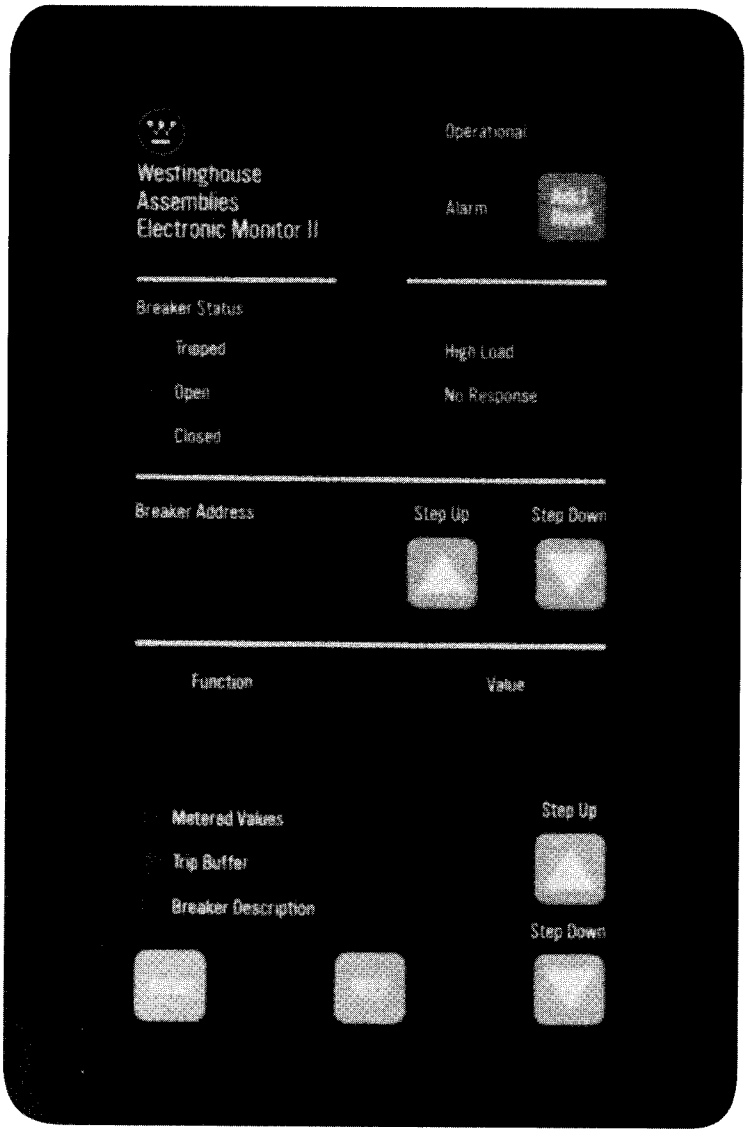
Cutler-Hammer
Westinghouse &
Cutler-Hammer Products
Five Parkway Center
Pittsburgh, Pennsylvania, U.S.A. 15220

ASSEMBLIES ELECTRONIC MONITOR II



Effective August, 1994

NOTE

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Cutler-Hammer representative should be contacted.

Effective August, 1994

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Section 1

INTRODUCTION

1.0 General — The Assemblies Electronic Monitor II (AEM II), Figure 1.1, is a microprocessor-based, self-contained, door-mounted device designed to monitor and display parameters of up to forty breakers equipped with Digitrip RMS 700, 800, 810, and 910 trip units. (For information on the trip units see I.L.'s 29-853 and 29-854, new IL# for 810, 910 respectively.) The two-way communication between the trip units and the AEM II utilizes integral INCOM chips and is accomplished using a single shielded twisted pair of conductors.

The parameters it displays are:

- Breaker Status
- AC Current (each phase, neutral or ground, depending if the trip unit has either element)
- Energy
- Time and date
- Cause of Breaker Trip
- Trip history
- Breaker Address

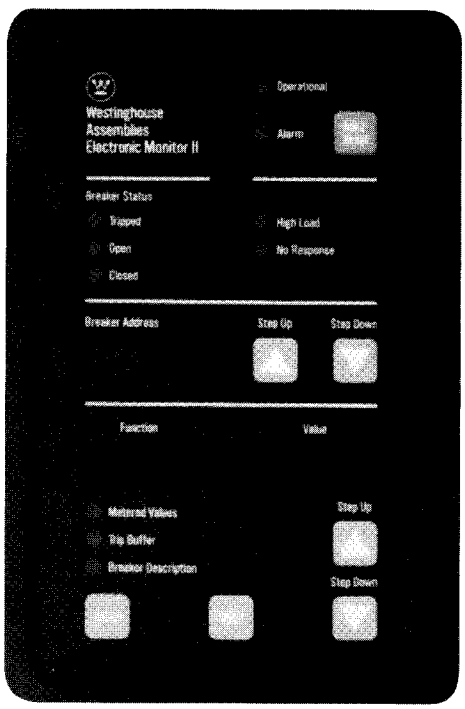

Figure 1.1 — Assemblies Electronic Monitor II

- High Load Condition
- Breaker Description (user-programmable)

When used with the remote communications option, the AEM II will pass data to a computer from IQ Data Plus, IQ Data Plus II metering and voltage protection devices, and IQ Data or IQ Generator metering devices, Digitrip 810 trip settings and Addressable Relay II Status. Information from these devices is not displayed by the AEM II.

NOTE: The only information displayed for the Digitrip 910 is the parameters listed above. All other information is not displayed by the AEM II. If remote communications is used, the balance of the information from the Digitrip 910 will be passed through in addition to the information displayed.

The program directing the functions of the AEM II is permanently stored in the AEM II; there is no need to reload after an AC power loss.

The addresses, types of devices, and descriptions stored in memory during the learn mode are also retained throughout a power loss.

The Operator Panel (Figure 1.1), which makes up the unit's front face, supports a function window, which visually indicates the actual metered values being displayed, the historical trip buffer, and a user-programmable description. A breaker address window shows the identification of the breaker being monitored. The Operator Panel also contains "Breaker Status" LEDs, an "Operational" LED, an "Alarm" LED and seven pushbuttons. The "Breaker Status" LEDs indicate the status of the breaker whose address appears in the breaker address window. If a breaker trips, the trip cause will be displayed in the function window, and the address of the tripped breaker will appear in the breaker address window.

The unit's primary function is to monitor and display at a common location the load current, status, energy, and cause of trip of each breaker in an assembly. A total of forty breakers may be monitored by one AEM II.

The unit's secondary functions are to:

1. Enable internal high load and trip alarm relays. Contacts from these relays may be used to sound a remote alarm.
2. Provide for optional remote communications.

The AEM II is a single-model product with remote communications as the only option. The remote communications option is available at any time by adding a communication module. No change in software is required.

1.1 Features and Options — A list of features and benefits is given in Table 1.A. Since the AEM II is standardized, only one style number is required when ordering new or spare units.

The remote communications option can be accomplished at any time with any one of the Product Operated Network Interfaces (PONI) modules available from Cutler-Hammer. This option enables the AEM II to exchange external data with a host computer. Electrical operating data supplied over a two-wire communication link will support plant energy management systems.

1.2 Required External Hardware — A 120 or 240 Vac 50/60 Hz supply is required to power the AEM II.

The optional remote communication module mounts on the rear of the AEM II. No external power is needed for the communication module.

1.3 Use of Manual — This manual is designed for use during installation, troubleshooting and, if necessary, unit replacement. It also has information of specific importance for the user's application engineer who is planning the overall system.

The scope of this manual is broad enough to form the basis of new employee familiarization, refresher training sessions, and on-going maintenance.

The application engineer is strongly advised to carefully read Sections 2 thru 5 before producing the system innerconnect diagrams. Installation teams should carefully read all of Section 5 **before** starting final installation. Maintenance personnel should be familiar with Section 6 before attempting to service the AEM II.

1.4 Level of Repair — This manual is written with the assumption that only unit-level troubleshooting will be performed. If the cause of the malfunction is traced to an AEM II, the unit should be replaced with a spare. The malfunctioning unit should then be returned to Cutler-Hammer for factory repairs.

Table 1.A

AEM II FEATURES AND BENEFITS

Features	Benefits
• Microprocessor-based control	• Reliable service
• Non-volatile memory	• No lost programs or special back-up batteries
• Simplified Operator Panel	• No elaborate, complex keyboard or confusing, multi-function readings
• Ease of startup	• Quick assembly and installation • No programming of devices required • Self-learning system
• Separate high load and trip alarm relay contacts	• Allow control of external devices
• Minimum wiring	• Only one shielded two-wire twisted pair daisy-chained from breakers to AEM II and three wires for 120 or 240 Vac, neutral, and ground. • Unit auto-selects 120 or 240 Vac power source
• Reduced number of devices	• Ammeters and switches with attendant current transformers for each circuit breaker not required
• Centralized monitoring	• Minimizes chances for errors • Eliminates need to interrogate each breaker location
• Ease of adding remote communication	• No re-programming • Retrofit at any time
• Help pushbutton	• Provides enhanced indication of metered values and trip and alarm conditions
• Trip buffer	• Maintains historical trip conditions for diagnostic purposes
• Breaker description	• User-programmable 8-character description to identify breaker
• Membrane NEMA Type 3R, 12 faceplate	• Can be used in harsh industrial environments

Section 2

HARDWARE DESCRIPTION

2.0 General — The purpose of this section is to familiarize the reader with the AEM II hardware, its nomenclature, and to list the specifications of the unit.

2.1 Hardware Description — The AEM II is designed to be mounted through a cutout in a panel. (This will generally be a cabinet's face or door.) Dimensions of the AEM II are shown in Figure 2.1.

The description is divided into the following:

- Operator Panel (Paragraph 2.1.1)
- Rear Access Area (Paragraph 2.1.2)
- External Hardware (Paragraph 2.1.3)

2.1.1 Operator Panel — The operator panel (see Figure 1.1), which is accessible from the outside of the panel or door, provides a means to:

- Determine which breaker is being monitored.
- Monitor the actual metered values in the function window.
- Determine which metered value is being displayed by means of the "Step Up/Down" pushbuttons located below the function window.
- Select metered values, trip buffer, or breaker description to be displayed in the function window.
- Determine the status of a breaker.
- Determine that a trip or alarm condition exists by means of two distinct LEDs.
- Acknowledge that a trip condition exists and silence a remote alarm by means of the "Ack/Reset" pushbutton.
- Determine the cause of a trip by means of the function window and "Help" pushbutton.
- Determine the value of current causing the trip condition.
- Reset the AEM II after a trip condition has occurred by means of the "Ack/Reset" pushbutton.

The use of the operator panel is detailed in Section 4.

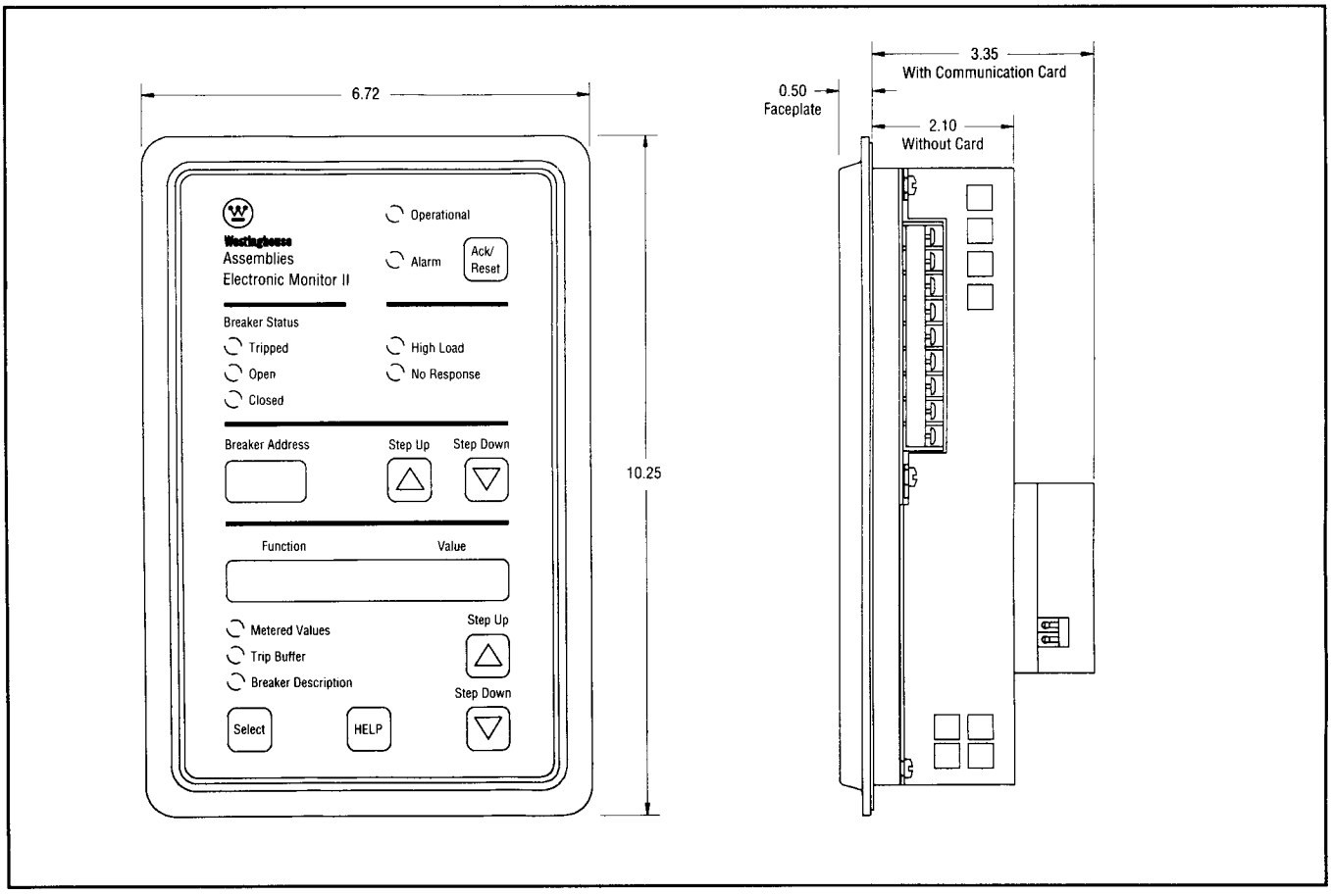

Figure 2.1 — Dimensions

2.1.2 Rear Access Area — The rear of the AEM II is accessible from the rear of the panel door. All wiring connections to the AEM II are made at the chassis' rear.

Study Figure 2.2 and note the following items:

1. The 120 or 240 Vac input connects to the terminal block at the top left of the AEM II.
2. Connections with controlled external devices, if used, are made at the terminal block. The alarm relay energizes on trip or no response conditions. The high load relay changes state on a high load condition. **The Terminal Block label shows contacts in the de-energized or normal position**. (These connections may be made at the NO or NC pairs (Form C) associated with the internal alarm and high load relays.)
3. A DIP switch located at the rear right side of the chassis allows the user to: place the AEM II in the learn mode, select the unit to operate as an AEM or AEM II, set the subnetwork communication speed, and place the AEM II in the test mode.
4. A three-connector port is located on the right of the chassis to connect to the AEM II local network.
5. A communications port, located on the right center portion of the chassis, is designed to connect with the optional communication module for the remote communications.

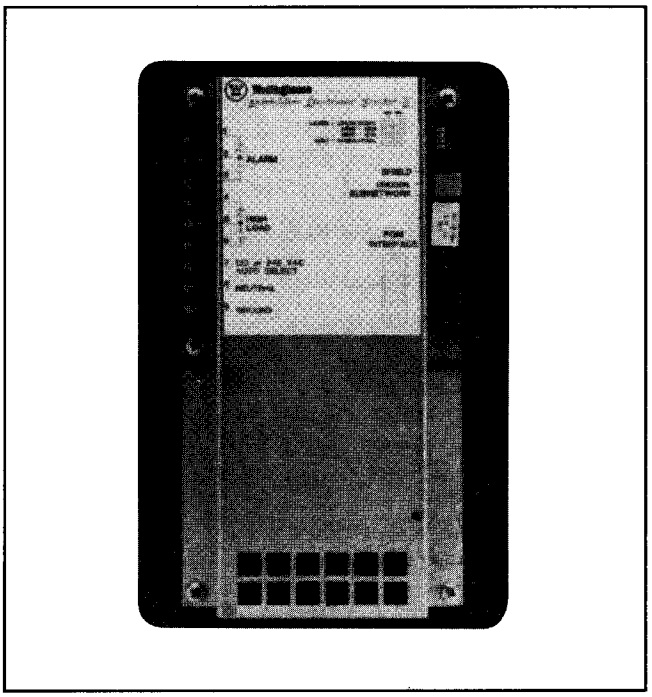

Figure 2.2 — Rear Access Area

2.1.3 External Hardware — Each AEM II requires that a customer-supplied 120 or 240 Vac 50/60 Hz supply be wired into the 9 point Terminal Block located at the upper left rear of the AEM II (see Figures 2.2 and 5.2).

2.2 Specifications — The specifications of the AEM II are contained in Table 2.A.

Table 2.A

GENERAL SPECIFICATIONS

Device's Power Requirement
10 VA Maximum
6VA typical

Frequency
50/60 Hz

Line Characteristics
120 or 240 Vac + 20%, –20%
(Autoselected)

Operating Temperature
0° to 70°C
(32° to 158°F)

Storage Temperature
–20° to 85°C
(–4° to 185°F)

Humidity
0 to 95% R.H.
noncondensing

High Load/Alarm Contact Ratings
10 amperes @ 277 VAC (Resistive)
10 amperes @ 30 VDC (Resistive)
1/3 HP 125, 250 Vac

Section 3

OPERATION

3.0 Introduction — This section describes the operation of the AEM II.

3.1 Power-Up — On power-up, all LEDs and display segments are illuminated for two seconds except for the "Operational" LED. The function window will then display AEM or AEM II, depending on the position of Switch 2. The microcontroller will do an internal diagnostics check and then a check of the non-volatile RAM. If these tests are passed, the microcontroller will initialize the displays to the breaker address of the first Digitrip RMS trip unit on the AEM II subnetwork. The description of that unit will also be displayed. If no addresses are found in the non-volatile memory or there is a non-volatile memory error, the learn mode will be initiated. (See Paragraph 3.2.)

If products are found, the microcontroller will go into its normal mode of requesting status and buffer data information from Digitrip RMS trip units and IQ metering devices, whose addresses were previously stored in the AEM II's memory. All pushbuttons are active at this time.

Any problems encountered during the diagnostics check will result in an error message being displayed in the function window. (See Table 6.A for a list of error messages.)

If an incorrect non-volatile RAM check-sum is found, the microcontroller will initiate a learn mode operation automatically, without any input from the mode switch on the rear of the AEM II, to reinitialize the system addresses. If a proper check-sum cannot be written to the non-volatile RAM at the end of this learn mode operation, the AEM II will display an error message in the function window. (See Table 6.A for a description of possible error messages.)

3.2 Learn Mode — When DIP switch 1 on the back of the AEM II is placed in the learn position, the microcontroller will initiate the learn mode. In the learn mode the AEM II can either allow for the addition of a unit to an existing network or it can poll the subnetwork for all devices. The function window will first display "ADD UNIT" for 5 seconds to allow the addition of devices to an already existing network. See Section 3.2.1 for instructions on adding devices to a subnetwork. After 5 seconds the micro controller will display "LEARNING" and the AEM II will automatically poll the subnetwork to learn all addresses between 001 and 099 on the AEM II subnetwork.

If a Digitrip RMS trip unit*, IQ Data Plus*, IQ Data Plus II*, IQ Data* or IQ Generator*, also the Addressable Relay II exists at any of the valid addresses (001 through 099), it will be logged and stored in the non–volatile portion of the AEM II memory. There is a maximum of 40 Digitrip trip units, 6 IQ metering devices, and 10 AR IIs that can be logged by the AEM II. If switch 1, slide #2, is set for AEM operation (on), IQ Data and IQ Generators will not be recognized on the subnetwork. Digitrip RMS trip units, IQ Data Plus and IQ Data Plus II will be recognized. If switch 1, slide #2 is set for AEM II operation (off), IQ Data Plus units will not be recognized on the subnetwork. Digitrip RMS trip units, IQ Data Plus II, IQ Data, and IQ Generators will be recognized.

During the learn mode, all the LEDs except the "Operational" LED will be off. Note that the "Operational" LED will flash only while the AEM II is polling the network.

The function window will blink "LEARNING" until a unit is found. The unit's address will show in the breaker address window and the type of unit will be displayed in the function window. The type can be one of the following:

DIGITRIP — for Digitrip RMS Trip Unit

DATAPLUS — for IQ Data Plus or IQ Data Plus II

DATA/GEN — for IQ Data or IQ Generator

RELAY — for Addressable Relay II

The AEM II will hold these displays for two seconds and then continue polling. "LEARNING" will blink until the next unit is found. It is recommended that while the addresses are being learned by the AEM II, they also be noted by the operator to ensure all desired devices on the AEM II subnetwork are logged into the AEM II memory. This is especially important when the communications option is used and the subnetwork contains IQ metering devices since these addresses are displayed on the AEM II only during this time. The "Operational" LED will continually flash until all 99 addresses have been polled and then will turn off.

NOTE: The IQ metering device addresses are displayed only during the learn mode. When the AEM II is in the operational mode the IQ metering devices pass through the AEM II but will not display on the AEM II.

As soon as the AEM II enters the learn mode, the DIP switch should be put back into the operational position. Polling of the network will continue until completed.

After all devices have been found, the AEM II will display the address of the first breaker found. The operator has the opportunity to input a description of the device for future

* Note that these devices must contain an INCOM chip which is inherent in the Digitrip RMS 700, 800, 810, and 910 trip units and contained in the optional communication module available for the IQ metering devices.

reference. The "Breaker Description" LED will be lit. The first character will flash to show which field is being edited. To change the charcter, hold down the "Step Up/Down" pushbutton while the flashing character changes. Press "Select" to advance to the next digit. Continue this process until all eight values are set. Pressing "Select" again will wrap around to the first character again.

Press the address "Step Up/Down" pushbutton to move to the next address. Repeat the above until all devices have been given custom names.

Enter the current time and date in the same fashion. (If using the remote communication option, the master computer may override this input with its time clock.) The screen will show "DONE". The operator may still scroll forward or back to edit if he/she chooses.

Pressing the "Ack/Reset" pushbutton will exit the learn mode. All addresses and descriptions will be saved in non-volatile memory.

If there were no units found and the DIP switch is put back in the operational position, a "NO UNITS" message will appear in the function window. The breaker address window will be blank. All of the pushbuttons will be inactive, although the DIP switch is active and will allow the AEM II to re-enter the learn mode again if so desired.

If units were found and the DIP switch is in the operational position, the AEM II will display the lowest Digitrip RMS trip unit that was found and its breaker description.

NOTE: Since the AEM II identifies the software version of a subnetwork device in the learn mode, it is necessary to place the AEM II in the learn mode whenever a device is replaced on the ARM II subnetwork.

3.2.1 Adding Devices to the Subnetwork — If a device is added to the subnetwork the AEM II must learn the new device. To add a device to the subnetwork, place DIP switch 1 on the back of the AEM II in the learn position. The function window will display "ADD UNIT" and within 5 seconds press the Ack/Reset pushbutton. If the Ack/Reset pushbutton is not pressed within that 5 seconds the AEM II will display "LEARNING" which will inidate the polling of all the devices on the subnetwork. See Section 3.2 for information on learning the devices.

NOTE: The "ADD UNIT" feature is availble only in software version 7.0 and greater.

NOTE: If devices already exist on the AEM II subnetwork, the descriptions of the existing devices will not be deleted when the subnetwork is relearned.

NOTE: As soon as the AEM II enters the learn mode, DIP switch 1 should be put back into the operational position. The AEM II will continue to learn the devices until complete.

If the Ack/Reset pushbutton is pressed within 5 seconds the function window will show "ADDR 01" and the address of the device can be added. Change the address of the device by pressing the function Step Up/Down pushbuttons. When the address on the display corresponds with the address of the device, press the Select pushbutton. The function display will show "VERIFY" and then either "VALID" if the unit is found or "INVALID" if the unit cannot be identified. If the display shows "INVALID" verify that the uit is powered, wired and addressed correctly.

If the unit shows "VALID" the function window will then display "ADD UNIT" for 5 seconds to allow the operator to add another unit to the subnetwork. Follow the instructions again to add another device or wait 5 seconds until the display window shows the description of any existing device or added device. The first character of the description will flash to show which field is being edited. To change the character, hold down the Step Up/Down pushbuttons while the flashing character changes. Press the Select pushbutton to advance to the next digit. Continue this process until all eight values are set. Pressing the Select pushbutton again will wrap around to the first character again.

Scroll through the Step Up/Down pushbuttons of the starter addresses to change the descriptions of any other devices. When all descriptions are complete press the Step Up/Down pushbuttons until "DONE" is displayed in the function window. The operator may still scroll forward or back to edit if he/she chooses. Pressing the Ack/Reset pushbutton while "DONE" is displayed will exit the learn mode. The new address and description will be saved in non-volatile memory.

3.3 High Load — When any Digitrip RMS trip unit is in a high load condition (current through the breaker equal to or greater than 85% of the trip unit's Long Delay setting for approximately 40 seconds), the high load relay will change state. If the AEM II is monitoring a breaker other than one with a high load, the display will remain on that breaker address and not change to the breaker address that has the high load condition. The "High Load" LED will turn on only when the address of the breaker with the high load condition is being displayed.

For the high load relay operation, the AEM II identifies the first unit to go into the high load condition. If the identified unit drops out of the high load condition, the high load relay will change state. If another unit is also in a high load condition, it then becomes the identified unit and the high load relay will change state again.

3.4 Trip — When a Digitrip RMS trip unit is in a tripped condition, the AEM II will log the address, buffer data from that unit and time stamp the event. The alarm relay will change state at this time, and the "Alarm" LED will illuminate. The AEM II will blank the display briefly as the latest trip buffer data is being read from the tripped unit(s). The display will show:

1. The "Alarm" LED on.
2. "Tripped" LED on under Breaker Status.
3. Trip cause flashing in the function window.
4. Address of the tripped breaker.

The AEM II will log up to 20 tripped Digitrip RMS trip units.

"Ack/Reset" and "Help" are the only active pushbuttons at this time.

If multiple units trip, their breaker buffer data will also be logged and the display will alternate once every two seconds between the tripped units, displaying their cause of trip. A blank message will flash in between each event so the operator may differentiate multiple trips on the same breaker. The message "Alarm" will appear to indicate the beginning of the trip display

cycle. The operator may count the number of events after the alarm message to see how many trips occurred since the last acknowledge.

At this moment, the AEM II is waiting for an acknowledgment from the operator. Trip cause, currents, date, and time are stored in the non-volatile memory for each trip. A breaker that does not respond to communication request is treated like a tripped breaker and flagged as a "No Response". If all the tripped units are reset and communications restored to any units not responding, then the AEM II will automatically reset the alarm mode and resume the normal display.

3.4.1 Trip Acknowledge — To acknowledge the trip condition, the operator must press the "Ack/Reset" pushbutton. The AEM II will then change the state of the alarm relay and display the latest tripped unit and its breaker description. After acknowledgment, the "Alarm" LED will flash if the trip is still active. All the pushbuttons are active at this time. The operator is now able to step between all units in the same manner as if there were no tripped breaker. The "Alarm" LED remains flashing even when the address of a non-tripped breaker is in the breaker address display window. This indicates that there is a tripped or not responding breaker on the subnetwork. The "Alarm" LED goes out only when all tripped breakers have been reset or communications re-established. The logged trip parameters remain in the AEM II until they are purged by the operator. The trip parameters may be viewed by the operator by selecting the "Trip Buffer" display.

After an alarm has been acknowledged, any subsequent alarm will return the AEM II to the alarm mode (alarm relay state changed, "Alarm" LED on, alarmed units cycling on the display). Subsequent alarms are automatically sequenced if the AEM II is in the alarm mode.

3.4.2 Trip Reset — The operator **must** acknowledge the tripped Digitrip RMS trip unit before its logged data can be purged from the AEM II. When the Digitrip is reset, the operator may choose to purge the trip data or leave it in the AEM II's trip buffer. The trip buffer is a non-volatile memory location with the ability to store up to 20 events by address. The oldest trip is automatically purged when the 21 event occurs. If the operator wishes to view the trip data, the "select" pushbutton must be pressed until the "Trip Buffer" LED is illuminated. To purge the file, use the function field "Step Up/Down" pushbuttons until "DELETE" is shown in the function window. Pressing the "Ack/Reset" pushbutton will bring up a "Confirm?" message; pressing any other pushbutton will abort the delete operation. Pressing "Ack/Reset" again will delete the file from the AEM II's memory.

It is possible to open a breaker through the AEM II from a remote computer when the remote communications option is used. Opening of a breaker by this means is considered a normal operation. However, the breaker status "Tripped" and trip cause "EXT TRIP" will be displayed in the function window. Activating the "breaker test" feature of the Digitrip RMS unit is considered a normal test operation. If displaying the address of the device being tested, the "Tripped" LED will illuminate and "BKR TEST" will appear in the function window. The AEM II will not go into the alarm mode of operation described previously in this section when opening or testing breakers.

Section 4

OPERATOR PANEL

4.0 Introduction — This section describes the operator panel of the AEM II. The operation of the AEM II as described in Section 3 should be read and understood before reading this section. This section is divided into the following three subsections:

- Pushbuttons (Paragraph 4.1)
- LEDs (Paragraph 4.2)
- Display Windows (Paragraph 4.3)

4.1 Pushbuttons — The operator panel supports seven pushbuttons (see Figure 4.1) that perform the following functions:

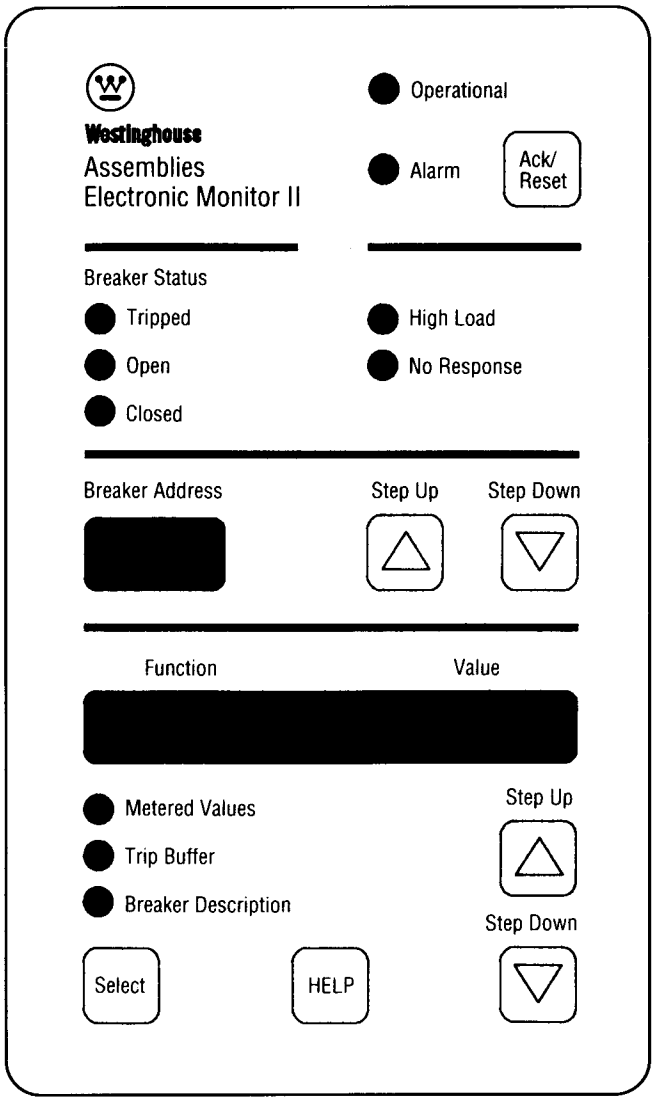

Figure 4.1 — Operator Panel

- Ack/Reset

1. Following a trip condition or no response (except for a communication network trip), the "Alarm" LED illuminates and the alarm relay changes state. Pressing this pushbutton will acknowledge the alarm and:

   a. Change the "Alarm" LED from steady on to flashing. A flashing "Alarm" LED indicates the AEM II has been acknowledged but the trip or no response condition still exists.

   b. Change the state of the alarm relay again.

2. After acknowledging the alarm, the AEM II will return to its normal display mode. The "Breaker Description" LED will be lit and the tripped breaker's description and address will appear in the display windows. The trip data is automatically stored in the trip buffer. The operator may review the trip data by selecting the trip buffer. Individual events may be purged from the trip buffer by following these steps:

   a. While "DELETE" is displayed in the function window, press the "Ack/Reset" pushbutton once.

   b. A "CONFIRM?" message will appear. Press the "Ack/Reset" pushbutton again to purge the event; push any other pushbutton to abort.

3. The "Ack/Reset" pushbutton allows the operator to exit the learn mode after the subnetwork has been polled, breaker descriptions have been entered, and the time and date have been set. Press the "Ack/Reset" pushbutton when the function window displays "DONE". This will exit the learn mode and begin normal operation (provided the learn mode switch is in the operational position). The "Ack/Reset" pushbutton is inactive while in the learn mode unless "DONE" is showing in the function window.

4. The demand watts and energy may be reset at the AEM II. Press the function field "Step Up/Down" pushbutton until "XX.XX MWD" or "XX.XX MWH" appears in the function window. Press the "Ack/Reset" pushbutton once to initiate the reset, press a second time to confirm. Press any other pushbutton to abort.

- Breaker Address Step Up/Down

These pushbuttons are used to step through the breaker addresses that are stored in the AEM II's non-volatile memory. The "Step Up/Down" pushbuttons raise/lower the breaker addresses accordingly. Each time one of these pushbuttons is pressed, the breaker address in the

display window will change. The addresses are in a loop to go back and forth from the highest and lowest addresses. For example, if breaker address 30 is the highest address in the memory and is being displayed, pressing the "Step Up" pushbutton will change the display to 01 (the assumed lowest address).

- Select

  Pressing this pushbutton will direct the function window to display one of the following:

  1. Metered Values
  2. Trip Buffer
  3. Breaker Description

- Function Field Step Up/Down

  Pressing these pushbuttons will step through the metered values or trip buffer data depending on which is selected on the AEM II faceplate. Each time the pushbutton is pressed, the newly selected value is displayed in the function window. **Note that I_G or I_N current will appear in the display window only if the Digitrip RMS trip unit is a model containing ground fault protection or a neutral current**. A value of zero will be displayed if the Digitrip does not have ground fault protection or neutral current.

- HELP

  Pressing this pushbutton will provide expanded information with respect to the field selected. This help will be displayed in the form of a scrolling message in the function window. For example, "IA 640" in the metered values window would scroll out to "PHASE 'A' CURRENT IN AMPERES"; "INST TRP" in the trip buffer would scroll out as "INSTANTANEOUS TRIP".

4.2 LEDs — The operator panel LEDs are divided into four types:

4.2.1 Alarm LED

- "Alarm" — This LED will be illuminated whenever:

  1. A breaker is tripped by any of the listed causes under trip cause, except for a communication network trip.
  2. There is no response from a logged breaker address.

     When this LED is flashing, it indicates that the "Ack/Reset" pushbutton has been pressed to acknowledge the alarm but the problem with breaker still exists.

4.2.2 Breaker Status LEDs

- "Tripped" — Indicates that the breaker is tripped. When this LED is illuminated, the "Alarm" LED (except for communication network trip — see Paragraph 4.2.1) will also be illuminated. The trip cause will be displayed in the function window until the "Ack/Reset" pushbutton is pressed. **Note that when this LED is illuminated, it requires that the Digitrip RMS trip unit be reset before the LED can be turned off**.

- "Open" — Indicates breaker is in the open position. Opening the breaker through the communication network is considered a trip of the breaker and not a normal operator action; however, this type of trip is not logged in the trip buffer. Note that when the Digitrip RMS trip unit **and** AEM II are reset following a trip operation and the breaker is open, this LED will be on.

- "Closed" — Indicates breaker is in the closed position.

- "High Load" — When the current flowing through a displayed breaker is equal to or greater than 85% of the Long Delay setting on the Digitrip RMS trip units for approximately forty seconds or more, this LED will be illuminated.

- "No Response" — Indicates that a Digitrip RMS trip unit address that has been logged and stored in the AEM II non-volatile memory has not responded to the AEM II request for data. See Table 6.B for possible causes of this problem.

4.2.3 Function Field LEDs

- "Metered Values" — Metered values from the Digitrip RMS trip unit are displayed in the function window. The "Step Up/Down" pushbuttons will step through available values. See Table 4.A for a list of metered values.

- "Trip Buffer" — The trip cause will be displayed in the function window. The "Step Up/Down" pushbutton will step through the trip data. The trip causes that may appear in the function window are listed below, along with their descriptions.

  1. LD TRIP — Long Delay Overload Trip – Trip action initiated as a result of an overload. Clear overload, reset trip unit and AEM II, and reclose breaker per customer's operating procedure.
  2. SD TRIP — Short Delay – Trip action initiated as a result of a fault exceeding the short delay trip setting. Examine the breaker to ensure reclosing is appropriate. Reset trip unit and AEM II; reclose breaker only after reason for trip has been cleared.
  3. INST TRP — Instantaneous – Trip action initiated as a result of a fault exceeding the instantaneous trip setting. Examine the breaker to ensure reclosing is appropriate. Reset trip unit and AEM II; reclose breaker only after reason for trip has been cleared.
  4. GND TRIP — Ground – Trip action initiated as a result of ground fault exceeding trip setting. Examine breaker to ensure reclosing is appropriate. Reset trip unit and AEM II; reclose breaker only after reason for trip has been cleared.
  5. ORID TRP / DISC TRP — Override/Discriminator – Trip action initiated by selective override circuit indicative of a high level fault or the Discriminator circuit – most likely on initial breaker closing action. Examine the breaker to ensure reclosing action is appropriate. Reset trip unit and AEM II; reclose breaker only after reason for trip has been cleared.
  6. PLUG TRP — Plug trip – Instantaneous trip caused by a missing, improperly installed or defective rating plug. Check rating plug, then reset trip unit and AEM II.
  7. RAM TRIP — RAM error trip – Trip action initiated in

response to a data memory test failure. Reset trip unit and AEM II to confirm the message. If the message reappears, replace the trip unit.

8. ROM TRIP — ROM error trip – Trip action initiated in response to a program memory test failure. Reset trip unit and AEM II to confirm the message. If the message reappears, replace the trip unit.
9. EXT TRIP — External trip – Trip action initiated by a command from a remote computer through the remote communications option. This is the only trip cause that does not place the AEM II in the alarm mode. The breaker may be reclosed by a command from the remote computer. To reclose the breaker from other than the remote computer, the Digitrip RMS trip unit on the breaker must first be reset or the breaker will be "trip free". This trip is not logged in the trip buffer.

- "Breaker Description" — The operator-programmed description is displayed in the function window. To program this description, see Paragraph 3.2.

4.2.4 Operational LED — This LED flashes when the AEM II is polling the network. Red indicates transmitting and green indicates receiving.

4.3 Display Windows — There are two display windows:

4.3.1 Breaker Address — This two-digit alphanumeric window displays the address of the breaker being displayed on the AEM II faceplate. When the DIP switch is in the learn network position, the addresses of the devices found on the AEM II subnetwork are displayed in this window (see Paragraph 3.2).

4.3.2 Function Window — This eight-digit alphanumeric window displays metered values, trip buffer data, and breaker descriptions.

Table 4.A

METERED VALUES

Selection	Display Format	Description
I_A Amps RMS	IA	Current in Amps. Ground current will only be displayed if trip unit has ground fault protection.
I_B Amps RMS	IB XXXXX	
I_C Amps RMS	IC	
I_G Amps RMS	IG	
I_N Amps RMS	IN	
Power Factor		Power Factor
Watts	XX.XX MW XXX.XX MW XXX.XX MW	Present demand. A minus sign (–) at the far left indicates negative power flow.
Demand Watts	XX.XX MWD XXX.XX MWD	Peak Demand in MegaWatts.
Positive Energy	XXXX PMWH	Positive energy used in Mega-Watt Hours.
Negative Energy	XXXX NMWH	Negative energy used in Mega-Watt Hours.
Total Energy	XX.XX MWH XXX.XX MWH	Energy used in MegaWatt Hours.

Section 5

INSTALLATION AND STARTUP

5.0 Introduction — This section describes the following items associated with the installation and startup of the AEM II:

- Mounting (Paragraph 5.1)
- Wiring (Paragraph 5.2)
- Initial Startup (Paragraph 5.3)

Read all sections, especially Section 2, Hardware Description, before using this section to install an AEM II.

5.1 Panel Preparation —This paragraph describes the panel preparation and mounting of the AEM II.

5.1.1 Cutout, Clearances — Since the AEM II is typically mounted in a cabinet door, it is necessary to prepare a cutout in which it will be placed. The dimensions for this cutout, along with the location of six mounting holes, are shown in Figure 5.1. Before actually cutting the panel, be sure that the required 3-dimensional clearances for the AEM II chassis allow mounting in the desired location. (Dimensions are shown in Figure 2.1.)

Remain close to tolerances when making the cutouts and placing the holes for the mounting screws. The horizontal dimensions between the center of the mounting holes and the cutout's vertical edge must be within –0 and +0.050 in. (0.13 cm).

5.1.2 Mounting — Do not use a tap on the face since this will remove excess plastic from the holes, resulting in insufficient threaded material to secure the AEM II to its mounting panel.

Place the AEM II through the cutout in the panel. Be sure the operator panel faces outward. Use 0.5 in. (1.2 cm) long screws (included with the AEM II) to mount the unit on a single-thickness panel. Be sure to start the screws from **inside** the panel so that they go through the metal first.

5.2 Wiring — The wiring of the AEM II must follow a suitable "wiring plan drawing". The term wiring plan, as used here, refers to the drawings made for the specific application. It describes all electrical connections between the AEM II and external equipment. This drawing is made up by the user or OEM.

A typical wiring plan is shown in Figure 5.4. Note the following:

- NO and NC contacts from the high load and alarm relays can be used to control external devices. These contacts are rated at 10 amperes maximum switching current and 277 Vac, 30 Vdc maximum switching voltage (resistive); 100,000 operations expected life.
- The wires to the AEM II 9-point terminal block must not be larger than AWG No. 14. Larger wire will not connect properly with the terminal block.
- The terminal block has No. 6-32 sems pressure saddle screws.
- Network interconnections use twisted pair conductors, No. 18 AWG shielded. The following distance rules apply (distances may vary depending on conductor type):

1. The last breaker or IQ metering device on the AEM subnetwork must not be farther than 6500 feet when using Belden 9463 or 8500 when using ImpCable from the AEM II. For additional guidelines in wiring AEM II networks, please refer to TD17513, IMPACC Wiring Specification.
2. Any branches from the main run must not exceed 200 feet in length. There is no limit to the number of branches that can be connected to the main run.
3. If remote communications are used, follow the communications module instruction literature for installation and distance rules.

All wiring must conform to applicable federal, state and local codes.

WARNING

Ensure that the incoming AC power and all "foreign" power sources are turned **OFF** and locked out before working on the AEM II or its associated equipment. Failure to observe this practice can result in serious or fatal injury, and/or equipment damage.

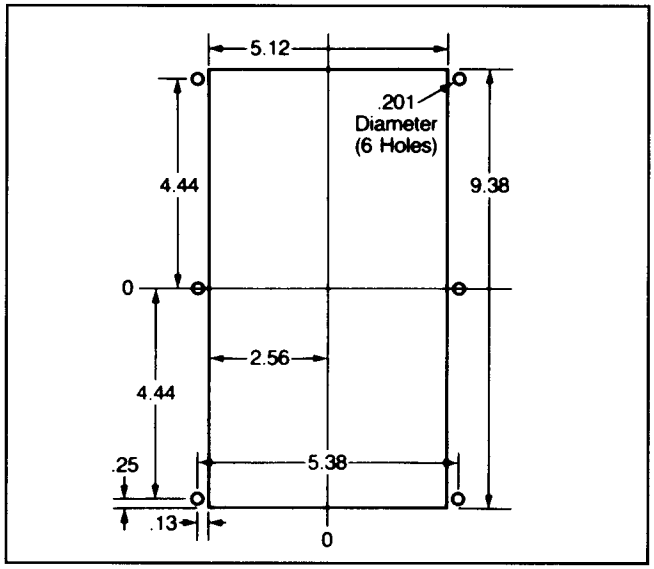

Figure 5.1 — Chassis Cutout Dimensions; Tolerance: –0 and +0.050 in.

5.3 Initial Startup — The information here is intended to be used when first applying AC power to the AEM II.

DIP Switch Settings — The DIP switches located and accessed from the rear-right portion of the chassis must be properly set according to application requirements. Obtain the installation record sheet produced specifically for the applica-

tion. A blank record sheet is shown in Table 5.A. The DIP switch contains four 2-position switches which are set in combination. (See Figure 5.3.) The switches are turned ON or OFF by sliding the switch. As you face the DIP switches, slide:

- To the LEFT to turn the switch OFF
- To the RIGHT to turn the switch ON

Figure 5.2 shows a side view of a single slide switch and how it is turned ON and OFF.

Observe the ON and OFF designations on the DIP switches shown in Figure 5.3. Always look for the OFF and ON designations on the hardware or printed circuit board to be sure you are setting the switches correctly.

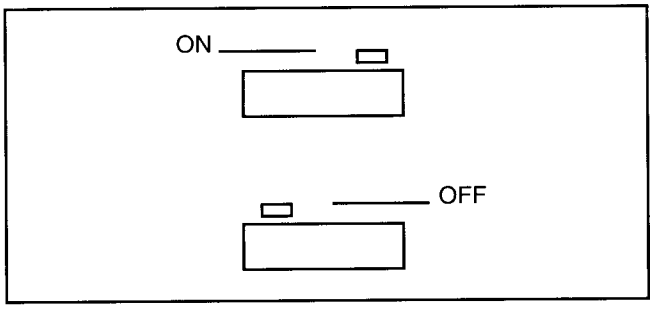

Figure 5.2 — DIP Switch (side view)

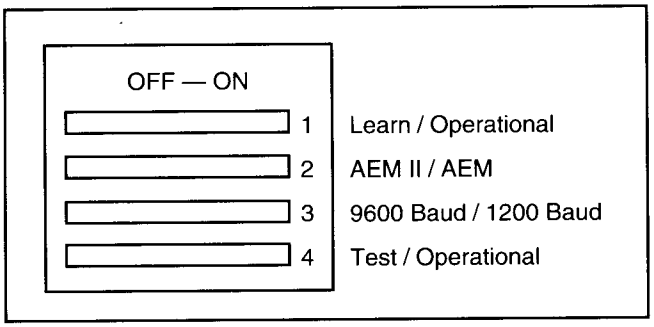

Figure 5.3 — DIP Switch

After all the DIP switches are set according to the settings listed on the installation record sheet, the system is ready to have AC power applied. Follow the procedure listed in Paragraph 5.3.2 when first applying power to the AEM II.

- SW1 #1 – Mode

  This switch should always be in the operational mode except when adding or deleting devices or changing time, date, or breaker description. When the switch is in the OFF position, it will poll the network for devices. See Paragraph 3.2 for learn mode.

- SW1 #2 – Type

  If set to AEM (ON), the device will emulate an AEM in the way it sends its data to the master computer. This could replace existing AEMs and communicate with all existing software programs. If set to AEM II (OFF), the AEM II will communicate only to master computers equipped to receive its new data buffers. The subnetwork speed can be programmed to either 1200 or 9600 baud. This switch affects the learn mode (refer to section 3.2).

- SW1 #3 – Baud Rate

  This switch tells the AEM II what speed the subnetwork (switchgear internal network) is communicating. All subnetwork devices must be set to communicate at the same speed.

- SW1 #4 – Test

  This switch should always be in the ON position for normal operation. It is used to functionally test the unit and check memory at the factory. If this switch is set to the OFF position, all non-volatile memory may be erased. "Test" will suspend communications to both the subnetwork and the master computer.

5.3.1 Before Power Application

- Verify that all wiring is correct, as shown on the wiring plan drawing.
- When possible, disable the AEM II until the rest of the equipment has been checked.

Table 5.A

INSTALLATION RECORD SHEET: SW1

DIP Switch	Slide Switch	Setting ON/OFF	Descriptions
SW1	1	____	Mode: ON = Operational OFF = Learn
	2	____	Type: ON = AEM OFF = AEM II
	3	____	BAUD Rate: ON = 1200 OFF = 9600
	4	____	Test: ON = Operational OFF = Test

- Set the address of each Digitrip RMS trip unit per the instructions in Paragraph 5.4. It is recommended that all addresses assigned be noted for reference during learn mode.
- Set the address of each IQ metering device that will feed through the AEM II into the remote communications network.

Notes:

1. The AEM II will communicate only with devices that have addresses 001 through 099 decimal. Addresses greater than 099 will not be recognized.
2. Each AEM II and the local devices that communicate with it are considered a local network or subnetwork. Do not use a duplicate address for any device connected to the same AEM II. Duplicate addresses will cause communication errors.

5.3.2 Initial Power Application

a. Apply 120 or 240 Vac power to the AEM II. (Refer to Paragraph 3.1 Power-Up)

b. Make sure all the breakers that are to be in the AEM II subnetwork are in the connected position with their addresses set per Paragraph 5.4. Note that the AEM II will poll and read addresses of circuit breakers that are in their Test position. To disable communications to the breaker while it is in the Test position, truck operated cell switch contacts may be wired to the breaker communications lines. Use of cell switch contacts is optional.

c. Set Switch 1 on the rear of the AEM II to the learn position. The AEM II will log and store the addresses of each device in the AEM II subnetwork. See Paragraph 3.2 for details.

d. Set Switch 1 on the rear of the AEM II to the operational position. The AEM II will be operational after it finishes polling the subnetwork and the operator exits the learn mode. See Paragraph 3.2.

Note: Any time a device is removed or added to the AEM II subnetwork, steps b., c. and d. must be repeated. If this is not done:

- When a device is added, the AEM II will not know it is there and will not communicate with it.
- When a device is removed, the AEM II will declare a "No Response" alarm for that device.

5.4 Address System — To enable the individual monitoring of multiple circuit breakers, each Digitrip RMS 700, 800, 810 and 910 trip unit is equipped with an adjustable address register. As shown in Figure 5.5, the three-digit INCOM address register is located at the right side of the rating plug cavity on the Digitrip RMS trip unit. It is accessible only when the rating plug is removed.

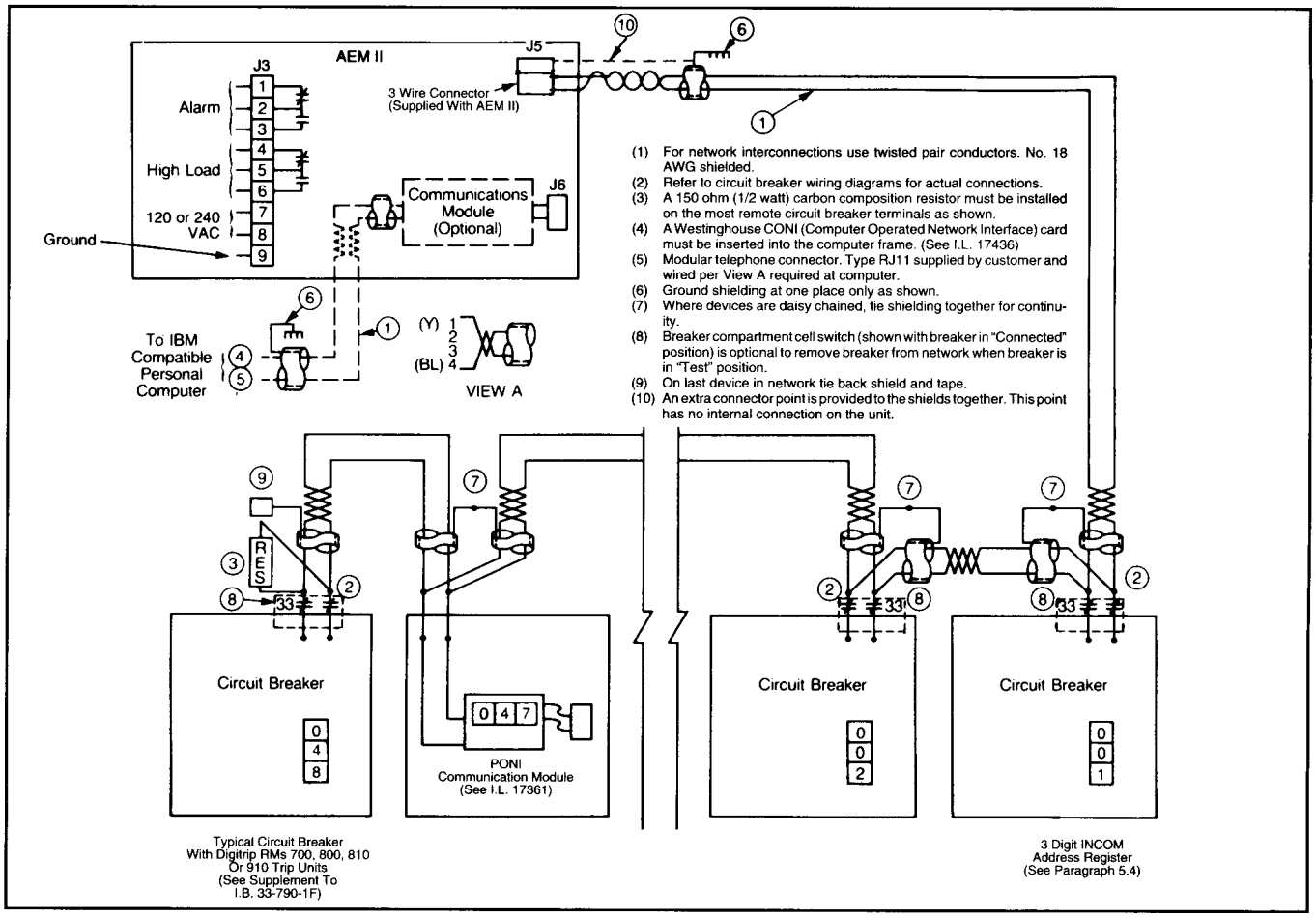

Figure 5.4 — Typical Wiring Diagram

CAUTION

Removal of the rating plug with the breaker closed and control power available will trip the breaker.

Each of the three digits in the trip unit address is independently set by rotating the ten-position selector switch with a small screwdriver. As the selector switch rotates, the address digit appears in the window. Since the AEM II will recognize only addresses 001 through 099, the top switch must be set on zero. Adjust only the lower two switches.

As indicated in Figure 5.5, each trip unit is provided with a space on the front face for marking the selected INCOM address and cell designation in which the circuit breaker is installed. It is recommended that these spaces be properly utilized.

NOTE

To ensure communications with the proper circuit breaker, care must be exercised by maintenance personnel to replace any removed circuit breaker in its proper cell when the maintenance operation is completed.

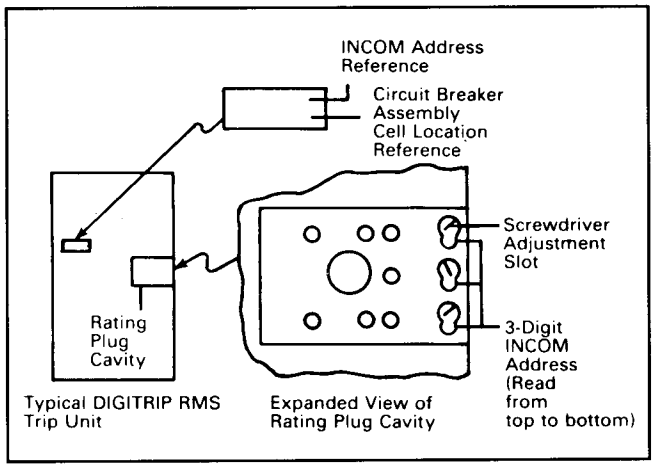

Figure 5.5 — INCOM Address System

Section 6

MAINTENANCE

6.0 General — This section describes maintenance procedures for the AEM II. The information contained here is divided as follows:

- Error messages (Paragraph 6.1)
- Isolating a malfunction (Paragraph 6.2)
- Replacing the AEM II (Paragraph 6.3)

Earlier sections of this manual, especially Section 2 – Hardware Description; Section 3 – Operation; Section 4 – Operator Panel and Section 5 – Installation and Startup, should be read thoroughly to familiarize the maintenance personnel with the AEM II.

The AEM II continuously runs self diagnostics in the background to check unit integrity. These background diagnostic routines are transparent to the operator. (See table 6.A for error messages.)

6.1 Error Messages — This paragraph lists error messages that appear in the function window. The "Help" pushbutton and Table 6.A offer explanations to the error messages.

6.2 Troubleshooting — This paragraph lists procedures to follow when the AEM II is not operating properly. Table 6.B lists the probable causes and solutions for each of a number of symptoms.

CAUTION

All maintenance procedures must be performed only by qualified personnel who are familiar with the AEM II and the associated devices being monitored. Failure to observe this caution can result in equipment damage.

Table 6.A

ERROR MESSAGES

Error Message	Description
RETRY	A BCH communication error occurred during learn mode; AEM II will automatically retry communications to the displayed address.
COMM ERR	3 consecutive BCH errors occurred when communicating to the displayed address. The address is ignored and the learn mode continues.
NO UNITS	No Digitrips RMS trip units or IQ metering devices were found on the subnetwork. Check communications link and toggle the learn switch (SW1 #1).
CHECK SWITCH (alternating)	The learn switch is in the wrong position. The AEM II cannot exit the learn mode. Slide SW1 #1 to the operational position (ON).
NVM ERR	Corrupt data was found in both non-volatile memories during the power-on test sequence. The AEM II will automatically invoke the learn mode to restore the subnetwork configuration.
RTC BAD	A Real Time Clock malfunction was detected by the background diagnostic routines.
NVM BAD	A non-volatile memory malfunction was detected by the background diagnostic routines.
LGC BAD	A random logic malfunction was detected by the background diagnostic routines.
ROM BAD	A stored program malfunction was detected by the background diagnostic routines.
Warning Message	**Description**
LDPU	The displayed breaker is in a long delay pick up condition.
DELETE	Operator is invoking the delete function to remove data from the non-volatile memory. This function is a confirmed process. Press "Ack/Reset" to proceed.
CONFIRM?	Safety check to prevent accidental deletion of non-volatile data. Press "Ack/Reset" to delete data; press any other pushbutton to abort.

Table 6.B

TROUBLESHOOTING

Symptom	Probable Cause(s)	Solution
All operator panel LEDs off	• 120 or 240 Vac power supply is deficient	• Locate cause of deficiency
	• AEM II is malfunctioning	• Replace the unit (See Paragraph 6.3)
On power-up, any LED or display segment is off except the "Operational" LED	• Defective LED or display	• Replace the unit (See Paragraph 6.3)
"Operational" LED off	• 120 or 240 Vac power supply is deficient	• Locate cause of deficiency
	• Defective LED	• Replace the unit (See Paragraph 6.3)
	• Mode switch in learn network position	• Move mode switch to operational position
Address of a specific breaker(s) is not displayed	• Address not in AEM II memory	• Put mode switch in learn network position and then return it to operational position. View breaker display window to determine if address is on network. a) Check that breaker is in operate position. b) Check that breaker Digitrip RMS trip unit is operational. c) Check wiring between Digitrip and AEM II d) Check the address to be sure it is between 001 and 099 (decimal)
No I_G current value	• No ground fault protection on Digitrip trip unit	• If I_G is required, replace Digitrip RMS trip unit with correct model containing ground fault protection
"Alarm" LED flashing and will not turn off	• Digitrip RMS trip unit not reset or not responding	• Push Reset button on breaker Digitrip RMS trip unit • Check communications link
High load alarm relay energized but "High Load" LED not on	• Breaker address with high load not displayed	• Step through breaker addresses until "High Load" LED comes on
Trip log data remains on display when Trip Buffer is selected, but trip data is no longer needed	• Event has not been purged from the trip buffer	• Step Up/Down through the function window to display "DELETE". Press the "Ack/Reset" pushbutton, and confirm.
Address of IQ metering devices only shows on display during learn mode	• AEM II is operating correctly. The AEM II only displays the IQ metering addresses when learning, not during normal operation.	• See Section 3.2

Table 6.B (Cont'd.)

TROUBLESHOOTING

Symptom	Probable Cause(s)	Solution
During learn mode, addresses of all breakers do not appear, only the addresses of the IQ metering devices	• AEM II subnetwork DIP switch and IQ metering PONIs set at 9600 baud. The Digitrip RMS Trip Units can only operate at 1200 baud.	• Switch DIP switch 3 to 1200 baud on the AEM II and DIP switches on all IQ metering PONIs to 1200 baud
"Operational" LED flashes red only	• Defective communications • AEM II not receiving information	• Verify Digitrip RMS trip unit and IQ metering devices on the AEM II subnetwork are functional • Verify devices on the AEM II subnetwork have valid address setting (addresses 001 through 099 decimal) • Verify continuity of twisted pair communication wire
	• AEM II is malfunctioning	• Replace the unit (See Paragraph 6.3)
"No Response" LED on, breaker address normal	• Defective communications	• Verify Digitrip RMS trip unit is functional • Verify continuity of twisted pair communication wire
	• Breaker not in connected position (if optional cell switch is used)	• Verify breaker is in connected position (see note 8 in Fig. 5.4)
"Alarm" LED on but the "Tripped" or "No Response" LED is not on	• Breaker address display window shows an address other than the alarmed breaker(s)	• Use "Step Up/Down" pushbuttons to step through breaker addresses until breaker status and function window indicate the alarmed breaker(s)

6.3 Unit Replacement — Follow this procedure to replace the AEM II.

Step 1 — Remove control power from the AEM II at the main disconnect or isolation switch of the 120 or 240 Vac supply. If the switch is located at a distance from the AEM II, lock it out to guard against personnel accidentally turning it on.

Step 2 — Verify that all "foreign" power sources wired to the AEM II are de-energized. These may be present on the Alarm and High Load relay connections at the 9-pin terminal block.

Step 3 — Before disconnecting any wires from the unit, make sure they are individually identified to assure correct reconnection. Make a sketch to help with the task of terminal and wire identification.

Step 4 — If an optional cable connects with the Communications Port, carefully unplug it. The connectors may be screwed together.

Step 5 — Loosen each screw terminal where there is a wire connection. Remove the associated wire.

CAUTION

Be prepared to support the AEM II from its front side once most of the screws are loosened or removed. Without such support, the unit could fall or the panel could be damaged.

Step 6 — Remove the 6 mounting screws holding the unit against the door or panel. These are accessed from the rear of the AEM II.

Step 7 — Carefully lay the screws aside for later use.

Step 8 — Read Paragraph 5.1.2 before attempting to mount the replacement unit.

Step 9 — Reverse the procedure noted in Steps 4 thru 6.

Step 10 — Using the sketch noted in Step 3 above, replace each wire at the correct terminal. Be sure each is firmly tightened.

Step 11 — Restore control power (see Paragraph 5.3.2 – Initial Power Application).

Information Request

- ☐ Please send me updated application materials when available.
- ☐ Please send me information on _____
- ☐ Please have a Sales Engineer call.
- ☐ Please contact me to discuss IMPACC Local Area network applications.

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