0 = 4 – 20 Ma 1 = Network	Default = 0 (4 – 20 Ma)
87 (0x0057)	RS232 Mode	0 or 1 0 = Normal 1 = Modbus	Default = 1 (Modbus)
88 (0x0058)	RS232 Baud Rate	0=2400, 1=4800, 2=9600, 3=14400, 4=19200	2 = 9600
89 (0x0059)	Number Of Network Boilers	0 to 32	Default = 2
90 (0x005A)	Min Slave Address	0 to 127	Default = 0
**91 (0x005B)	Max Slave Address	0 to 127,	Default = 0
**92 (0x005C)	Net Boiler 1 Address	Address for Network Boiler 1	Default = 1
**93 (0x005D)	Net Boiler 2 Address	Address for Network Boiler 2	Default = 2
94 (0x005E)	Net Boiler 3 Address	Address for Network Boiler 3	Default = 0
95 (0x005F)	Net Boiler 4 Address	Address for Network Boiler 4	Default = 0
96 (0x0060)	Net Boiler 5 Address	Address for Network Boiler 5	Default = 0
97 (0x0061)	Net Boiler 6 Address	Address for Network Boiler 6	Default = 0
98 (0x0062)	Net Boiler 7 Address	Address for Network Boiler 7	Default = 0
99 (0x0063)	Net Boiler 8 Address	Address for Network Boiler 8	Default = 0
100 (0x0064)	Net Boiler 9 Address	Address for Network Boiler 9	Default = 0
101 (0x0065)	Net Boiler 10 Address	Address for Network Boiler 10	Default = 0
102 (0x0066)	Net Boiler 11address	Address for Network Boiler 11	Default = 0
103 (0x0067)	Net Boiler 12 Address	Address for Network Boiler 12	Default = 0
104 (0x0068)	Net Boiler 13 Address	Address for Network Boiler 13	Default = 0
**105 (0x0069)	Net Boiler 14 Address	Address for Network Boiler 14	Default = 0
106 (0x006A)	Net Boiler 15 Address	Address for Network Boiler 15	Default = 0
107 (0x006B)	Net Boiler 16 Address	Address for Network Boiler 16	Default = 0
108 (0x006C)	Net Boiler 17 Address	Address for Network Boiler 17	Default = 0

Page 132 of 139
GF-131

AERCO International, Inc. • 100 Oritani Dr. • Blauvelt, New York 10913
Phone: 800-526-0288

11/22/2017
OMM-0081_0F

TABLE H2: ACS Standard Holding Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
109 (0x006D)	Net Boiler 18 Address	Address for Network Boiler 18	Default = 0
110 (0x006E)	Net Boiler 19 Address	Address for Network Boiler 19	Default = 0
111 (0x006F)	Net Boiler 20 Address	Address for Network Boiler 20	Default = 0
112 (0x0070)	Net Boiler 21 Address	Address for Network Boiler 21	Default = 0
113 (0x0071)	Net Boiler 22 Address	Address for Network Boiler 22	Default = 0
114 (0x0072)	Net Boiler 23 Address	Address for Network Boiler 23	Default = 0
115 (0x0073)	Net Boiler 24 Address	Address for Network Boiler 24	Default = 0
116 (0x0074)	Net Boiler 25 Address	Address for Network Boiler 25	Default = 0
117 (0x0075)	Net Boiler 26 Address	Address for Network Boiler 26	Default = 0
118 (0x0076)	Net Boiler 27 Address	Address for Network Boiler 27	Default = 0
119 (0x0077)	Net Boiler 28 Address	Address for Network Boiler 28	Default = 0
120 (0x0078)	Net Boiler 29 Address	Address for Network Boiler 29	Default = 0
121 (0x0079)	Net Boiler 30 Address	Address for Network Boiler 30	Default = 0
122 (0x007A)	Net Boiler 31 Address	Address for Network Boiler 31	Default = 0
**123 (0x007B)	Net Boiler 32 Address	Address for Network Boiler 32	Default = 0
124 (0x007C)	Network Baud	0=2400, 1=4800, 2=9600, 3=14400, 4=19200	2 = 9600
125 (0x007D)	Network Timeout	5 to 240 sec	Default = 60 sec.
126 (0x007E)	Password Lo	0 to 255 (73)	Default = 0
127 (0x007F)	Password Hi	0 to 255 (79)	Default = 0
128 (0x0080)	Modbus Control Type	0 = Round-Robin 1 = Broadcast	Default = 0 (Round Robin)
129 (0x0081)	Modbus Pass-Thru	0 = Disabled 1 = Enabled	Default = 0 (Disabled)
130 (0x0082)	RESERVED		Only for BMS II
131 (0x0083)	Outside Temp Sensor Offset	-50 to +50°F	Default = 0
132 (0x0084)	Dyn Up	0 to 300%/Min	Default = 20
133 (0x0085)	Dyn Down	0 to 300%/Min	Default = 200
134 (0x0086)	Fault Alarm Boilers	0 = No Blr Faults 1 = All Blr Faults	Default = 0
135 (0x0087)	4 to 20 mA Current Offset	-1.00 mA to 1.00 mA	Default = 0

TABLE H2: ACS Standard Holding Register Address Mapping			
Modbus Data Address Decimal (Hex)	**Menu Item**	**Units and Range**	**Default/ Comments**
136 (0x0088)	Return Sensor Offset	-10.0°F to 10.0°F	Default = 0
137 (0x0089)	Load Start Pct	1 to Blr Start Level	Default = 1
138 (0x008A)	Load Stop Pct	0 to Load Start Pct - 1	Default = 0
139 (0x008B)	PASS THROUGH WRITE ENABLE	0 = Disabled 1 = Enabled	Default = 0
140 (0x008C)	LEAD BOILER SELECT	0 (None) or 1	Default = 0
141 (0x008D)	LAST BOILER SELECT	0 (None) or 1 - 32	Default = 0
142 (0x008E)	ROTATE TIME	0 to 999 hrs	Default = 168 hrs
143 (0x008F)	NUMBER OF DHW BOILERS	0 to 8	Default = 1
144 (0x0090)	DHW OPTION	0 to 3 3 = No Option 0 = Option 1 (1 Valve) 1 = Option 2 (2 Valve) 2 = Option 3 (Boost)	Default = 3
145 (0x0091)	SYSTEM RELAY OPTION	0 or 1 0 = Normal 1 = DHW Valve 1 Close	Default = 0
146 (0x0092)	NUMBER DHW PRIORITY	O to Num DHW Boilers - 1	Default = 1
147 (0x0093)	DHW SIGNAL	0 or 1 0 = No Signal 1 = Special Signal	Default = 0
148 (0x0094)	RETURN SENSOR MODE	0 to 2 0 = Off 1 = Normal (Return Sensor) 2 = DHW/Tank Temp	Default = 0
149 (0x0095)	HIGH DB SETPT ENABLE LEVEL	Blr Stop Level to 100%	Default = Blr Stop Level
150 (0x0096)	DEADBAND HIGH	0 to 25°	Default = 1°
151 (0x0097)	DEADBAND LOW	0 to 25°	Default = 1°
152 (0x0098)	SETPOINT DOWN RATE	0 to 100°/Min	Default = 100°
153 (0x0099)	DEMAND OFSET	0 to 100°	Default = 0°
154 (0x009A)	PLANT DT LIMIT	10 to 100°	Default = 40°
155 (0x009B)	BOILER DELAY TIME	10 to 999 Sec	Default = 30

Page **134** of **139**
GF-131

AERCO International, Inc. ● 100 Oritani Dr. ● Blauvelt, New York 10913
Phone: 800-526-0288

11/22/2017
OMM-0081_0F

TABLE H2: ACS Standard Holding Register Address Mapping

Modbus Data Address Decimal (Hex)	Menu Item	Units and Range	Default/ Comments
156 (0x009C)	VALVE WAIT STATE	0 = Off 1 = Current State	If Option 1 or 2, Default = 0
157 (0x009D)	BOOST TEMP	Hdr Low Limit to Hdr High Limit	Default = 140
158 (0x009E)	VALVE WAIT TIME	0 to 500 Sec	Default = 120
159 (0x009F)	RETURN TEMP BOOST DISABLE	Off, -80° to +80°	Default = Off (64726)
160 (0x00A0)	MODBUS ON.OFF	0 to 2 0 = Front Panel Off 1 = On 2 = Modbus Off	Default = 0
161 (0x00A1)	BOILER CONTROL SELECT	0 to 2 0 = None 1 = C-more 2 = MLX (BCM)	Default = 0
162 (0x00A2)	BOOST MAX TIMER	0 (Off), 1 to 999 Min	Default = 0
163 (0x00A3) Thru 65535 (0Xffff)	(Reserved For Future Expansion)	Undefined	

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APPENDIX I: START AND STOP LEVELS

The ACS Configuration Menu contains options for the Boiler (BLR) Start and Boiler Stop Levels. The default settings for these options are as follows:

- Boiler Start Level: 20%

- Boiler Stop Level: 16%

In order for the ACS to properly control the boilers in the Boiler Plant, the corresponding Start and Start levels must be entered in the ACS Configuration Menu for the type of AERCO boilers being controlled.

For C-More controlled Benchmark or KC1000 Boilers, the Required Start and Stop Levels are listed at the end of Chapter 3 in the appropriate Boiler O & M Manual. If the correct O & M Manuals are not available at the installation site, the correct values can be verified by accessing the Calibration Menu in the C-More Boiler Controllers.

For Modulex Boilers, the corresponding Start and Stop Levels for each Boiler Model are listed in the following Table.

Modulex Series Start/Stop Levels			
Model	# Modules	Start Level	Stop Level
MLX 303 / EXT 321	2	17%	15%
MLX 454 / EXT 481 / EXT 450	3	12%	10%
MLX 606 / EXT 641 / EXT 600	4	9%	7%
MLX 757 / EXT 802 / EXT 800	5	7%	5%
MLX 909 / EXT 962	6	6%	4%
MLX 1060 / EXT 1123 / EXT 1100	7	5%	3%
EXT 1500 / 1530	4	9%	7%
EXT 1912	5	7%	5%
EXT 2295 / 2300	6	6%	4%
EXT 2600 / 2677	7	5%	3%
EXT 3000 / 3060	8	10%	6%

When the Boiler Plant being controlled by the ACS is comprised of a combination of AERCO Boiler types and sizes, the following guidelines should be used:

- Modulex Boilers: For different sizes of Modulex Boilers, use the Lowest Start/Stop levels for the Modulex Boilers included in the plant.

- C-More Controlled Boiler: For different sizes of C-More controlled Boilers, use the highest Start/Stop levels for the Boilers included in the plant.

- Modulex & C-More Controlled Boilers: When a mix of Modulex and C-More Boilers is include in the heating plant, use the C-More controlled Boiler Start/Stop levels.

11/22/2017
OMM-0081_0F
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Phone: 800-526-0288
Page 137 of 139
GF-131

NOTES:

Change Log:

Date	Description	Changed By
12/30/2015	Rev F: Corrected labels to V1 and V2 Pumps in Figure 2-14a, renumbered section in Appendix B; B1 is now correctly labeled ACS Status & Fault messages.	Chris Blair
11/22/2017	Rev G: **DIR 17-008:** Added new Modulex model numbers to Appendix I, updated formatting per current standard	Chris Blair

11/22/2017
OMM-0081_0F

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Phone: 800-526-0288

Page **139** of **139**
GF-131