



**User Manual for the  
*HE500ACS100-12 & HE500ACS110-12***

**AC Control Station for Stemac**  
First Edition  
22 January 2002

MAN0489-01



## PREFACE

This manual explains how to use the AC Control Station for Stamac.

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**Note: The programming examples shown in this manual are for illustrative purposes only. Proper machine operation is the sole responsibility of the system integrator.**

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## CHAPTER 1: INTRODUCTION

### 1.1 Overview

The AC Control Station Modules (ACS) are standalone modules that monitor voltage and current on two separate circuits of 3-phase AC lines and provides indications of voltage, current, real power, reactive power, apparent power, power factor, power usage, frequency and phase difference. The ACS provides this information to registers in the control station, which can be accessed via ladder logic. In addition, the ACS is user configurable to allow either delta or wye connections and select different Potential Transformer (PT) and Current Transformer (CT) ratios [ACS110 only] based on the application. Loading of these configuration parameters is accomplished using CScape I/O Configure.

The ACS also provides 10 user definable LEDs on the keypad along with a connector sense input bit for detecting when the current connector is unplugged.

The ACS100 provides eight bidirectional inputs and eight 1/2 amp protected bidirectional outputs, which are read and controlled respectively through registers in the control station. There are also three 0 to 10VDC inputs.

The ACS110 provides sixteen bidirectional inputs and sixteen 1/2 amp protected bidirectional outputs, which are read and controlled respectively through registers in the control station. It also provides three 0 to 5A current inputs and an overcurrent fault protection bit which are also read through registers in the control station. There are also three 0 to 10VDC inputs.

The ACS uses a Digital Signal Processor for data capture, true power and true RMS processing, and I/O. An internal watchdog circuit is used to improve reliability. Firmware and calibration constants are stored in FLASH memory.

**NOTE: The ACS is a customized version of a MiniOCS. For additional information, refer to the MiniOCS User Manual (MAN0305).**

**Some illustrations in this user manual depict a MiniOCS module, but all of the information applies to the ACS modules.**

## 1.2 Specifications

<b>Table 1.1 – ACS100 / 110-12 Specifications</b>			
<b>VOLTAGE INPUTS</b>			
Input Range	90-600Vac	Input Frequency	40 to 70Hz
Conversion Time	.20 Sec	Voltage Measurement	True RMS
Accuracy	1%	Voltage Resolution	0.1Vac
Differential Phase Accuracy	0.5°	Frequency	Referenced to Line A
Differential Phase	Circuit 1A to Circuit 2A	Frequency Resolution	0.01Hz
Differential Phase Resolution	0.1°	Frequency Accuracy	0.1%
Input Impedance	> 2 Megohm to neutral;		
<b>CURRENT INPUTS</b>			
AC Current	Three-phase 5A, External Current Transformers (CTs) required	Common Mode	CTs returned to neutral
Overrange	50%	Input Frequency	40 to 70Hz
Accuracy	1%	Current Measurement	True RMS
Conversion Time	.20 Sec	Resolution	0.001A
<b>DIGITAL INPUTS</b>			
Inputs per Module	8 (ACS100) 16 (ACS110)	Input Characteristics	Bidirectional
Commons per Module	3	Input Impedance	10K Ohms
Input Voltage Range	12-24VDC	Minimum ON Current	1mA
Peak Voltage	35VDC Max.	Maximum OFF Current	200µA
Isolation (Channel to Channel)	500VDC	OFF to ON Response	1ms.
ON Voltage Level	9VDC /1mA minimum	ON to OFF Response	1ms.
OFF Voltage Level	3VDC		
<b>DIGITAL OUTPUTS</b>			
Outputs per Module	8 (ACS100) 16 (ACS110)	Maximum Inrush Current	650mA
Commons per Module	1	Minimum Load	None
Operating Voltage	10 - 28VDC	OFF to ON Response	1ms.
Output Type	Sourcing / 10K Pull-Down	ON to OFF Response	1ms.
Peak Voltage	28VDC Max.	Output Characteristics	Current Sourcing
Maximum Load Current per channel	0.5A Max.	Output Protection	Short Circuit
<b>GENERAL SPECIFICATIONS</b>			
Required Power (Steady State)	To Be Determined	Relative Humidity	5 to 95% Non-condensing
Current (Inrush)	To Be Determined	Operating Temperature	0° to 60° Celsius
Terminal Type	Screw Clamp, Removable	Weight	9 oz. (256 g)



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**CH. 1****1.3 Technical Assistance**

For assistance, contact Technical Support at the following locations:

**North America:**

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**Europe:**

(+) 353-21-4321-266

NOTES

## CHAPTER 2: INSTALLATION

### 2.1 Safety Warnings

**WARNING:** Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. **Failure to observe this precaution could result in severe bodily injury or loss of life.**

**WARNING:** The ACS is directly connected to incoming AC power. Disconnect, lock out, and tag all incoming power to the ACS before performing the following procedure. **Failure to observe this precaution could result in severe bodily injury or loss of life.**

**WARNING:** For ease of installation and replacement, plug-in connectors are provided for the AC inputs. These connectors **MUST NOT BE UNPLUGGED** if any current is flowing through the CT primaries. **Failure to observe this precaution will result in damage to the connector and an electrical shock hazard.** Screw locks are provided on all I/O connectors to prevent accidental circuit interruption. Installation personnel must verify that the connectors are properly secured.

**NOTE:** All applicable codes and standards are to be followed in the installation of this product.

### 2.2 ACS Mounting Requirements

**NOTE:** The ACS is a customized version of a MiniOCS. Some illustrations in this user manual depict a MiniOCS module, but all of the information applies to the ACS modules.

#### 2.2.1 ACS Mounting Procedures (Installed in a Panel Door)

The ACS is designed for permanent panel mounting. To install the ACS, follow the instructions below and use the provided template.

1. Prior to mounting the ACS, observe requirements for the panel layout design and adequate clearances. A checklist is provided in Section 2.2.4.
2. Cut the host panel. (See Figures 2.1 – 2.6.)

**Warning:** Make sure the power and network connectors are removed from the MiniOCS.

3. Insert the ACS through the panel cutout (from the front). The gasket material needs to lie between the host panel and the ACS panel.
4. Install and tighten the mounting clips (provided with the ACS) until the gasket material forms a tight seal. (See Figure 2.7.)

**Caution:** Do not over-tighten. Over-tightening can potentially damage the case.

5. Connect the communications, programming, and power cables to the ACS ports using the provided connectors.

6. Begin configuration procedures for the ACS models.

2.2.2 ACS Dimensions and Panel Cut-outs

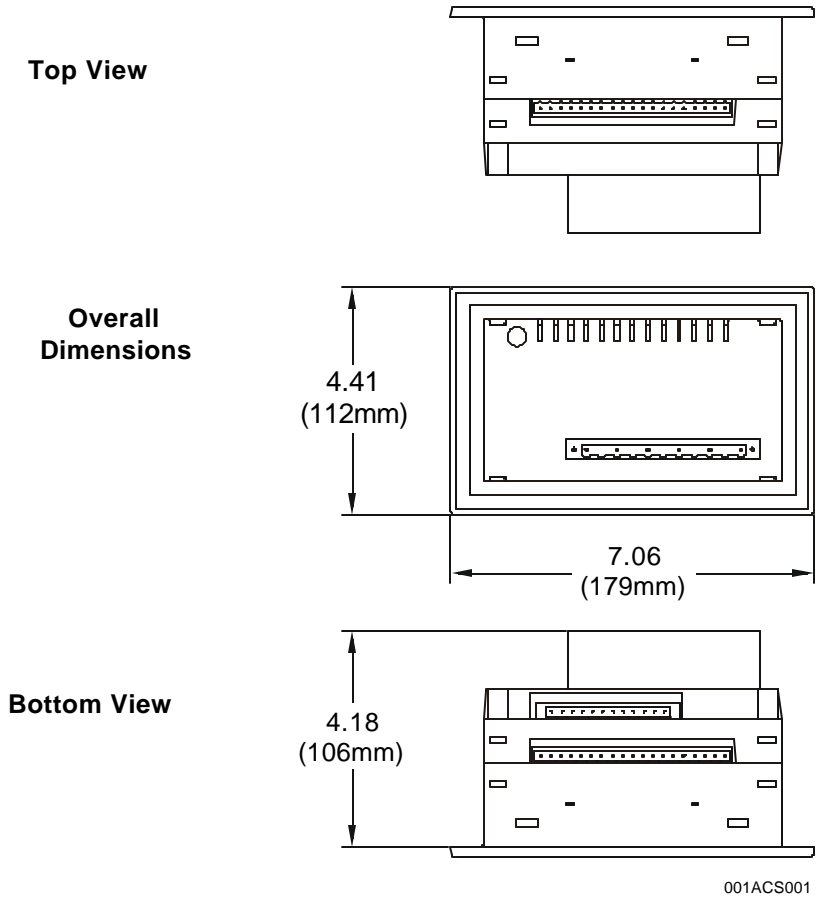


Figure 2.1 – ACS Overall Dimensions and Top / Bottom View

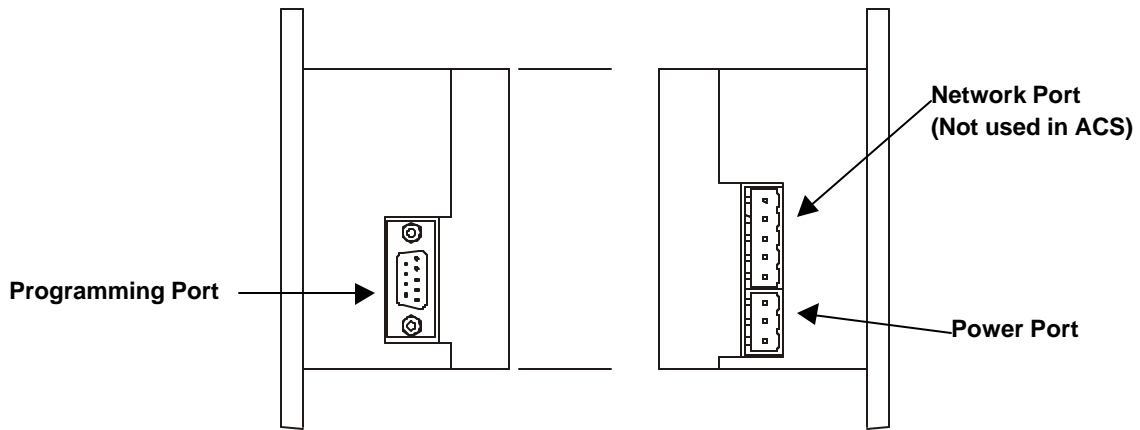


Figure 2.2 –Right-end View  
Network Model

Figure 2.3 Left-end View  
Network Model

Shows Port Locations

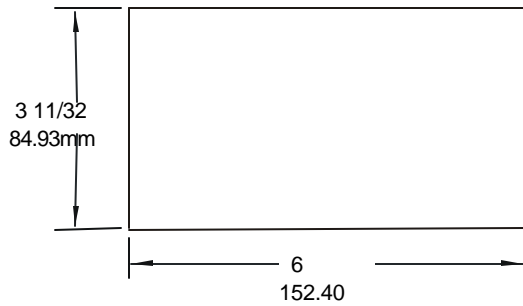
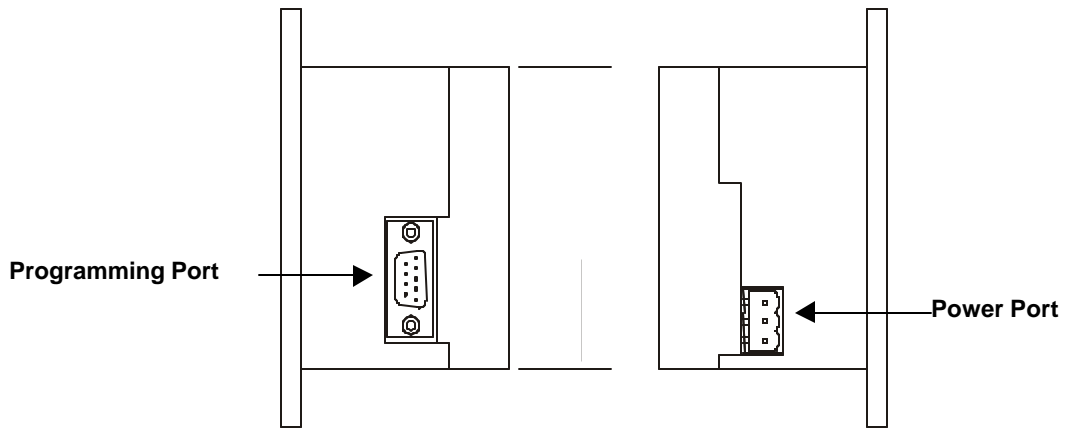


Figure 2.6 –Panel Cut-out for ACS

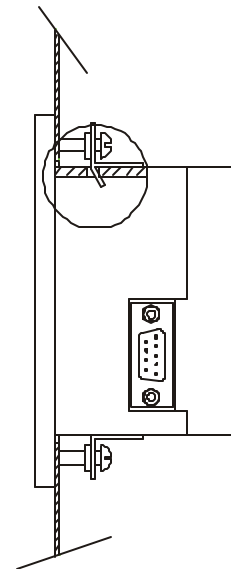
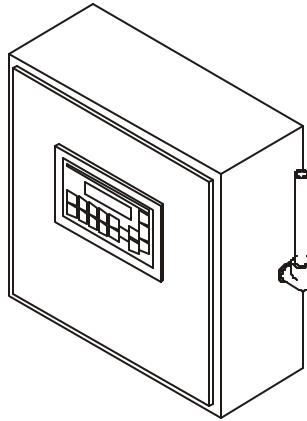


Figure 2.7 – ACS Mounted in Panel Box using Mounting Clips.

### 2.2.3 ACS Mounting Orientation

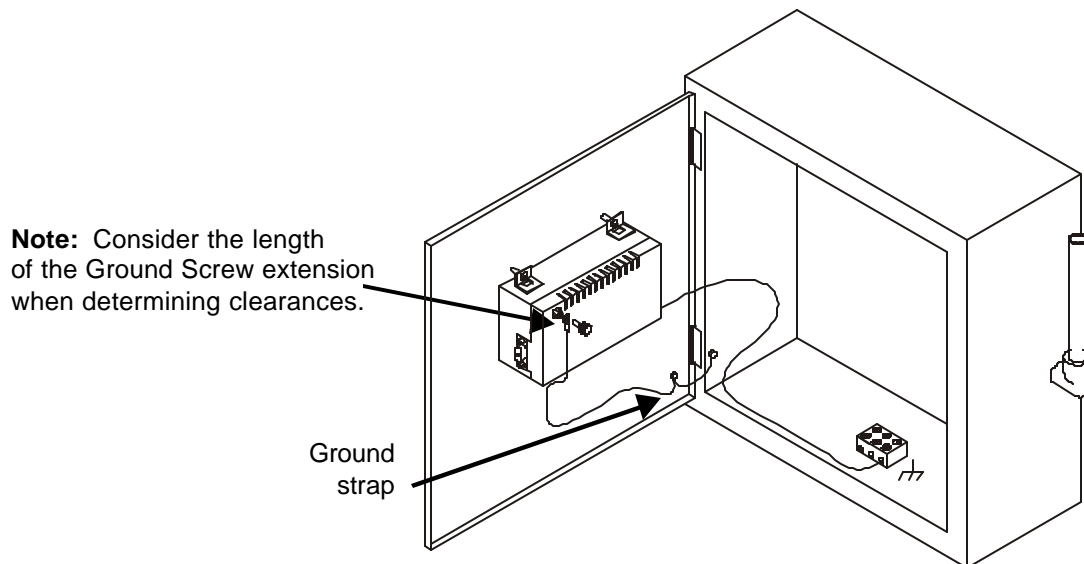
The base of the ACS model needs to be mounted with the proper orientation.



**Figure 2.8 - Orientation of ACS (Shown in Panel Box)**

**NOTE:** There are NO orientation restrictions on the ACS. However, the above orientation provides for optimum readability of the screen and ease of use of the keypad.

The designer of a panel layout needs to assess the requirements of a particular system and to consider the following design factors. A convenient checklist is provided in Section 2.2.4.



**Figure 2.9 – Back view of MiniOCS (Shown On Panel Door)  
(Note: Grounding applies to ACS models)**

a. Clearance / Adequate Space

Install devices to allow sufficient clearance to open and close the panel door. Note that the ACS is mounted on a panel door.

Minimum Distance between base of device and sides of cabinet	2 inches (50.80mm)
Minimum Distance between base of device and wiring ducts	1.5 inches (38.10mm)
<u>If more than one device installed in panel box (or on door):</u> Minimum Distance between bases of each device	4 inches between bases of each device (101.60mm)
<u>When door is closed:</u> Minimum distance between device and closed door (Be sure to allow enough depth for ACS Model and Ground Screw Extension.)	2 inches (50.80mm)

b. Grounding

**Warning:** Be sure to meet the ground requirements of the panel manufacturer and also meet applicable electrical codes and standards.

**Warning:** To provide maximum noise immunity and to insure minimum EMI radiation, the V- signal (DC power return) need to be connected to earth ground at the power supply. The user must ensure that the power supply selected is compatible with this method of grounding.

Panel box: The panel box needs to be properly connected to earth ground to provide a good common ground reference.

Panel door: Tie a low impedance ground strap between the panel box and the panel door to ensure that they have the same ground reference (Figure 2.9).

Devices in panel box and on the panel box door:

Use the mounting hardware provided with the device, which includes mounting clips.

c. Temperature / Ventilation

Ensure that the panel layout design allows for adequate ventilation and maintains the specified ambient temperature range. Consider the impact on the design of the panel layout if operating at the extreme ends of the ambient temperature range. For example, if it is determined that a cooling device is required, allow adequate space and clearances for the device in the panel box or on the panel door.

d. Orientation

Observe guidelines for proper orientation of the bases when mounting the ACS. (Refer to Section 2.2.3). Proper orientation helps to ensure a good connection when ACS models are installed into the devices.

## e. Noise

Consider the impact on the panel layout design and clearance requirements if noise suppression devices are needed. Be sure to maintain an adequate distance between the ACS and noisy devices such as relays, motor starters, etc.

**Note:** Do not route power and signal wires in the same conduit.

#### 2.4.1 Panel Layout Design and Clearance Checklist:

The following list provides highlights of panel layout design factors.

\_\_\_ Meets the electrical code and applicable standards for proper grounding, etc.?

\_\_\_ Meets the panel manufacturer's requirements for grounding, etc.?

\_\_\_ Is the panel box properly connected to earth ground? Is the panel door properly grounded? Has the appropriate procedure been followed to properly ground the devices in the panel box and on the panel door? (See Figure 2.9.)

\_\_\_ Are minimum clearance requirements met? (See Table 2.1.) Can the panel door be easily opened and closed? Is there adequate space between device bases as well as the sides of the panel and wiring ducts?

\_\_\_ Is the panel box deep enough to accommodate the ACS. (Be sure to consider the Ground Screw extension.)

\_\_\_ Are the device bases oriented correctly? (See Section 2.2.3.) The ACS devices are mounted on the door of a panel box.

\_\_\_ Is there adequate ventilation? Is the ambient temperature range maintained? Are cooling or heating devices required?

\_\_\_ Are noise suppression devices or isolation transformers be required? Is there adequate distance between the base of the ACS and noisy devices such as relays or motor starters? Ensure that power and signal wires are not routed in the same conduit.

\_\_\_ Are there other requirements that impact the particular system, which need to be considered?

<p><b>Warning:</b> To provide maximum noise immunity and to insure minimum EMI radiation, the V-signal (DC power return) need to be connected to earth ground at the power supply. The user must ensure that the power supply selected is compatible with this method of grounding.</p>
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


2.3 Ports, Connectors, and Wiring

2.3.1 Power, Network, and Programming Ports

The ACS Power, Network, and Programming Ports are shown for non-network versions of the ACS.

2.3.2 Primary Power Port

Table 2.2 – Primary Power Port Pins		
Pin	Signal	Description
1		Frame Ground
2	V+	Input power supply voltage
3	V-	Input power supply ground

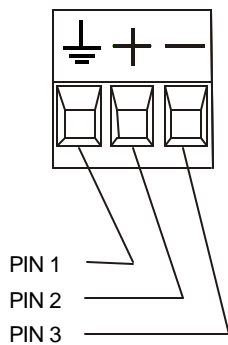


Figure 2.10 Power Connector  
(Primary Power Port)  
(Front and Side Views Shown)

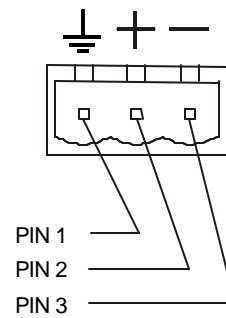


Figure 2.11 As viewed looking at  
the ACS

**Note:** Power Supply Voltage Range is from 10-30 VDC.

**Warning:** To provide maximum noise immunity and to insure minimum EMI radiation, the V-signal (DC power return) need to be connected to earth ground at the power supply. The user must ensure that the power supply selected is compatible with this method of grounding.

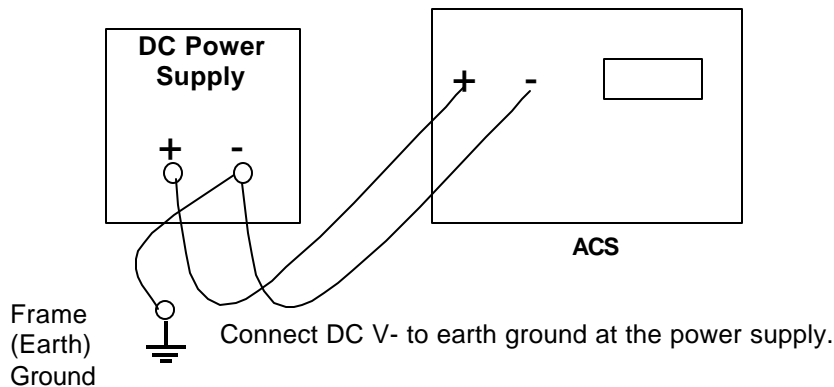


Figure 2.12 – Grounding

2.3.3 RS-232 Programming Port and Wiring

Table 2.6 – RS-232 Port Pins			
Pin	Signal	Description	Direction
1	DCD	Always high	Out
2	RXD	Received Data	Out
3	TXD	Transmitted Data	In
4	DTR	Data Terminal Ready	In
5	GND	Ground	-
6	DSR	Data Set Ready	Out
7	RTS	Request to Send	In
8	CTS	Clear to Send	Out
9	RI	Ring Indicate	Out

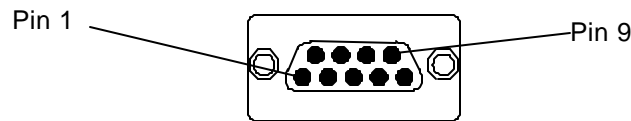


Figure 2.13 – RS-232 Port

a. RS-232 Communications Wiring

The ACS features an RS-232 port (Programming/Debug) for connection to a personal computer. This port is used for the purposes of ACS programming, configuring, monitoring, and debugging. This port can also be used for general ladder logic controlled serial communications to printers, modems, terminals, etc. When ladder has control of this port, it is not available for programming or debugging. The wiring diagram for the RS-232 ports is shown in Figure 2.14. For connection between the ACS and the PC, the use of a shielded, multiple conductor wire with a maximum length of 15.24 meters (50 feet) enables proper performance.

**Note:** A shorter cable can be required when used for high-speed ACS firmware updating.

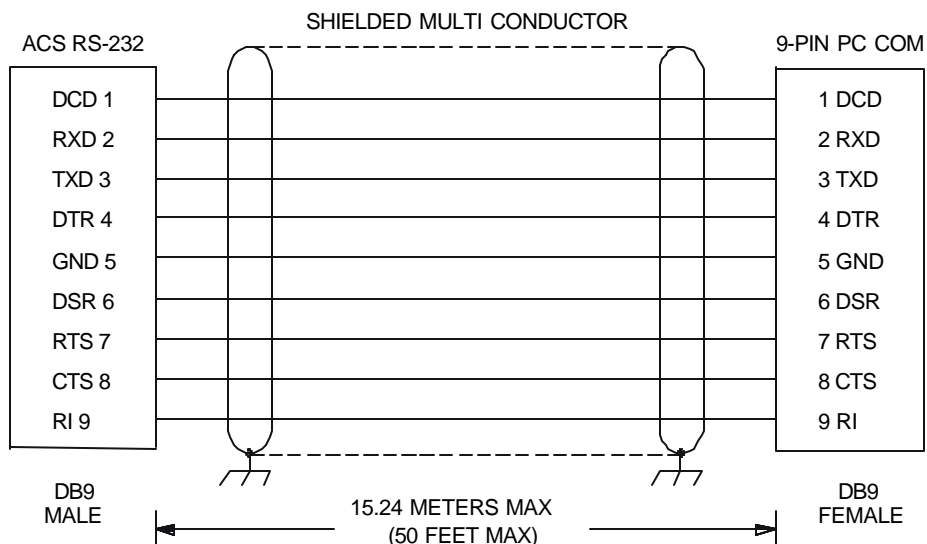


Figure 2.14 – ACS to PC Wiring

2.3.4 Modem Setup

A modem can be used for remote communications between a computer (using Cscape Software) and the ACS. The modem must operate at 9600 baud or higher.

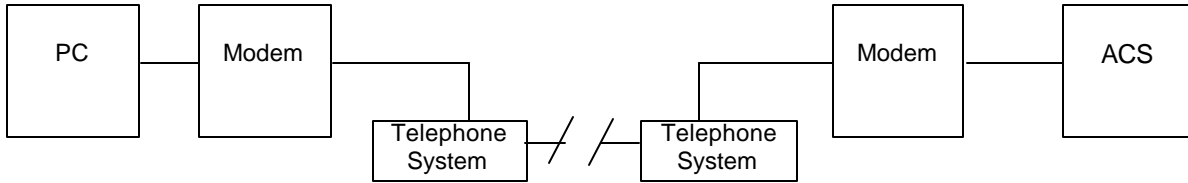


Figure 2.15 – Modem Setup

a. Setup

Setup the modems to match the default serial port characteristics of the ACS.

- 9600 baud
- 8 data bits
- No parity
- 1 stop bit
- disable error checking
- disable compression

b. Cable Wiring

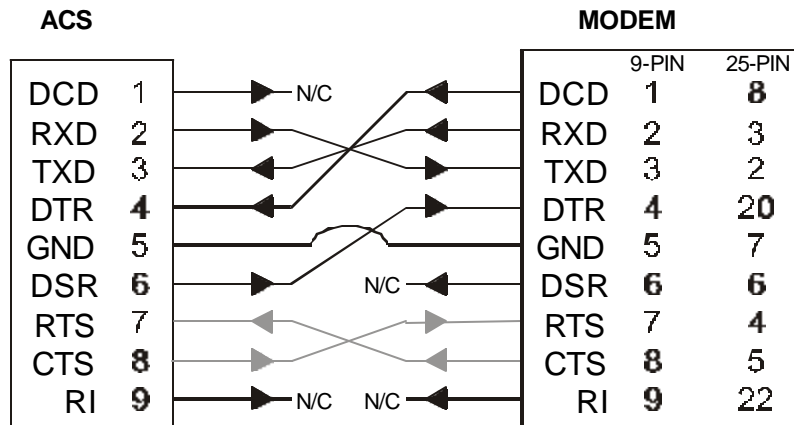



Figure 2.16 – Modem Wiring

**Note:** If the modem has a DB25 connector, a 9-to-25-pin adapter may need to be supplied.

The grayed connections  are used only if hardware handshaking between the controller and modem is required.

The wire type used in not overly critical except where the length of the cable must be between 30 and 50 feet (10 to 15 meters). In all cases, the cable must be shielded multi-conductor with conductors of at least 20 gauge. The length of the cable must be as short as possible, and in no case, longer than 50 feet (15 meters).

The modem must be located as close as possible to the ACS, preferably less than one meter. However, EIA-232 specifications allow for cable runs up to 50 feet (15 meters). If cable lengths longer than 30 feet (10 meters) are required, a special low capacitance cable must be used.

**Warning:** Damage can result if the CD and RI lines are connected to each other or to any other signal on the connector or through the cable to the other unit.

**Warning:** To connect a modem to the ACS the controller to modem cable must be constructed or purchased. Using a Null Modem cable can cause damage to the ACS, modem or both.

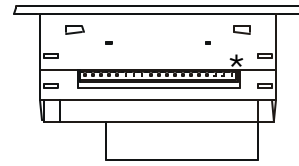
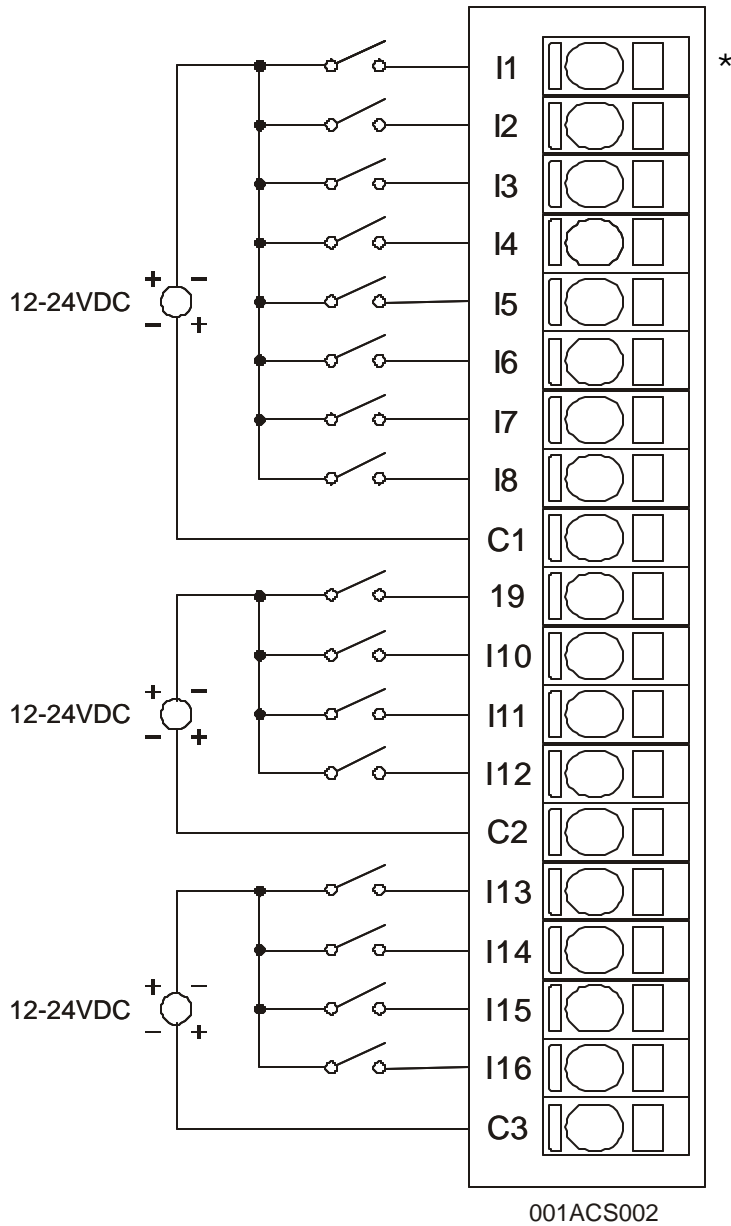
c. Recommended Modem

U.S. Robotics Sportster Modem (Model 0701) (56K v.90)

For additional information regarding the use of modems with Control Station products, contact Technical Support. (See Section 1.3.)

2.3.5 Discrete I/O Connection

a. Input I/O Connector



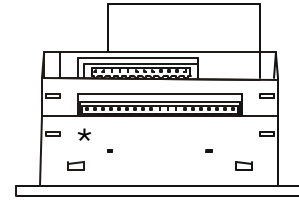
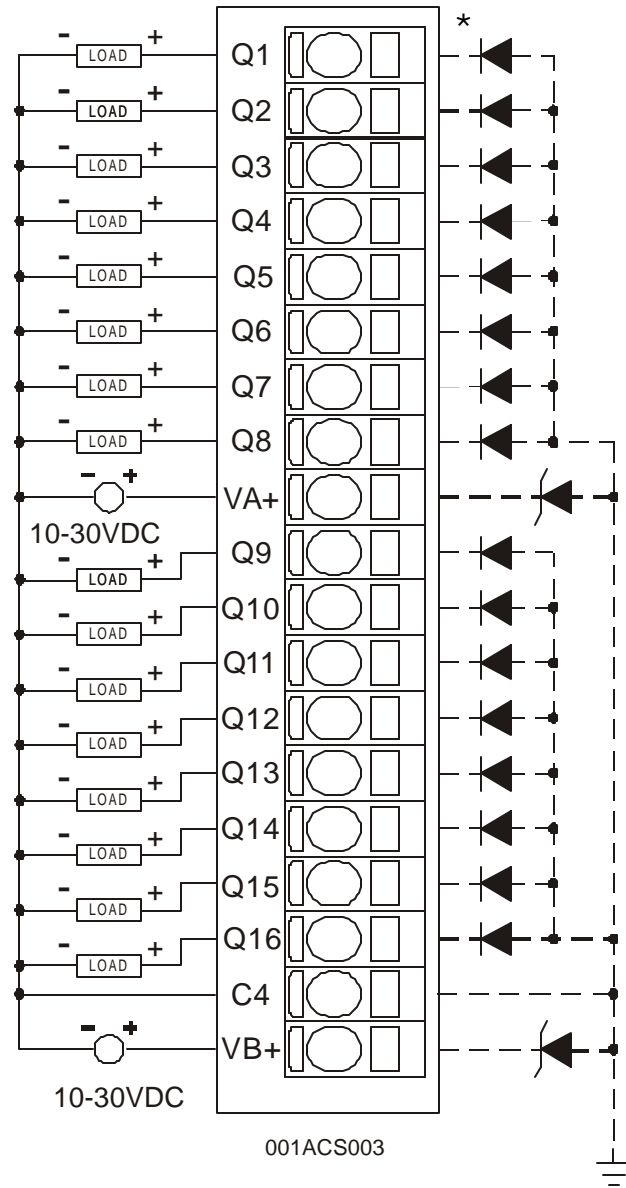
ACS Top View - Shows corresponding I/O pin location.

Pin	Signal
	ACS INPUT
I1	Input 1
I2	Input 2
I3	Input 3
I4	Input 4
I5	Input 5
I6	Input 6
I7	Input 7
I8	Input 8
C1	Common 1 (Isolated)
I9	Input 9
I10	Input 10
I11	Input 11
I12	Input 12
C2	Common 2 (Isolated)
I13	Input 13
I14	Input 14
I15	Input 15
I16	Input 16
C3	Common 3 (Isolated)

001ACS002

Figure 2.17 - Input I/O Wiring Diagram

b. Output I/O Connector



ACS Bottom View - Shows corresponding I/O pin location.

Pin	Signal
	ACS Output
Q1	Output 1
Q2	Output 2
Q3	Output 3
Q4	Output 4
Q5	Output 5
Q6	Output 6
Q7	Output 7
Q8	Output 8
VA+	Load Power A
Q9	Output 9
Q10	Output 10
Q11	Output 11
Q12	Output 12
Q13	Output 13
Q14	Output 14
Q15	Output 15
Q16	Output 16
C4	Common
VB+	Load Power B

Figure 2.18 – Output I/O Wiring Diagram

2.3.6 AC Voltage and Current input Connection

The AC inputs are divided into two circuits. Each circuit has three voltage signals (A, B, C), which accept input voltages from 0 – 600VAC with respect to neutral (N). These inputs can be directly connected or passed through external potential transformers (PTs). If voltages greater than 600VAC are to be measured, external PTs are required.

For the ACS110, there are three current signals (CA, CB, CC), which are designed for standard 5 amp secondary current transformers (CTs). Correct polarity as indicated in the wiring diagram is essential for valid power measurements.

External PT transformers are required for Delta configurations.

**Note:** The mode (wye or delta) and PT and CT ratios must be provided to the ACS as configuration data and must match the physical configuration for proper operation. Ratios are used to scale voltage and current input measurements to match those on the primary side of the PTs and CTs for internal power calculations. ACS accuracy specification assumes no error is contributed from the external PTs and CTs.

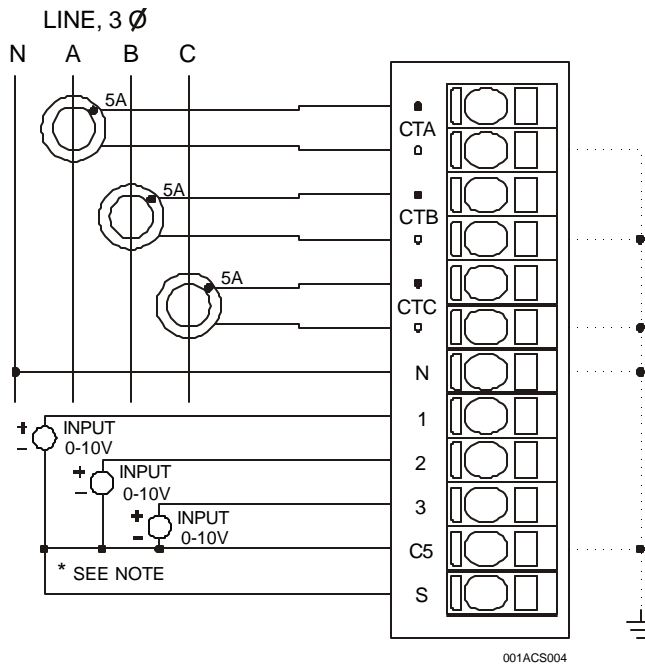


Figure 2.18 – DC Voltage and CT Connection

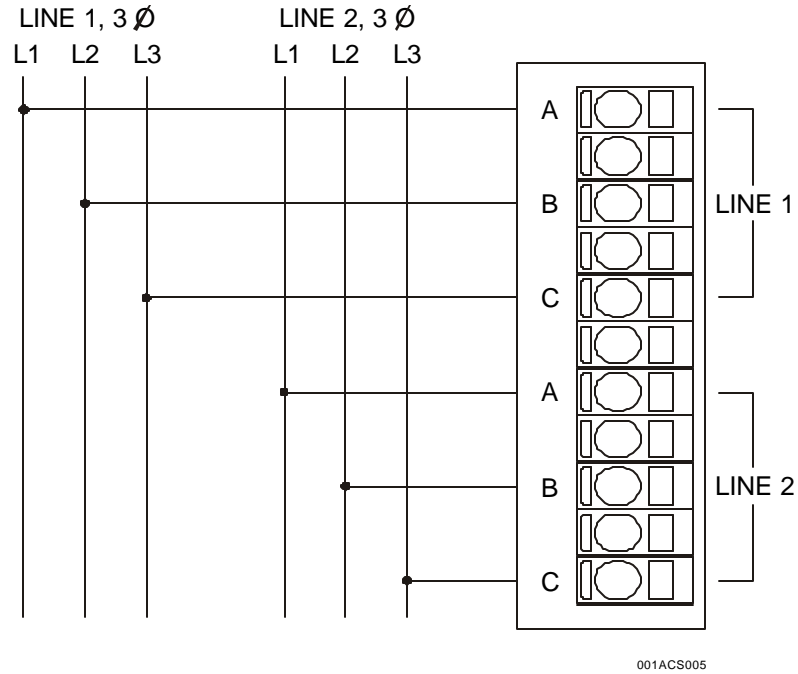


Figure 2.19 – 3-Phase Line Voltage Inputs



## CHAPTER 3: CONFIGURATION

The ACS stores the most recent configuration settings. Configuration settings can be modified by pressing the **I/O Configure** pull-down menu on Cscape's main screen. After the configuration is completed, it is downloaded to the ACS via the Ladder Program.

### 3.1 CScape I/O Configuration

Use the following steps to configure the ACS using Cscape Software.

1. Go to the Main Screen of Cscape. The following screen appears.

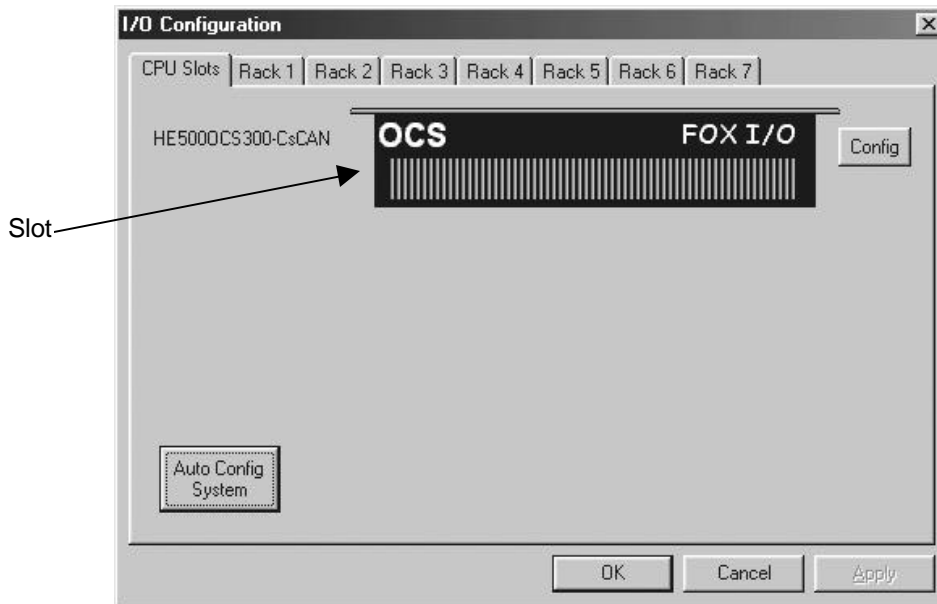
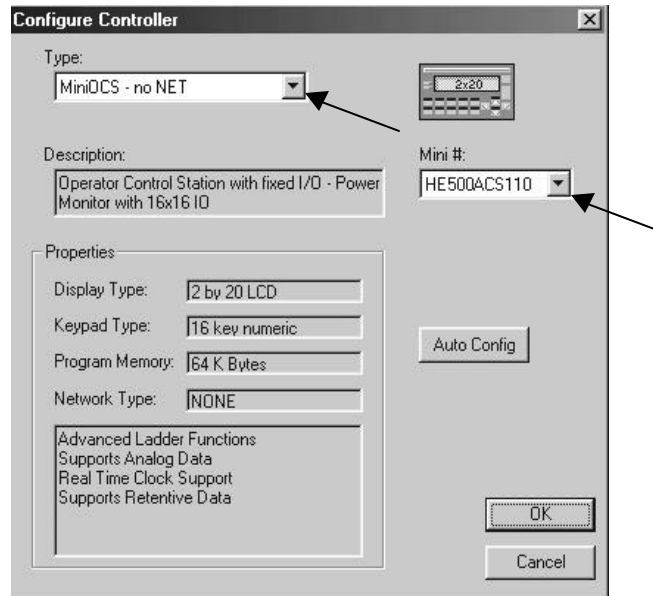


Figure 3. 1 - Main Configuration I/O Screen

2. Ensure that the desired controller is selected. The OCS300-CsCAN is shown as the selected controller (Figure 3.1) in this example. To select a different controller, press the **CPU Slots** tab located in the upper left corner of the screen, and then, either click on the slot or the **Config** button.

**Note:** The **Auto Config System** button can be pressed *prior* to selecting the desired controller *and* I/O. By pressing the button, the settings will be deleted from any controller *and* I/O that is physically connected to the PC. A dialog box appears and indicates that settings will be deleted from currently configured models. If OK, press **Yes**. Then press **OK**.

3. The following screen appears.



**Figure 3.2 – Configure Controller**

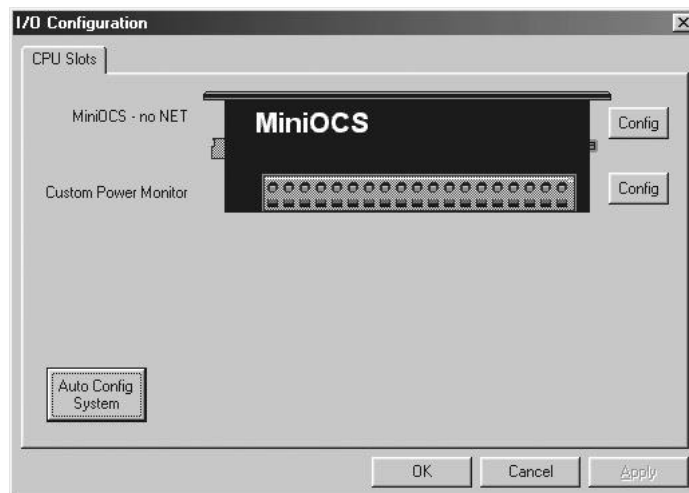
To select the desired controller, click on the pull-down menu located in the **Type** selection box and select the **MiniOCS – noNet**. (The ACS is a type of MiniOCS.) (See Figure 3.2.)

**Note:** The **Auto Config** button can be pressed *prior* to selecting the desired controller. By pressing the button, the settings will be deleted from any controller that is physically connected to the PC.

Next, click on the pull-down menu located in the **Mini #** selection box and select the desired I/O. In this case, the HE500ACS110 is selected.

The description and properties of the selected controller and I/O are provided. If satisfied with the selections, press **OK**.

4. The following screen appears.



**Figure 3.3 – ACS Selected**

To configure the ACS (Custom Power Monitor), click on the CONFIG button to the right of the desired model or double-click on the slot containing the ACS.

- 5. The Module Configuration Screen appears (Figure 3.4). Two tabs are available for selection:

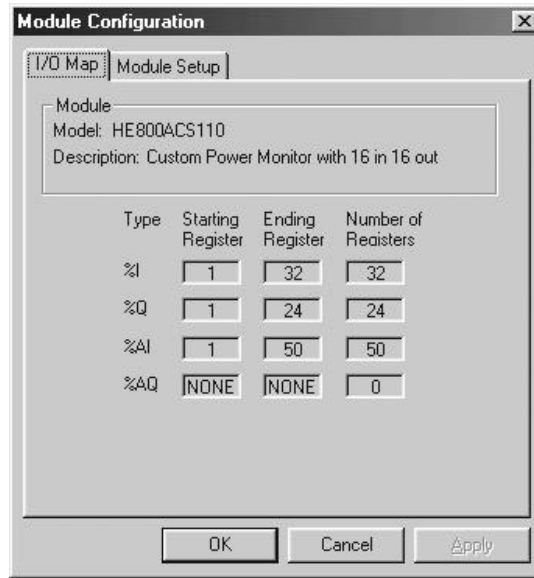


Figure 3.4 – I/O Map Tab Selected

- a. I/O Map Tab

The **I/O Map** (Figure 3.4) describes which I/O registers are assigned to a specific ACS module. Although there are no user-defined parameters, the I/O Map can be viewed after the ACS is configured to review the registers.

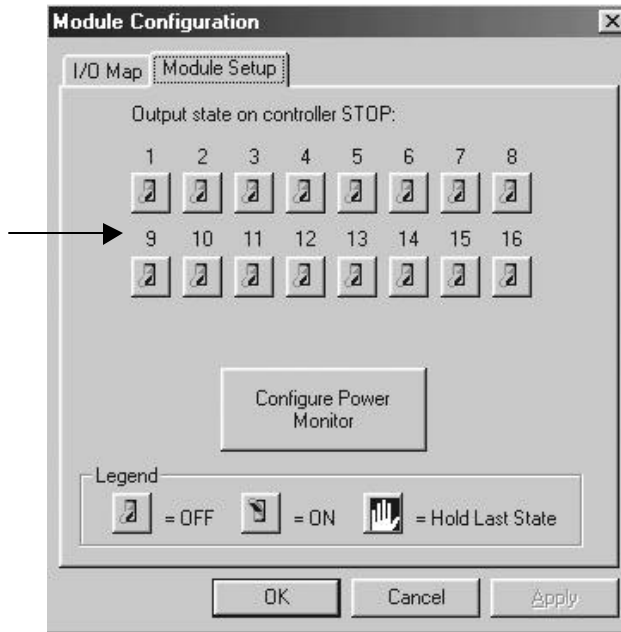
- b. Module Setup Tab

The **Module Setup** (Figure 3.5) is used in applications where it is necessary to change the default states or values of the outputs when the controller enters idle/stop mode. It is also used to enter the **Power Monitor Configuration**.

**Note:**

As depicted, the **ACS110** has 16 channels out.

If the **ACS100** had been selected, 8 switches would be displayed on the screen for 8 channels out.



**Figure 3.5 – Module Setup Tab Selected**

Digital Outputs:

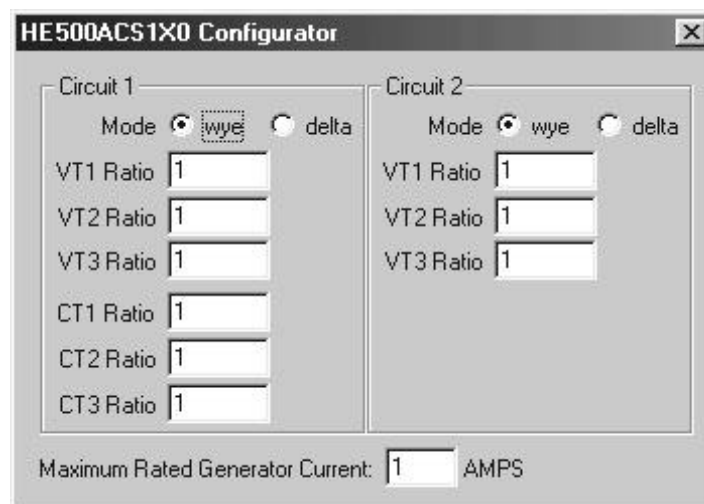
The default turns the outputs OFF when the controller enters idle/stop mode. By selecting the Module Setup tab, each output can be set to either turn ON, turn OFF or to hold the last state. Generally, most applications use the default settings.

**Warning:** The default turns the digital outputs OFF when the controller enters idle/stop mode. To avoid injury of personnel or damages to equipment, exercise extreme caution when changing the default settings.

Power Monitor Configuration: Click the **Power Monitor Configuration** button to begin this configuration.

6. The following screen appears:

Default settings are displayed.



**Figure 3.6 – Power Monitor Configuration Screen**

- a. To select the **Mode** for each circuit, click the desired option: wye or delta. This field specifies if the AC inputs are to be treated as 4-wire wye **or** 3-wire delta; the option selected must match what is physically wired.

wye = 4-wire (3 PTs, 3 CTs)  
delta = 3-wire (2 PTs, 2 CTs)

- b. Next, enter **Ratio** values in the text boxes for the VT (voltage) and CT (current) transformers. These fields specify the multiplier for each Voltage and Current input. The ratio is a floating-point number used to scale the PT/CT secondary value to represent the true (primary) value.

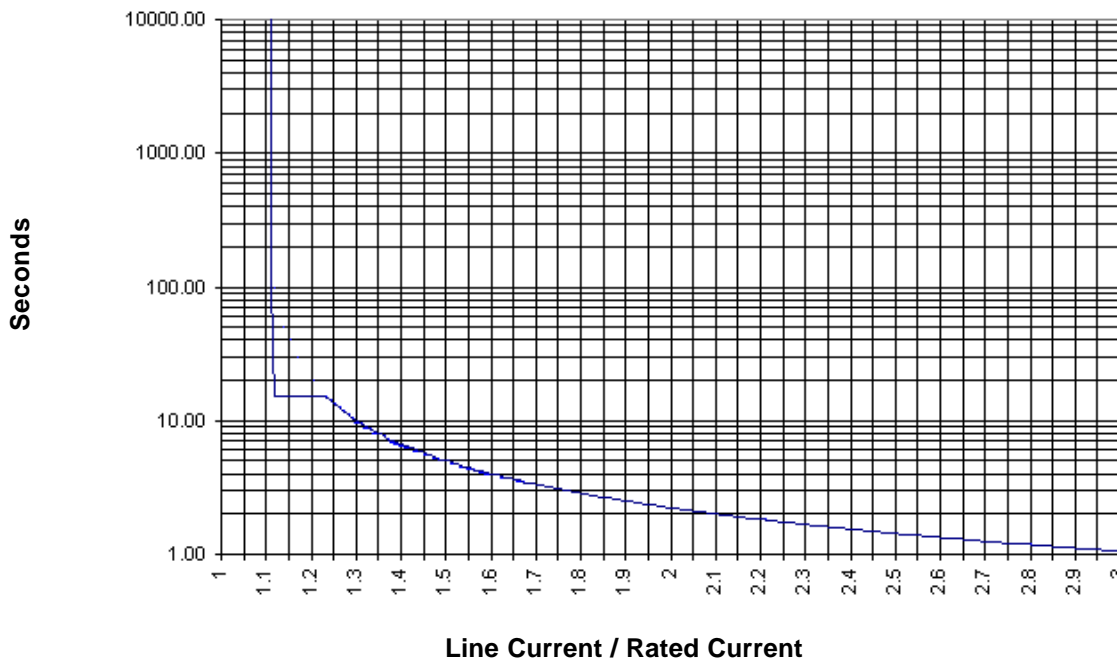
- For voltage direct connection, supply a ratio of 1.00

input		ratio	=	displayed output
480 V	*	1.00	=	480 Volt

- For CT with 500 Amp primary and 5 Amp secondary (500:5) use a ratio of 100.00

input		ratio	=	displayed output
5 Amp	*	100.00	=	500 Amp

- c. Next, enter a value into the text box for the **Maximum Rated Generator Current**. The Maximum Rated Generator Current is used to control the over-current alarm as indicated in the following graph (Figure 3.7).



3.7 – Over-current vs. Time Graph

**Example:** If the Maximum Rated Generator current is 100 amps, an over-current of 130 amps trips the over-current alarm after 10 seconds.

7. After completing the configuration, press **OK**. When Cscape is downloaded to the ACS, the configuration is included.

### 3.2 Calibration

The ACM is calibrated at the factory and calibration data is not user accessible.

## CHAPTER 4: SYSTEM MENU

### 4.1 General

Chapter Three describes the System Menu for the ACS.

**NOTE: The following information covers the MiniOCS but also applies to the ACS.**

The following list contains examples of parameters that can be set using the System Menu:

- Network ID
- Network Baud
- RS232 Mode
- Time/Date
- LCD contrast
- Fkeys mode

### 4.2 Navigating Through the System Menu

Prior to configuration, it is important to know how to navigate through the System Menu using the following guidelines.

1. Pressing the  $\uparrow$  and  $\downarrow$  keys scroll up or down through the menu options.
2. Pressing the **Enter** key selects the system screen that the indicator arrow is pointing to.
3. Once in a system screen, press **ESC** (if not currently modifying a field) to return to the main System Menu.

### 4.3 Editing System Menu Screen Fields

Prior to configuration, it is important to know how to edit the System Menu screen fields using the following guidelines.

1. Some fields in the system screens are editable; others are not editable. The ACS model indicates an editable field with a solid cursor (  $\_$  ) under the first character in the field.
2. To change a value in an editable field, press the **Enter** key to select edit mode. The ACS model indicates edit mode by displaying a flashing block cursor.
3. In edit mode, the fields require one of the following methods for modifying the value. Refer to the field description to determine which method to use.
  - Enumerated entry - use  $\uparrow$  and  $\downarrow$  keys to select appropriate value.
  - Numeric entry - use Numeric keys or  $\uparrow$  and  $\downarrow$  keys on the appropriate digit.
  - Bar graph entry - use  $\leftarrow$  and  $\rightarrow$  keys to adjust value.
4. After the value is correctly entered, press the **Enter** key to accept the value.
5. Should the user not wish to accept the value before the **Enter** key is pressed, the **ESC** key may be pressed instead. This action restores the original value to the display. The ACS model also immediately exits edit mode; however, the Text models remains in edit mode with the original value and requires the **Enter** key to be pressed to exit.

#### 4.4 Initial System Menu Screens and Self-Test

**NOTE:** The following screens depict the MiniOCS, but they also apply to the ASC.

1. After turning on the power to the ASC, the following screen appears which indicates the product name and the network it is connected to. It also indicates that the Self-Test is running.

```
MiniOCS - CsCAN  
Self-Test Running
```

- a. If the Self-Test passes, the following screen appears:

```
** Self-Test **  
**** Passed ****
```

- b. If the Self-Test fails, see **View OCS(RCS) Diags** in Section 4.6.

#### 4.5 Entering the System Menu

To enter the System Menu on the ACS using the **local** keypad, press both the ↑ and ↓ keys at the same time. Notice that the two keys are surrounded by a white outline and the word "System" on the silkscreen of the keypad.

#### 4.6 System Menu Option Screens

In addition to providing access to the ACS, configuration parameters, the System Menu also provides power-up and runtime status. For brevity, both configuration and status fields are covered in this section

There are up to ten different menu options which include the following:

- Set Network ID
- Set Network Baud
- Set Contrast
- View OCS(RCS) Status
- View OCS(RCS) Diags
- View I/O LEDs
- View I/O Slots
- View Char Set
- Set Fkeys Mode
- Set RS232 Mode.
- Set Time/Date



- **Set Network ID**

This screen contains two fields. The first field contains the current network status. The second field contains the current Network ID of the model. The second field is numerically editable and is used to configure the Network ID.

Each unit on the network **needs a unique ID number**. The correct ID number should be entered here before physically attaching the unit to the network.

Cscan model: [ 1 - 253 ]  
DeviceNet model: [ 0 - 63 ]

**Note:** If the Network ID setting is changed, the unit stops executing the ladder code (for up to 1 second) while the network is re-tested. If the "Network OK?" status changes from "Yes" to "No," the new Network ID is a duplicate, and another ID needs to be selected.

- **Set Network Baud**

**Note:** All devices on the network must be at the same baud rate. A device configured for the wrong baud rate may shut down the network entirely.

- **Set Contrast**

This menu contains an editable bar graph entry allowing the user to set the contrast of the LCD display.

- **View OCS (RCS) Status**

This screen contains both a single enumerated editable field that sets the ACS scan mode and status fields that display information about the internal state of the ACS. Pressing the ↑ and ↓ keys scrolls through the different items. Pressing `ESC` returns to the System Menu.

<u>Parameter</u>	<u>Description</u>
OCS Mode	Displays the current scanning mode ( <b>Idle, Run, DoIO</b> ). In <i>Idle</i> mode, the I/O is <u>not</u> scanned and the OCS ladder program does <u>not</u> execute. The green "RUN" LED is OFF. In <i>Run</i> mode, the ladder program executes and the green "RUN" LED illuminates. <i>DoIO</i> mode is similar to <i>Run</i> mode, except the ladder logic is not solved. When the OCS is in <i>DoIO</i> mode, the user is able to exercise all of the I/O from Cscape, without interference from the ladder program. In this mode the green "RUN" LED flashes. This feature is a valuable troubleshooting tool.
Scan-Rate	Shows the number of milliseconds for the scan. The scan-rate is the sum of the time required to execute the following items:  a. Scan inputs b. Solve logic c. Write outputs d. Handle network communications e. Handle host communications request f. Process data for operator interface
OCS Net Use	Shows the percentage of the network used by the Mini.
All Net Use	Shows the percentage of the network used by all devices on the network.

<b>Ladder Size</b>	Shows the number of bytes used by the ladder program.
<b>Config Size</b>	Shows the number of bytes used by the I/O configuration
<b>Text Size</b>	Shows the number of bytes used by the text screens
<b>Firmware Rev</b>	Shows the execution engine firmware version.
<b>BIOS Rev</b>	Shows the BIOS firmware revision.
<b>FPGA Rev</b>	Shows the FPGA Image version.
<b>Self-Test</b>	Shows if the power-up self-test passed or failed by displaying <b>Ok</b> or <b>Fault</b> .

- **View OCS(RCS) Diags**

This screen displays a list of self-test diagnostics results (no editable fields). Each item describes a test and shows a result of **Ok** if the test passed or **Fault/Warn** if an error was found while running the test. **Fault** indications will prevent the loaded application from running. **Warn**(ing) indications allow the application to run but inform the user that a condition exists that needs correction.

**System BIOS** - This test checks for a valid BIOS portion of the controller firmware.

- Ok** The loaded BIOS firmware is valid
- Fault** The loaded BIOS is invalid.

**(Engine) Firmware** - This test validates the controller firmware.

- Ok** The firmware is valid.
- Fault** The controller firmware is invalid.

**User Program** - This tests for a valid user program and configuration data.

- Ok** The user program and configuration is valid.
- Fault** The user program and/or configuration are not valid.

**System RAM** - This test checks the functionality of the controller RAM at power up.

- Ok** The RAM is functioning correctly.
- Fault** The RAM is not functioning correctly.

**Logic Error** - This test checks for problems with the user program while running.

- Ok** No errors have been encountered while running a user program.
- Fault** Indicates the user program contained an instruction that was invalid or unsupported.

**W-Dog Trips** - This test checks for resets caused by hardware faults, power brownouts or large amounts of electrical interference.

- 0** No unintentional resets have occurred.
- xx** Indicates a fault with xx showing the number of occurrences.

**Net Errors** - This test checks for abnormal network operations while running. (Network models only.)

- 0** No network errors were counted
- xx** Indicate serious networking problems exist, xx indicates the number of occurrences.

**Network State** - This test checks that the network sub-system is powered and operating correctly. (Network models only.)

- Ok** The network system is receiving power and has determined other devices are communicating on the network.
- Warn** Power is not being applied to the network or no other devices were found to be communicating on the network.

**Network ID** - This test checks that the network ID is valid. (Network models only.)

- Ok** The network ID is valid.
- Warn** The network ID is not valid for the selected protocol.

- Dup Net ID** - This test checks for duplicate IDs on a network. (Network models only.)  
**Ok** This controller's ID was not found to be a duplicate.  
**Warn** Another controller on the network was found with the same ID as this controller.
- DeviceNet In** - This does not apply to the ACS. (DeviceNet model only.)  
**Ok** DeviceNet master is maintaining a polled connection and not sending IDLE.  
**Warn** The DeviceNet master is no longer maintaining a polled connection or sending IDLE. (IDLE is a network state in which 'some' masters maintain a polled connection but sends zero data if an associated PLC controller is in IDLE mode. Refer to Master documentation for more information.)
- Clock Error** - This test checks that the real time clock contains valid data.  
**Ok** The real time clock contains valid data.  
**Warn** Indicates invalid data in the real time clock.
- I/O System** - This test checks that the I/O configuration downloaded and the physical devices (SmartStack) attached to the controller match.  
**Ok** The I/O configuration matched the installed modules.  
**Warn** Indicates the downloaded configuration and attached modules do not match. (See View I/O Slot system screen for more information.)

- **View I/O LEDs**

The View I/O LEDs simulate the LEDs and show the statuses of the first 16 %I and first 16 %Q registers.

- **View I/O Slots**

The View I/O Slots screen allows the user to view any ACS CPU model number. The View I/O Slots screen also indicates the keypad being used (by displaying the number of keys) and the type of LCD being used (by displaying the character grid). Press the ↑ and ↓ keys to scroll up and down through the options. Press **ESC** to return to the System Menu.

When viewing the CPU model in the, there are five possible displays:

1. If the Mini is properly configured and no I/O board is present, the message "-I/O Missing" is displayed in the appropriate slot.
2. If the wrong I/O board is physically attached to the Mini, the following message is displayed (?CPU:ACS/RCSxxx.) (Note that the ACS/RCSxxx is the actual product number of the attached ACS / MiniRCS .)
3. If an I/O board that is not supported by the Mini firmware is attached, the CPU slot indicates that an "\*\*Unsupported" module is attached. The I/O board is either defective or a firmware upgrade is required to support the I/O board.
4. If there is an I/O board attached to the Mini, and the Mini is not configured yet, the message (+CPU:ACSxxx) is displayed. (Note that the ACSxxx is the actual product number of the attached ACS.)
5. If the ACS is configured and has the correct I/O board, the message (CPU: ACS) is displayed. (Note that the ACS is the actual product number of the attached Mini.

- **View Char Set**

The View Char Set allows the user to view the entire character set available in the Mini. The character set range is from 8-255. To select a character for viewing, press `Enter` and then use the `↑` and `↓` keys to scroll through the character set. Press `Enter` and then `Esc` to return to the System Menu.

- **Set FKeys Mode**

This screen contains an editable enumerated field that allows the Function keys to be configured to operate in one of two modes. When a function key is pressed, it can TOGGLE the point associated with the key or it can MOMENTARILY turn the point ON when the key is pressed.

- **Set RS232 Mode**

This screen contains an editable enumerated field that allows the mode of the serial port to be set to one of two modes. The **CsCAN** mode allows Csape to connect to the serial port for uploads, downloads, monitoring and control. The **Update** mode allows a firmware update and factory test utility to be used. When Update mode is selected, the firmware is ready to download when the OK LED flashes. When using Cscape to perform firmware updates, the "Update" mode is not necessary.

- **Set Time/Date**

This screen contains two editable enumerated fields for displaying and modifying the Mini's time and date. Each field is subdivided and allows the `↑` and `↓` key to modify the value.

## CHAPTER 5: SYSTEM MENU

### 5.1 Keypad Description

The ACS keypad contains 10 user-programmable keys, Sair, Entra and four direction keys.

The user-programmable keys, or function keys, also serve the purpose of numeric and alphabetic character entry. Function keys F1-F10 are available (%K registers). Depending on the configuration of the ACS and the field needing to be edited, the ACS automatically knows what type of digit or alphanumeric character needs to be entered.

The ACS keypad also contains four direction keys. The ↑ and ↓ keys contain split fields. The ↑ key also contains the +/- function. The ↓ key also contains the . function. Similar to the operation of the function keys, the ACS automatically knows if a decimal point or a positive or negative indicator is required. The ↑ and ↓ keys are also used to increment and decrement fields, respectively. The ← and → keys are used to move the cursor from one character to another in an editable field and to switch from one editable field to another editable field.

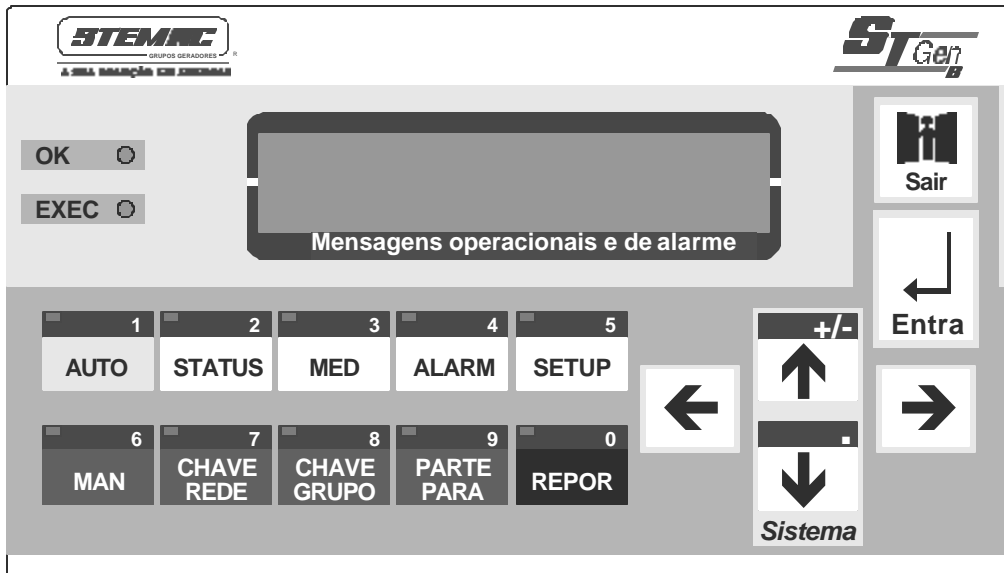


Figure 5.1 - ACS Keypad

The ACS features an **Sair** and an **Entra** key. The **Sair** key is used to exit out of a number of different menus and fields or abort an editing operation. The **Entra** key is used to select a field for editing and for sending data to the ACS. The **Entra** key can also be used to escape out of some selected fields.

The ACS keypad has **OK** and **Exec** indicators. These indicators are green LEDs that are built into the keypad. When there are no errors present in the ACS and the Self-Tests have “passed,” the green **OK** LED illuminates. When the controller is running logic, the **Exec** LED illuminates. If the controller is in the **Exec** mode with no logic loaded or if it is in the DO I/O mode, the **Exec** LED flashes.

## 5.2 Operation

When the ACS unit first powers-up, it displays "ACS Self-Test In Progress." Next, the message "ACS Self-Tests In Progress..." appears. After the Mini displays this message, the unit performs tests to examine the current state of the network. Four different scenarios can occur:

**Scenario #1:** No power is supplied to the CAN port. The message "No Network Power Network Disabled" is displayed. Assuming the controller is configured to require the network, the OCS then displays the message "Self-Tests Failed." Also, there is a Fault Code of 80 displayed in "View OCS Info" in the System Menu. The green OK light does not illuminate.

**Scenario #2:** No other units are on the CAN network (or this is the first device to power-up on the network). The message "**Waiting for Net: F1 = Disable Net**" is shown. If another device is placed on the CAN network, the message clears and operation continues. The message "Self-Tests Passed" is displayed. The green OK light illuminates. If F1 is pressed the message "No Net Response Network Disabled" appears and is followed by the message "Self-Tests Failed". The green OK light does not illuminate.

**Scenario #3:** If a unit powers-up and finds another unit with the same node number as itself, the display shows "**Duplicate ID Network Disabled**". The network is disabled, and the unit displays the message "Self-Tests Failed." The green "OK" light does not illuminate.

**Note:** The ID checking works when one of two devices with the same ID is powered-up more than 1 second before the other. If both devices are powered-up at the same time, this method of ID checking may not work. In this case, the Mini continues to check for duplicate IDs during operation.

**Scenario #4:** If a unit powers up and it has network power, and other units are powered up on the network, the message "Self-Tests Passed" is displayed, and the green OK light is illuminated.

At any time, the ACS can be reset by pressing: ↑ + F1 + F2 (press the keys at the same time).

## 5.3 User Screens

In the normal operating mode there are a set of user-defined screens that can be scrolled through using the ↑ and ↓ keys.

If the ladder program energizes a text coil, the screen associated with this coil is displayed and overrides the "normal" user screens. This is designed to show alarm conditions or to display other ladder-detected events. When the text coil is de-energized, the previous screen that was being viewed before the alarm is returned.

If the screen contains an editable field, the user can press the Entra key to enter the edit mode. When in edit mode, a cursor appears on one digit of the editable field. Use the direction keys (← and →) to move to the cursor to the desired position. Use the ↑ and ↓ keys to increment or decrement the digit or enter the number/data with the alphanumeric keys.

If there is more than one field on the screen needing to be edited, use the direction keys (← and →) to move the cursor to the desired location.

The value chosen by the user may not exceed the minimum or maximum set by the user program. If the user tries to exceed the maximum point or enter a value below the minimum point, the value does not change.

**Note:** If the ACS displays ">>>>>" in a text field, the value is too big to display in the field or is above the maximum for an editable field. If the MINI displays "<<<<" in a text field, the value is too small to display or is below the minimum for an editable field.

### 5.3.1 *Cursor Types*

There are three different cursor types, which may show on the display:

- a. Solid underline
- b. Blinking block
- c. Blinking underline

A *solid underline cursor* appears under an editable field which is not being edited yet. The ← key and the → key can be used to move this type of cursor to select a different editable field, if required. Press Entra to start editing the selected field. This causes a *blinking block cursor* to appear.

A *blinking block cursor* appears in an editable field when Entra is first pressed to start editing the field. The *blinking block cursor* indicates that the field will be cleared when a numeric (or alphanumeric for an ASCII field) key is pressed. This allows a new value to be entered for the field just as it would be entered on a PC keyboard or a calculator. If a direction key (←, →, ↑, ↓) is pressed, the cursor changes from a *blinking block* to a *blinking underline*, and single-digit edit mode is entered.

A *blinking underline cursor* appears under an editable field which is being edited in single digit edit mode. In this mode, the digit (or character) above the cursor can be modified individually. This can be done by pressing ↑ or ↓ (increments or decrements) or by pressing a numeric (or alphanumeric) key. Pressing ← or → moves the cursor to the previous or next digit (or character).

NOTES



## CHAPTER 6: OPERATION

### 6.1 Power-up

At power-up, the ACS performs the necessary hardware checks, verifies the integrity of the factory calibration data and prepares to receive operational parameters from the network.

### 6.2 Discrete I/O

Eight (ACS100) and sixteen (ACS110) bidirectional DC inputs are provided which individually report a 1 (ON) when switched to common and are reported to %I1-8 /%I1-16 registers. Refer to %I Input Register Data for format information.

Eight (ACS100) and sixteen (ACS110) bidirectional DC outputs are also provided which activate when driven with a logic 1 or true %Q1-8/%Q1-16 register value. Refer to %Q Output Register Data for format information.

### 6.3 Status

Status information is stored in the %I registers

#### 6.3.1 *Loss of Phase (A, B, C) bits*

For each circuit, a minimal voltage and frequency must be applied to each voltage input to determine the AC values for proper indication and calculations. Should a signal on one of the voltage inputs fall out of the minimal range, its associated bit is asserted to warn the operator of the problem

#### 6.3.2 *Circuit A/B and A/C Phase Error bits*

For each circuit, the phase difference of each voltage input zero crossing is continuously tested for a valid difference. In wye mode, if the phase varies more than  $\pm 3$  degrees from 120 and 240 degrees respectively, the appropriate bit is asserted to warn the operator of a phase imbalance. Likewise, in delta mode, if the phase varies more than  $\pm 3$  degrees from 60 degrees (between circuit A/B), the appropriate bit is asserted. In delta mode, the A/C phase error bit is inactive.

#### 6.3.3 *Freeze kWh acknowledge*

This value is asserted when the ACS recognized that the freeze kWh bit has been asserted. See Power usage (kWh).

## 6.4 Register Maps

All incoming and outgoing data is stored in registers. Then following are the register definitions used by the ACS.

### 6.4.1 %SR58 Register Data

The ACS controls the 10 user definable keypad LEDs by writing to register %SR58.

Register(s)	Identifier
%SR58.1	Keypad LED 1
%SR58.2	Keypad LED 2
%SR58.3	Keypad LED 3
%SR58.4	Keypad LED 4
%SR58.5	Keypad LED 5
%SR58.6	Keypad LED 6
%SR58.7	Keypad LED 7
%SR58.8	Keypad LED 8
%SR58.9	Keypad LED 9
%SR58.10	Keypad LED 10

### 6.4.2 %I Register Data

The ACS stores status and discrete input information in registers %I1-32.

#### %I1-8/%I1-16 Discrete Inputs (ACS100 /ACS110)

Register(s)	Identifier
%I1	Digital Input 1
%I2	Digital Input 2
%I3	Digital Input 3
%I4	Digital Input 4
%I5	Digital Input 5
%I6	Digital Input 6
%I7	Digital Input 7
%I8	Digital Input 8
%I9	Digital Input 9
%I10	Digital Input 10
%I11	Digital Input 11
%I12	Digital Input 12
%I13	Digital Input 13
%I14	Digital Input 14
%I15	Digital Input 15
%I16	Digital Input 16

**Note:**

**ACS100 uses bits 1-8.**

**ACS110 uses bits 1-16.**

**%I17-32 Power Monitor Status Bits**

Register(s)	Identifier
%I17	Loss of Phase (A) Circuit 1
%I18	Loss of Phase (B) Circuit 1
%I19	Loss of Phase © Circuit 1
%I20	Phase AB Phase Error Circuit 1
%I21	Phase AC Phase Error Circuit 1
%I22	kWh freeze acknowledge
%I23	reserved
%I24	reserved
%I25	Loss of Phase (A) Circuit 1
%I26	Loss of Phase (B) Circuit 1
%I27	Loss of Phase © Circuit 1
%I28	Phase AB Phase Error Circuit 1
%I29	Phase AC Phase Error Circuit 1
%I30	kWh freeze acknowledge
%I31	Overcurrent Protection Alarm
%I32	Connector Not Installed

6.4.3 *%AI Register Data*

The ACS stores power monitor values in registers %A11-50.

**%A11-50 Power Monitor Input and 0-10V Input Values**

Register(s)	Identifier
%A11-2	Voltage A Circuit 1 [32bit Float]
%A13-4	Voltage B Circuit 1 [32bit Float]
%A15-6	Voltage C Circuit 1 [32bit Float]
%A17-8	Current A Circuit 1 [32bit Float]
%A19-10	Current B Circuit 1 [32bit Float]
%A111-12	Current C Circuit 1 [32bit Float]
%A113-14	Frequency Circuit 1 [32bit Float]
%A115-16	Watts Circuit 1 [32bit Float]
%A117-18	PF Circuit 1 [32bit Float]
%A119-20	VA Circuit 1 [32bit Float]
%A121-22	VAR Circuit 1 [32bit Float]
%A123-24	KWhr Circuit 1 [32bit Float]
%A125-26	Voltage A Circuit 2 [32bit Float]
%A127-28	Voltage B Circuit 2 [32bit Float]
%A129-30	Voltage C Circuit 2 [32bit Float]
%A131-32	Frequency Circuit 2 [32bit Float]
%A133-34	Watts Circuit 2 [32bit Float]
%A135-36	PF Circuit 2 [32bit Float]
%A137-38	VA Circuit 2 [32bit Float]
%A139-40	VAR Circuit 2 [32bit Float]
%A141-42	KWhr Circuit 2 [32bit Float]
%A143-44	Diff. Phase [32bit Float] (Both Circuits Phase A voltage must be present)
%A145-46	Voltage A Circuit 2 [32bit Float]
%A147-48	Voltage B Circuit 2 [32bit Float]
%A149-50	Voltage C Circuit 2 [32bit Float]

#### 6.4.4 %Q Register Data

The ACS controls discrete outputs power monitor functionality by writing to registers %Q1-24.

#### %Q1-8/%Q1-16 Discrete Outputs (ACS100 /ACS110)

Register(s)	Identifier
%Q1	Digital Output 1
%Q2	Digital Output 2
%Q3	Digital Output 3
%Q4	Digital Output 4
%Q5	Digital Output 5
%Q6	Digital Output 6
%Q7	Digital Output 7
%Q8	Digital Output 8
%Q9	Digital Output 9
%Q10	Digital Output 10
%Q11	Digital Output 11
%Q12	Digital Output 12
%Q13	Digital Output 13
%Q14	Digital Output 14
%Q15	Digital Output 15
%Q16	Digital Output 16

**Note:**

**ACS100 uses bits 1-8.**

**ACS110 uses bits 1-16.**

#### %Q17-32 Power Control Bits

Register(s)	Identifier
%Q17	kWh Freeze Circuit 1
%Q18	kWh Freeze Circuit 2
%Q19	reserved
%Q20	reserved
%Q21	reserved
%Q22	reserved
%Q23	reserved
%Q24	reserved

## 6.5 AC Monitored and Calculated Data

### 6.5.1 RMS Voltage and Current

Voltage and current indications are true RMS values and are calculated by squaring each sample over one line cycle, averaging the resulting squares, and taking the square root of the result. User supplied configuration ratio (scaling) constants are then applied for the appropriate PT or CT attached to the input (direct attachment of voltage input requires a ratio of 1.00).

For delta mode, the third phase voltage and current are computed from the difference of the measurements of the other phases. Should the load on the third phase become open, the third phase values will not be correct.

### 6.5.2 *Power Calculations*

True power consists of a point-by-point product of the associated voltage and current values averaged over one line cycle. Volt-amperes (VA) is the sum of the product of the RMS voltage and current values. Volt-amperes-reactive (VAR) is the vector difference of volt-amperes (VA) and true power. Power factor is true power divided by volt-amperes (VA).

### 6.5.3 *Power Usage (kWh)*

Power usage (kWh) is calculated as the time integral of true power and is expressed in Kilowatt-hours. To prevent overflow and loss of this accumulated value over power-cycles, the ACS must periodically sample and reset this accumulation. Synchronization is provided for reading and resetting the power usage (kWh) accumulation such that an immediate calculation is not lost. To start this process, the ACS asserts the broadcasted 'kWh Freeze' (%Q) bit. The ACS responds by freezing the value in the register (%AQ). Next, the ACS resets the kWh accumulator and begins a new calculation. Finally, the ACS asserts the 'kWh Freeze Acknowledge' (%I) bit once the value is frozen.

Once the value has been retrieved, the ACS releases the 'kWh Freeze' (%Q) bit to allow the ACS's kWh variable to revert to reflecting the real-time value of the kWh accumulator.

### 6.5.4 *Circuit 1 and 2 Phase Difference*

The phase difference is calculated by comparing the zero crossings of the voltage (A) input of each circuit. Each of the voltage (A) inputs must fall within the voltage and frequency limits of this device. If either circuit is providing a status of Loss-of-Phase (A), then the phase information is not calculated and displayed as zero.

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