3300 ACM

DIGITAL POWER METER

INSTALLATION AND OPERATION MANUAL

Written by:
Bradford Forth, P.Eng.
Simon Ki, B.Eng.

Layout:
T. W. Tobin

August 18, 1992

© PML 1992
All Rights Reserved

POWER MEASUREMENT LTD.

POWER MEASUREMENT LTD.
6703 RAJPUR PLACE, VICTORIA, B.C., CANADA V8X 3X1
TEL: 604-652-5118 FAX: 604-652-0411

POWER MEASUREMENT LTD. (EUROPE)
AVENUE DES GAULOIS 15, 1040 BRUSSELS, BELGIUM
TEL: 32-2-732-5850 FAX: 32-2-732-6344

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION

1.1 DESCRIPTION

The 3300 ACM is a 16-bit, microprocessor based 3-phase power meter which provides advanced features at an affordable price.

The 3300 ACM expands the successful PML line of power meters by offering a four function alternative to full featured digital instrumentation packages, while still providing high accuracy, high reliability, and high transient, surge and hipot withstand capabilities. Volts and Amps measurements are true RMS, including harmonics.

The basic model 3300 ACM can directly replace up to four standard analog meters and selector switches, while additional measurement options make it possible to replace even more. Further savings are realized through a unique 2-module design, which simplifies wiring and reduces installation time. This makes the 3300 ACM perfectly suited for economical metering on 3-phase industrial and commercial switchboards and switchgear.

A communications port is standard, allowing the 3300 ACM to be used as either a stand-alone power monitoring station, or as one element in a large energy management network. The 3300 ACM is also available without the display module, making it an ideal digital power transducer for PLC, EMS, DCS and SCADA applications.

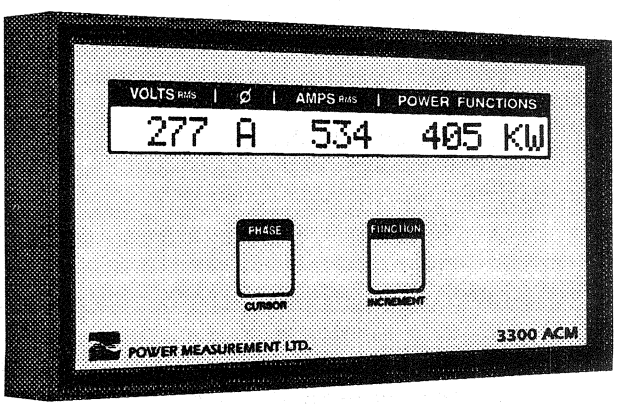
A choice of many measurement functions and displays

The 3300 ACM may be configured to operate in Wye (Star), Delta, or Single phase voltage modes. The following standard measurements are available:

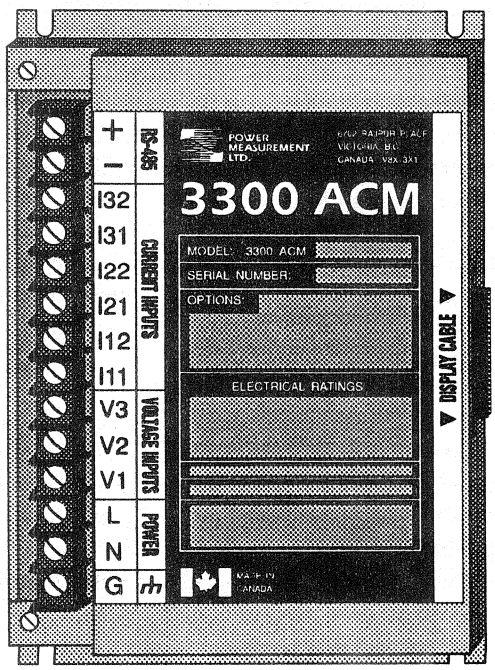
- Line to neutral voltages (Van, Vbn, Vcn)
- Line to neutral average voltage
- Line to line voltages (Vab, Vbc, Vca)
- Line to line average voltage
- Current on each phase (Ia, Ib, Ic)
- Average current
- KW total for all phases
- KWH total for all phases

Many other measurements are offered as options, including KVAR, KVARH, KVA, KVAH, Power Factor, and Frequency. Demand and minima/maxima values on all measured parameters are also available. See Chapter 3 for a complete listing of standard and optional measurements.

The separate ***display module*** offers a high-visibility 20-character LCD display providing many convenient options for presenting measured data, including ***simultaneous display*** of: Volts, Amps, and Power Function; all 3 Volts phases; or all 3 Amps phases.



DISPLAY MODULE



BASE MODULE

Quick and easy installation

The separate *display* and *base* modules of the 3300 ACM simplify wiring connections and reduce installation time. The compact, rugged base module provides a large, utility approved, barrier-style terminal strip for reliable connections. No transducers are required. Connections from CTs can be made directly (via shorting blocks), and no PTs are required for 4-wire Wye systems under 347/600 Volts.

The separate display/keypad module is panel mountable, requiring only a single cutout. The module has been designed to fit ANSI C39.1 cutouts, simplifying replacement of existing analog meters. The display module connects via a single pluggable cable to the base module, allowing the base module to be mounted inside the switchgear cabinet. No switches or additional wiring are required on the panel door.

Field programmability

Volts and Amps Scales, Volts Mode (wye, delta, single phase), and Baud Rate are all easily programmable from the front panel. A portable or remotely located computer can also be used to program setup data via the communications port. All setup data is saved when 3300 ACM power is turned off. All programming is password protected.

Communications and SCADA compatibility

The 3300 ACM is equipped with an optically isolated RS-485 communications port for remote display of measured data. This allows the 3300 ACM to be incorporated as one element within sophisticated SCADA or Energy Management Systems.

RS-485 can operate as a 2-wire LAN with up to 32 devices per loop, and is capable of addressable polling of multiple units, packet transmission, and high throughput (300 to 19,200 baud).

The 3300 ACM maintains communication compatibility with PML's other 3000 series devices and low cost PC-based power monitoring systems, PowerView and M-SCADA. An IBM PC/XT, PC/AT, or PC/386 compatible computer running PowerView or M-SCADA software can be used to display the real-time measured data from each 3300 ACM, or for the entire power distribution system.

A comprehensive description of the 3300 ACM communications protocol can be found in Appendix F. This open protocol enables other systems to access the 3300 ACM. PML's ongoing development program provides further compatibility with third-party communications protocols.

New feature upgrades made easy

The 3300 ACM has been designed to maintain its position at the forefront of current technology through upward compatibility. An advanced system architecture was developed by PML to support simple upgrading of the 3300 ACM on-board operating firmware. New features or performance enhancements can be installed easily via the device's communications port - ***without any interruption to electrical service.***

Each 3300 ACM should be connected to a local RS-485 communications bus during initial installation to allow firmware upgrades to be accomplished without the need for wiring disconnections or removal of units from their mountings. This is described in detail in Chapter 2.

KWH pulsing feature

The 3300 ACM offers an additional feature which allows the RS-485 port to be used as a KWH pulse output, suitable for driving an external relay.

1.2 SYSTEM APPLICATIONS

The 3300 ACM is a state-of-the-art alternative to traditional analog electro-mechanical metering devices. Because of its unique measurement, display, and communications capabilities the 3300 ACM should be considered for use in:

a) Utility Installations and Substation Metering
b) Industrial, Office and Commercial Buildings
c) Hospitals
d) Telephone Exchanges
e) Factories and Chemical Process Plants
f) Pulp Mills and Saw Mills
g) Large Stores, Shopping Centers, and Hotels
h) Co-generation Systems
i) Multi User Sites where allocation of electrical costs is desirable.
j) Any other installation which uses significant amounts of electrical energy.
k) Any other locations where remote monitoring is needed.

2. INSTALLATION

2.1 LOCATION

The 3300 ACM should be mounted in a dry, dirt free environment away from heat sources and very high electric fields. Temperatures should not exceed 50°C (112°F) or fall below 0°C (32°F).

2.2 MOUNTING

Appendix A provides the mounting dimensions for the 3300 ACM.

The *display module* of the 3300 ACM can be panel mounted for easy access and viewing. This module is typically mounted on the switchgear cabinet door. The panel into which the display module is to be mounted requires four holes and one cutout to allow for connection of the *display cable*. The layout of the display module mounting studs and cable connector have been designed such that the module will fit an existing ANSI C39.1 panel cutout.

The *base module* of the 3300 ACM can be mounted flush against any flat surface. The unit provides four slots on its mounting flange for this purpose. The base module is typically mounted inside the switchgear cabinet. Labelling on the base module has been positioned to allow the module to be mounted against a wall with the terminal strip in a vertical orientation. However, the module can be mounted in whichever orientation is most convenient.

Note that the distance between the mounting locations of the display and base modules will be limited by the length of the interconnecting display cable (6 feet / 1.82 meters).

2.3 POWER SUPPLY

The standard 3300 ACM is powered by a nominal 120 Volts AC (47 to 66 Hz) at 0.1 Amps. This unit can be powered from a dedicated fused feed, or it may be powered by the voltage source which it is monitoring, as long as it is a 120 Volt system. An optional power supply is available for 240 VAC (47 to 66 Hz) at 0.05 Amps.

2.4 WIRING

Electrical and communications connections to the 3300 ACM are made to the terminal strip located on the base module. Appendix A provides 3300 ACM terminal block dimensions.

ELECTRICAL CONNECTIONS

12 to 14 gauge wire is recommended for all electrical connections. Phasing and polarity of the AC current and voltage inputs and their relationship is critical to the correct operation of the unit. Figures 2.7.1 to 2.9.1 provide wiring diagrams to ensure correct installation. Ring or spade terminals may be used to simplify connection.

COMMUNICATIONS CONNECTIONS

RS-485 communications connections are made via a 22 gauge shielded twisted pair cable. Section 2.10 describes communications connections.

IMPORTANT NOTE

It is very important that communications wiring be made to the RS-485 port of every 3300 ACM being installed, and extended to a location which is easily and safely accessible. All field service work including running diagnostics, testing, software upgrades, feature upgrades, etc., are performed via the communications link. Refer to Section 2.10 for more information.

2.5 PT AND CT TRANSFORMER SELECTION

For proper monitoring, correct selection of CTs and PTs (if required) is critical. The following paragraphs provide the information required to choose these transformers.

PT Selection

Whether or not potential transformers (PTs) are required depends on the nature of the system being monitored, the voltage levels to be monitored, and the input option of the 3300 ACM. The 3300 ACM may be used for direct connection to 120/208, 220/381, 240/415, or 277/480 4-wire and 3-wire WYE systems, or 347/600 Volt 4-wire WYE systems.

These inputs can also be used with potential transformers (PTs) that have a 120 Volt secondary. If system voltages are over 347/600, PTs are required. PTs are used to scale down the system L-N (Wye) or L-L (Delta) voltage to 120 Volts full scale. The PTs are selected as follows:

a) Wye (Star): PT primary rating = system L-N voltage or nearest higher standard size. PT secondary rating = 120 Volts.

b) Delta: PT primary rating = system L-L voltage. PT secondary rating = 120 Volts.

PT quality directly affects system accuracy. The PTs must provide good linearity and maintain the proper phase relationship between voltage and current in order for the Volts, KW, and PF readings to be valid. Instrument Accuracy Class 1 or better is recommended.

CT Selection

The 3300 ACM uses current transformers (CTs) to sense the current in each phase of the power feed. The selection of the CTs is important because it directly affects accuracy.

The CT secondary rating depends on the current input option installed in the 3300 ACM. The standard 3300 ACM current input rating is 5 Amps. A 1 Amp input option is also available.

The CT primary rating is normally selected to be equal to the current rating of the power feed protection device. However, if the peak anticipated load is much less than the rated system capacity then improved accuracy and resolution can be obtained by selecting a lower rated CT. In this case the CT size should be the maximum expected peak current +25%, rounded up to the nearest standard CT size.

Other factors may affect CT accuracy. The length of the CT cabling should be minimized because long cabling will contribute to inaccuracy. Also, the CT burden rating must exceed the combined burden of the 3300 ACM plus cabling plus any other connected devices (burden is the amount of load being fed by the CT, measured in Volt-Amps).

Overall accuracy is dependent on the combined accuracies of the 3300 ACM, the CTs, and the PTs (if used). Instrument accuracy Class 1 or better is recommended.

2.6 GROUND CONNECTION

CONNECTING THE G TERMINAL

The ground terminal, G, of the 3300 ACM serves as the measurement reference point, as well as the chassis ground connection for the meter. This lead must be connected to earth ground.

A good, low impedance chassis ground is essential for accurate measurement. Do not rely on metal door hinges as a ground path.

[CAUTION]

The 3300 ACM ground must be connected to the switchgear earth ground using a **dedicated 14 gauge (or larger) wire** in order for the noise and surge protection circuitry to function correctly. Failure to do so will void the warranty.

2.7 CONNECTION FOR THREE PHASE WYE (STAR) SYSTEMS

Figures 2.7.1 to 2.7.3 provide wiring diagrams for 4 and 3 wire WYE system configurations. The 3300 ACM senses the line to earth ground voltage of each phase. If the power system to be monitored is a 120 to 347 VAC system, the inputs may be connected directly.

The wiring diagram for these configurations is shown in Figure 2.7.1 below. The VOLTS MODE of the 3300 ACM should be set to 4 WIRE WYE (as described in Section 3.3).

... continued

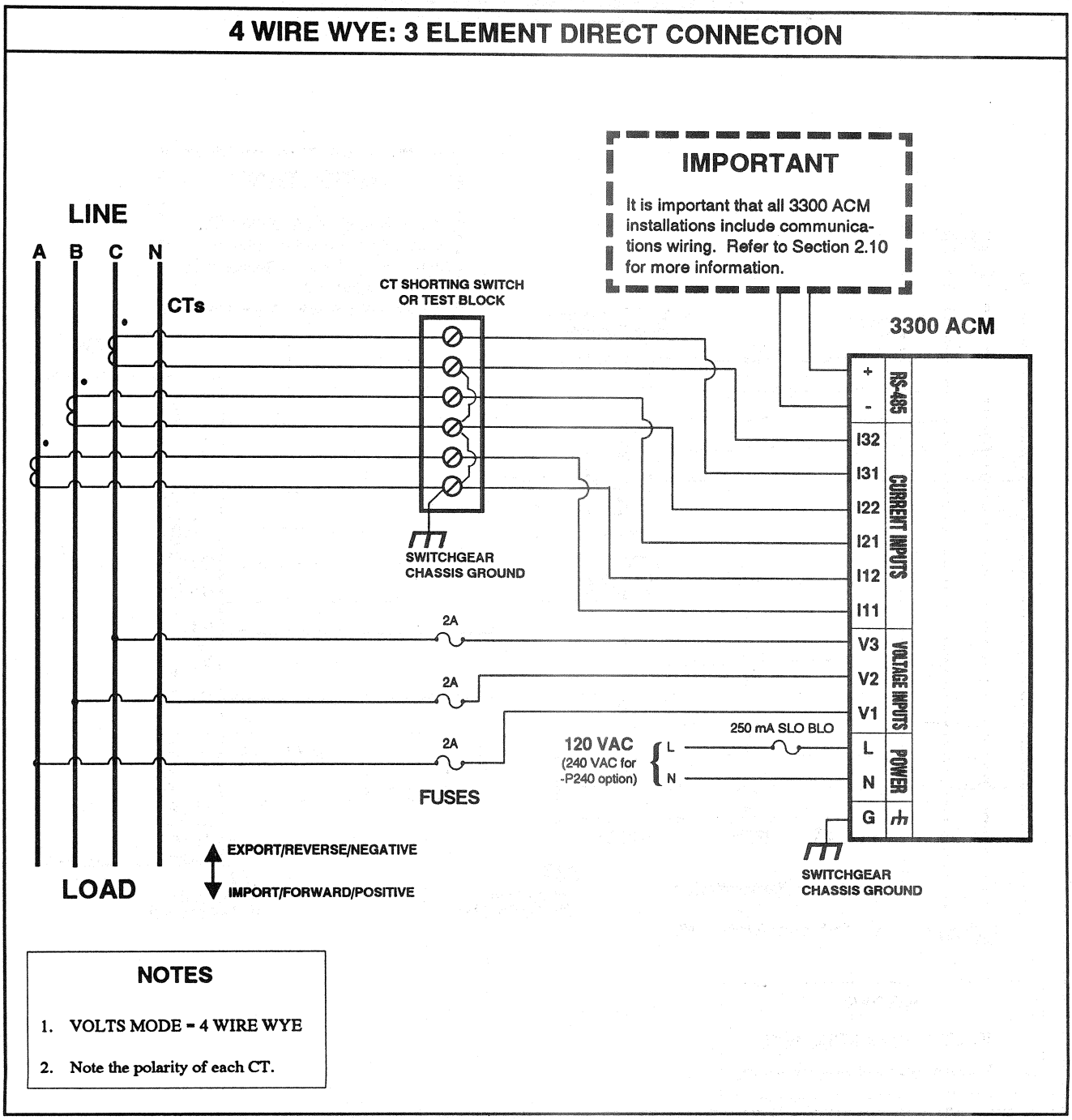


Figure 2.7.1 4 Wire WYE: 3 Element Direct Connection (for 120/208 to 347/600 Volt Systems)

For system voltages over 347/600 Volts, PTs must be used. When PTs are used, both the PT primary and secondary must be wired in a Wye (Star) configuration as shown in Figure 2.7.2 below. Voltage sense leads should be protected by breakers or fuses at their source.

If the power rating of the PTs is over 25 Watts the secondaries should be fused. Wiring must be exactly as shown for correct operation.

VOLTS MODE should be set to 4 WIRE WYE.

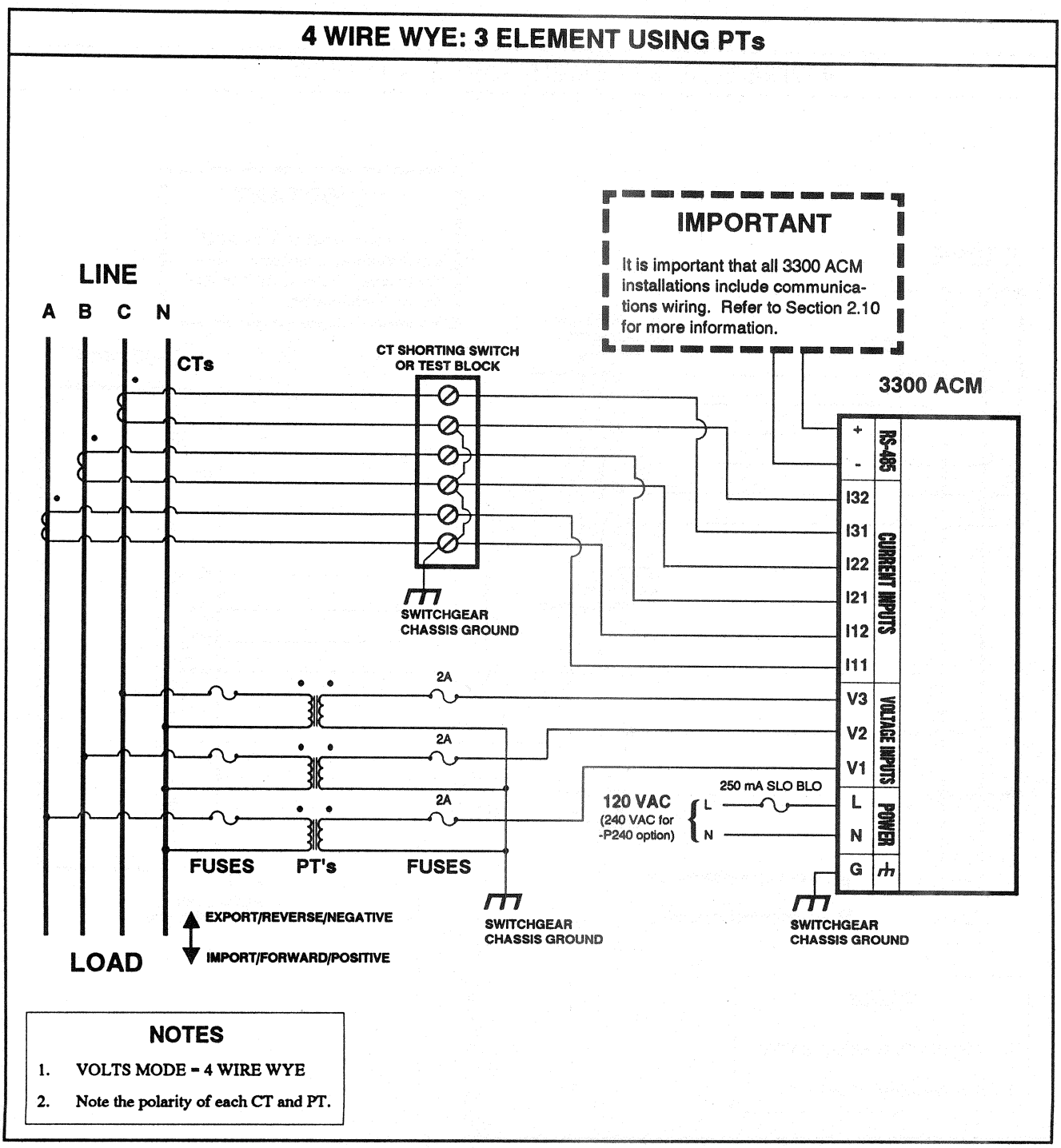


Figure 2.7.2 4 Wire WYE: 3 Element Connection Using PTs

When the Star point of a 3 wire WYE system is grounded, the 3300 ACM may be connected directly without the use of PTs (provided the voltages are within the input range of the unit).

This configuration is shown in Figure 2.7.3. The VOLTS MODE should be set to 4 WIRE WYE.

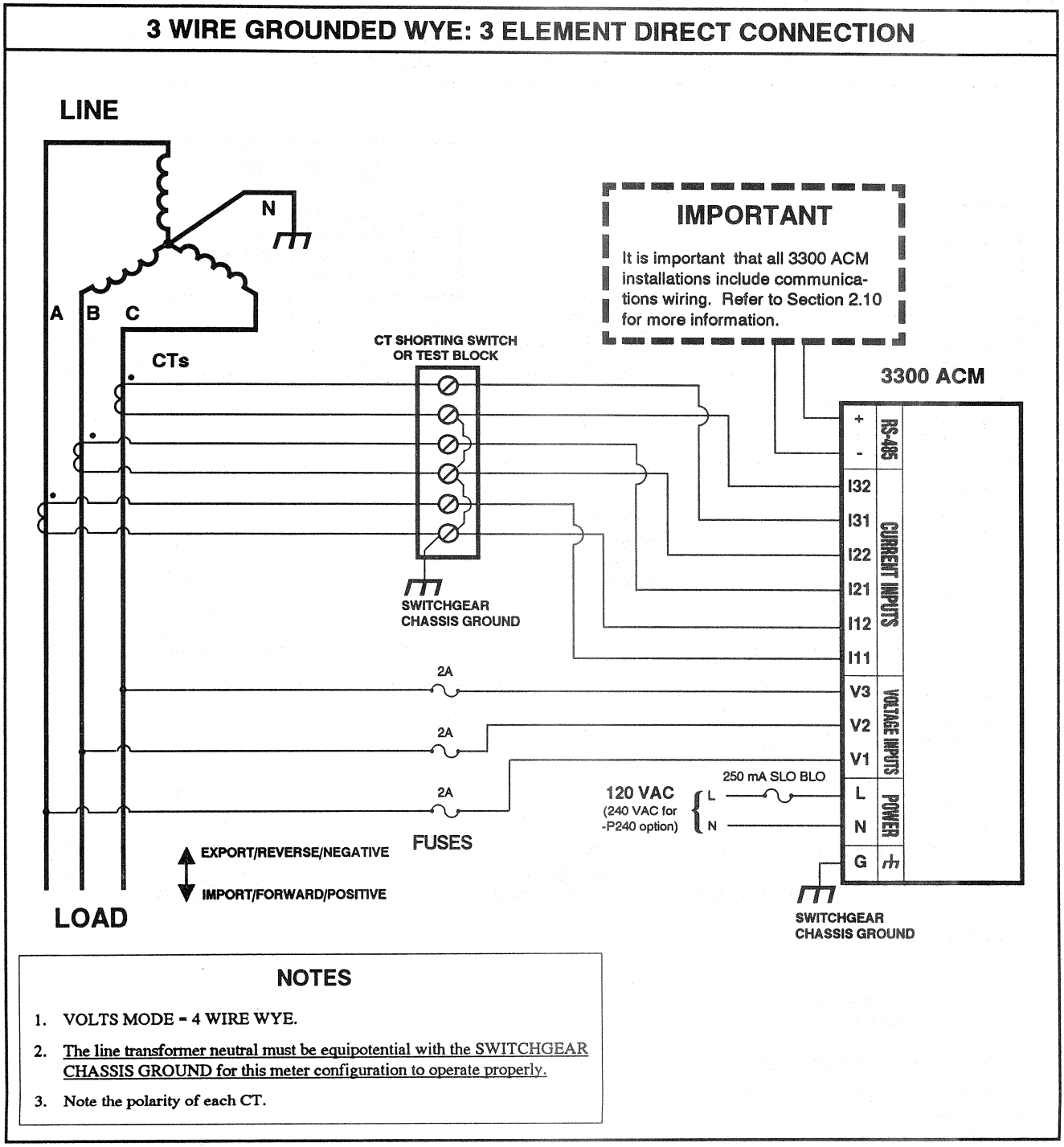


Figure 2.7.3 3 Wire WYE: 3 Element Direct Connection (For 120/208 to 347/600 Volt Systems)

2.8 CONNECTION FOR THREE PHASE DELTA SYSTEMS

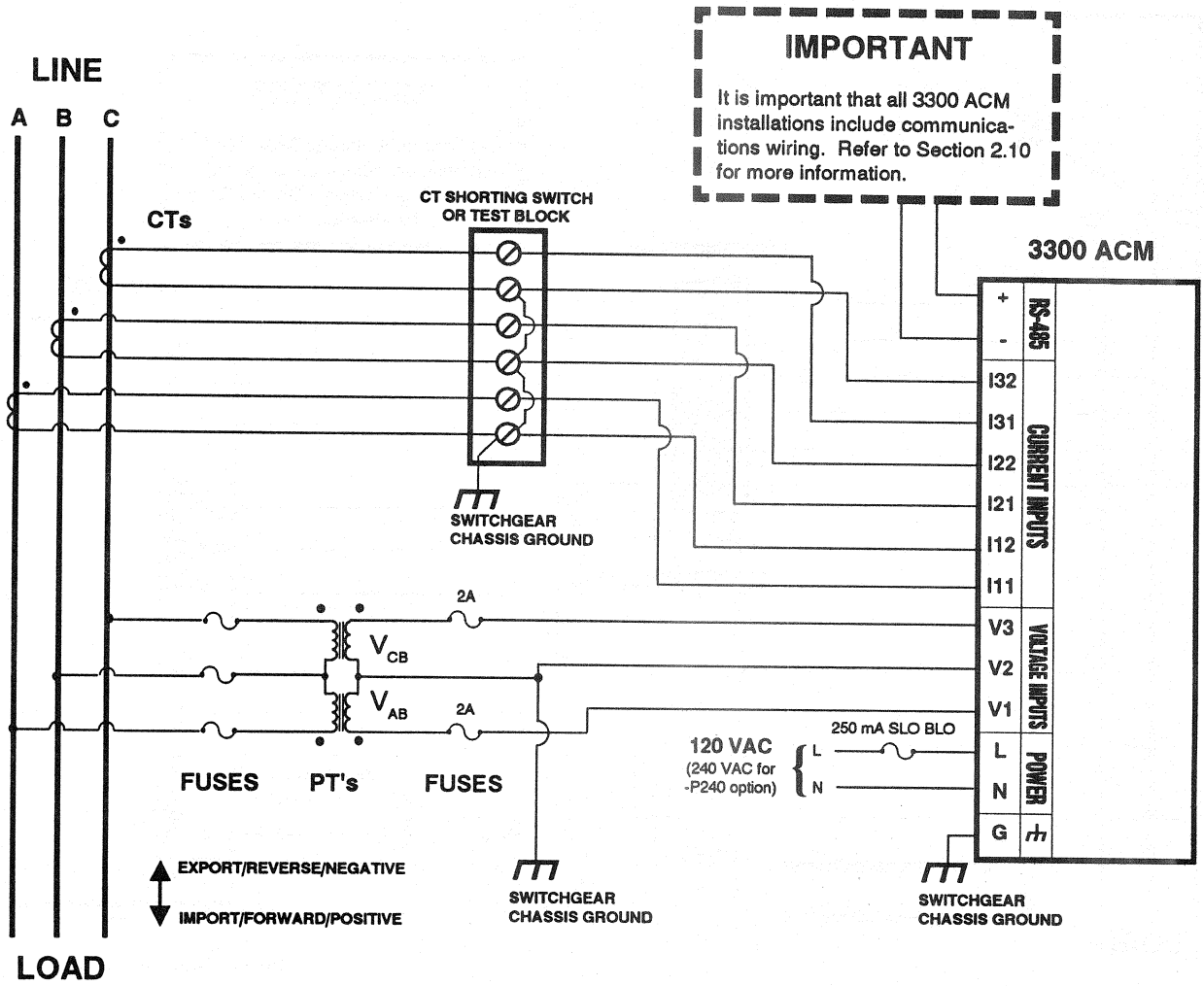
When configured for ungrounded (floating) DELTA operation, the 3300 ACM requires PTs and senses the L-L voltages between each of the phases.

VOLTS MODE of the 3300 ACM should be set to 3 WIRE DELTA. In the open DELTA configuration, the 3300 ACM may be connected in either of two ways: using 2 or 3 CTs.

Figure 2.8.1 below shows DELTA connection using 3 CT's.

... continued

3 WIRE DELTA: 3 ELEMENT USING 2 PTs & 3 CTs



NOTES

1. VOLTS MODE = 3 WIRE DELTA
2. Note the polarity of each CT and PT.

Figure 2.8.1 3 Wire DELTA: 3 Element Using 2 PTs and 3 CTs

Figure 2.8.2 below shows DELTA connection using 2 CTs.

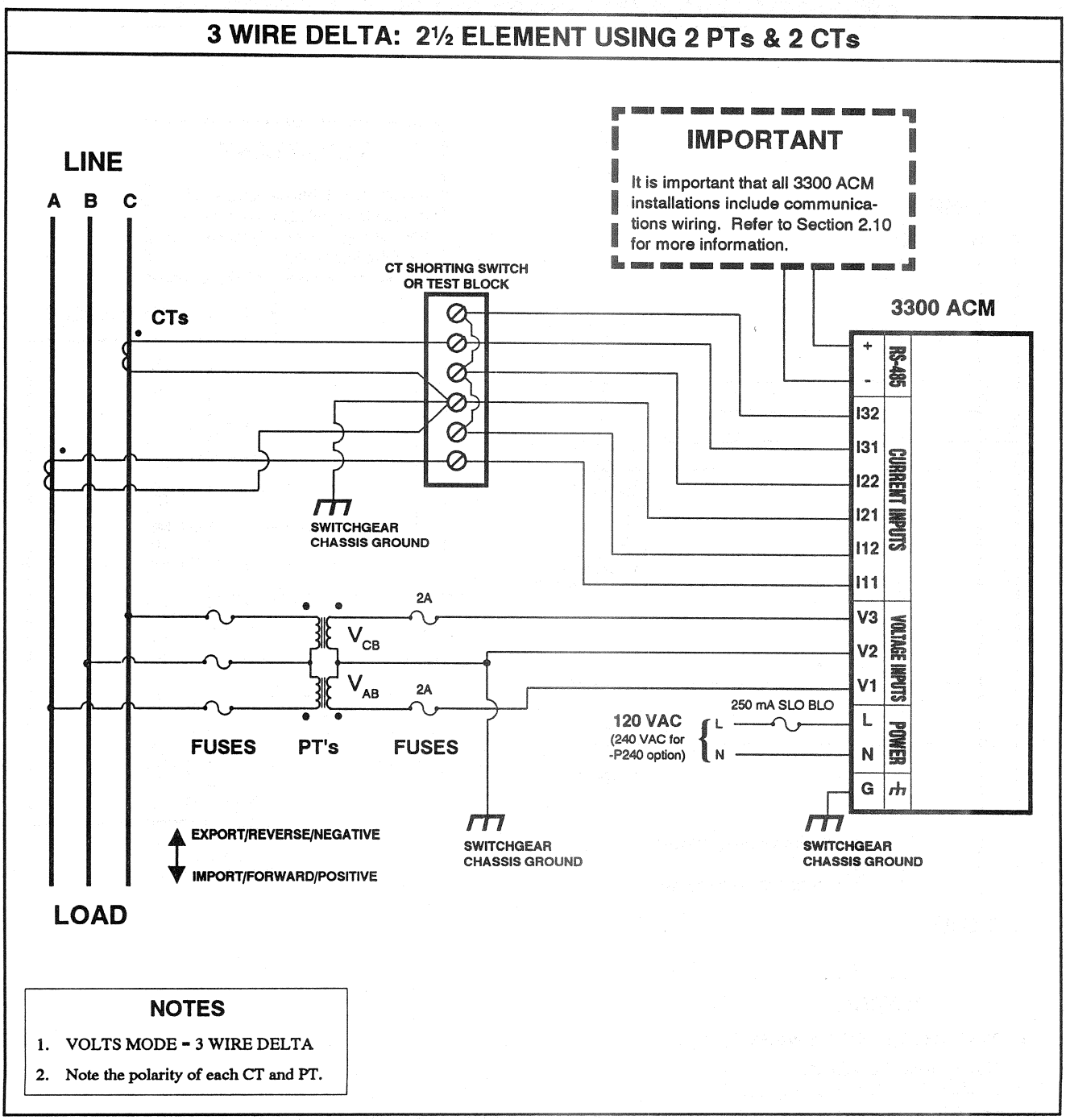


Figure 2.8.2 3 Wire DELTA: 2½ Element Using 2 PTs and 2 CTs

2.9 CONNECTION FOR SINGLE PHASE 3 WIRE SYSTEMS

Wiring for single phase systems is performed by connecting the two voltage phases (each 180 degrees with respect to each other) to the V_1 and V_2 inputs of the 3300 ACM, and the outputs of the two corresponding current transformers to the I_1 input pair and I_2 input pair. This is illustrated in Figure 2.9.1 below. Note that the V_3 input and I_3 input pair are unused and should all be grounded. For single phase systems, the VOLTS MODE of the 3300 ACM should be set to SINGLE PHASE.

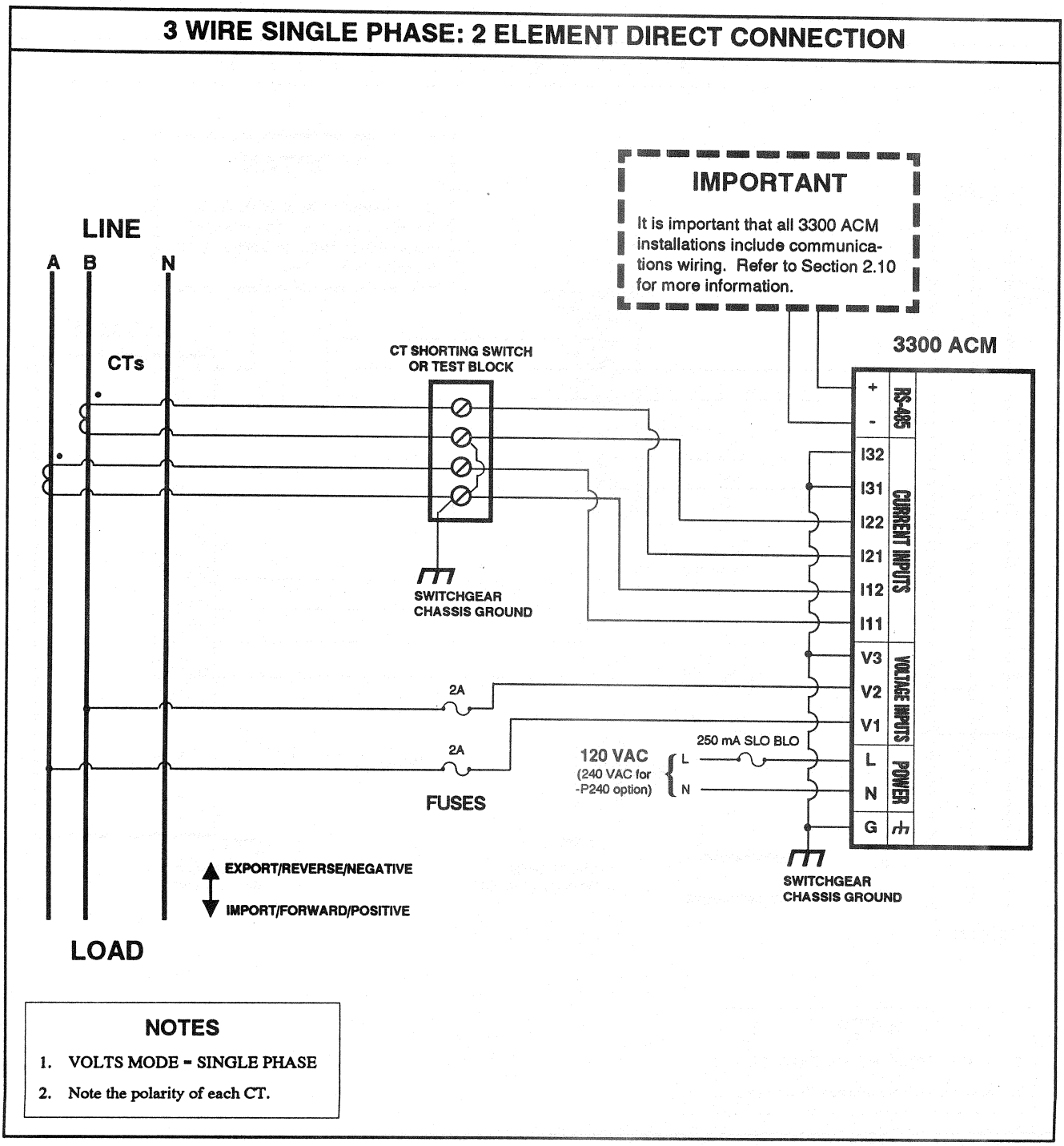


Figure 2.9.1 3-Wire Single Phase: 2 Element Direct Connection

2.10 COMMUNICATIONS CONNECTIONS

The 3300 ACM performs remote communications using the RS-485 communications standard. Connections are made to the RS-485 terminals on the main terminal strip. It is very important that communications wiring be made to the RS-485 port of every 3300 ACM being installed, even if remote communications are not initially required. All field service work including running diagnostics, testing, software upgrades, feature upgrades, etc., are performed via the communications link.

TEST BLOCK TERMINATION

RS-485 communications wiring should always be extended to a location which is easily and safely accessible. Communication wiring should be terminated at a test block (terminal strip) as illustrated in Figure 2.10.1. To simplify field testing and diagnostics, test block termination is always recommended, regardless of connection to a remote computer.

... continued

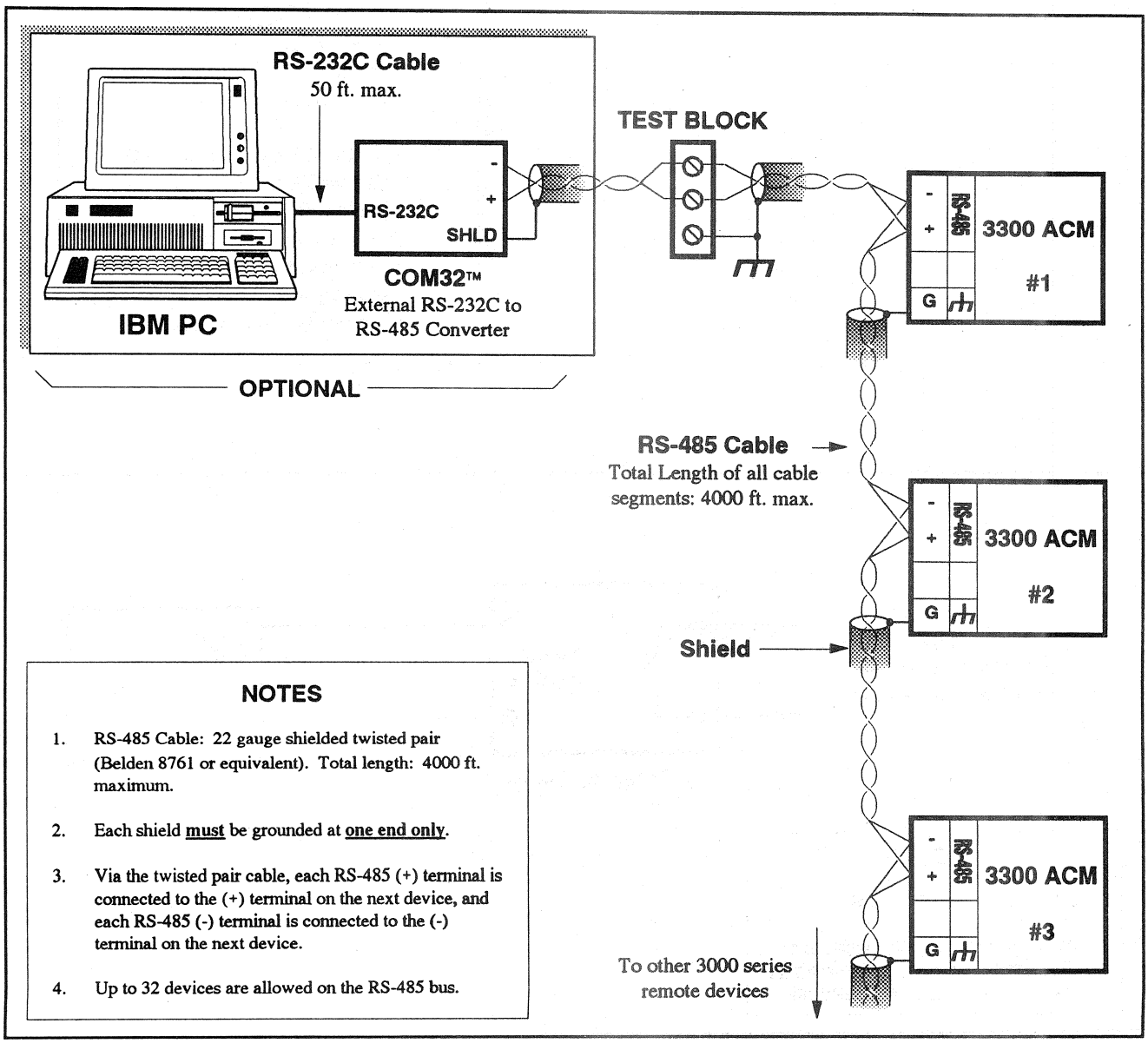


Figure 2.10.1 RS-485 Communications Connections

CONNECTION TO A COMPUTER

If a computer is to be connected to the RS-485 network, the host computer requires either an internal RS-232C to RS-485 converter board, or an external converter such as PML's COM32™. Figure 2.10.1 illustrates connection to a computer. An intermediate test block termination is again recommended to simplify local testing as described above.

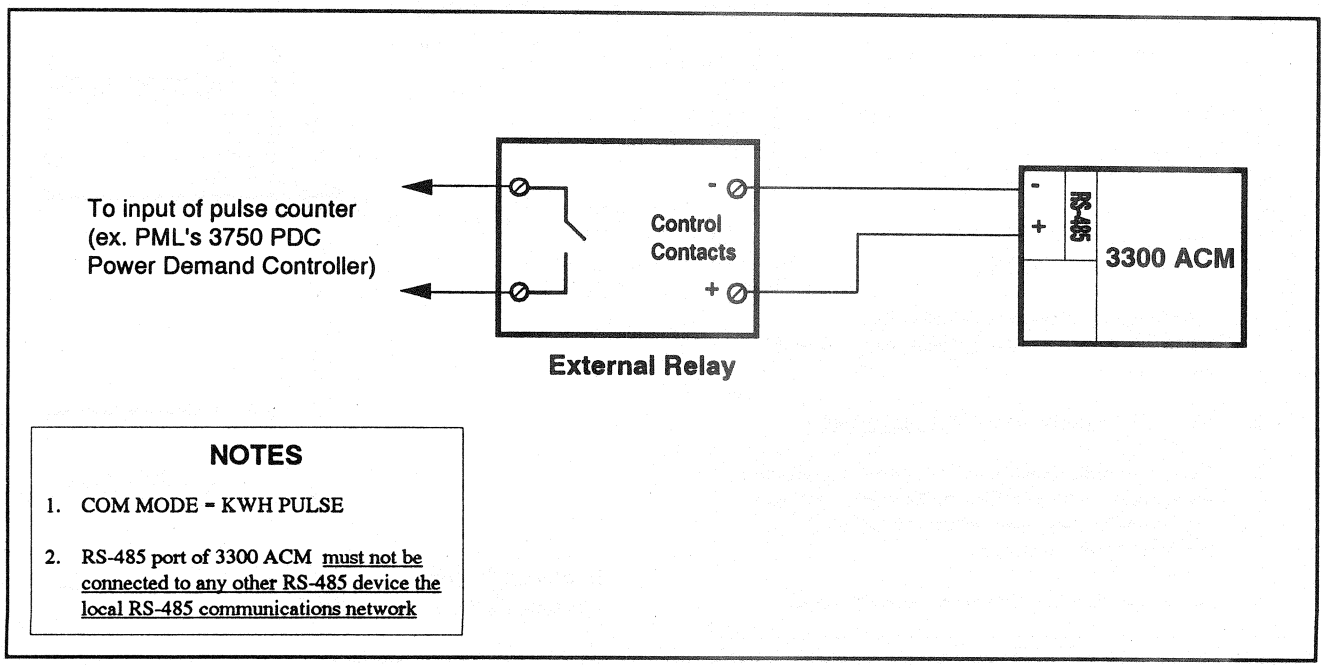
2.11 KWH PULSE OUTPUT

The RS-485 communications port of the 3300 ACM can alternatively be used to provide a KWH pulse output, suitable for driving a relay. Figure 2.11.1 illustrates the connections required for this function.

[CAUTIONS]

1. Use only a PML approved external relay with the 3300 ACM. Using a non-approved relay can seriously damage the RS-485 port output and will void the 3300 ACM warranty. Contact PML for complete information regarding relay specifications and applications.

2. The RS-485 port of any 3300 ACM which is being used for KWH pulsing must not be connected to any local RS-485 communications network. Doing so will inhibit all communications on the network.



NOTES

1. COM MODE = KWH PULSE
2. RS-485 port of 3300 ACM must not be connected to any other RS-485 device the local RS-485 communications network

Figure 2.11.1 KWH Pulse Output Connections

2.12 MAINTENANCE

The 3300 ACM contains a battery backed non-volatile memory. The rated life of the battery is seventy years at 50°C, 28 years at 60°C, and 11 years at 70°C.

If the unit operates at less than 50°C for 60% of the time, less than 60°C for 90% of the time, and less than 70°C for 100% of the time, the expected battery life is 35 years. If the meter is operating in an environment where the temperatures regularly exceed 60°C, the battery should be replaced every ten years.

When battery replacement is required, contact PML or your local PML sales representative for instructions.

Other than battery replacement, the 3300 ACM does not require any regular maintenance.

2.13 CALIBRATION

The calibration interval for the 3300 ACM depends on the user's accuracy requirements. The rated accuracy drift is 0.1% per year.

Contact PML for calibration procedure details.

2.14 FIELD SERVICE CONSIDERATIONS

In the unlikely event that the 3300 ACM unit should fail, it will generally be serviced by exchanging the unit for a replacement unit. The initial installation should be done in a way which makes this as convenient as possible:

1. A CT shorting block should be provided so that the 3300 ACM current inputs can be disconnected without open circuiting the CTs. The shorting block should be wired so that protective relaying is not affected.

2. All wiring should be routed to allow easy removal of the connections to the 3300 ACM terminal strips, the 3300 ACM rear cover, and the 3300 ACM itself.

3. GENERAL OPERATION

NOTES

1. All measurements and setup information displayed via the 3300 ACM display module are available via the communications port. See Chapter 5 for detailed information on communications with the 3300 ACM.

2. The TRAN option of the 3300 ACM comes with no display/ keypad module. Data is read, and field programming performed, via the device's communications port. Refer to Appendix E for instructions regarding TRAN operation. For the TRAN option, disregard all references made to display module operations in Chapter 3.

3.1 POWER UP

After all installation wiring is complete and has been double checked, the unit may be powered up.

The 3300 ACM will first enter its default ***display mode*** which displays Volts, Phase, Amps, and Power Function (KW). Note that the Power Function value may not initially be displayed if it is too large - see Section 3.2 for a description of this condition.

The values initially appearing will probably not be correct, since the unit has not yet been told a number of necessary pieces of information about the installation. The process of giving the 3300 ACM this information is known as ***field programming.***

The 3300 ACM display mode is described in Section 3.2. Programming mode is described in Section 3.3.

3.2 DISPLAY MODE

3.2.1 INTRODUCTION

The 3300 ACM display/keypad module has been designed for flexibility and ease of operation, offering many data display and programming functions. Two main operation modes are provided: ***display mode*** and ***programming mode***. Display mode allows the user to view all measured data. Programming mode provides access to all 3300 ACM setup parameters.

Display mode provides a variety of real-time data display configurations to choose from. The two display module buttons, PHASE and FUNCTION, are used to select different display options (see Figure 3.2.1).

On power-up the 3300 ACM will be in display mode, and will be presenting the ***Volts-Phase-Amps-Power Function*** display. The power function displayed on power-up will depend on the measurement options with which the 3300 ACM has been equipped.

NOTE

In circumstances where a power function requires many significant figures or characters to be clearly interpreted, the power function will not be displayed simultaneously with the Volts and Amps displays. In this case, the POWER FUNCTION field of the display will appear blank.

To display the power function, press the FUNCTION button. This will allow the power function to be presented using the entire width of the display, replacing the Volts-Phase-Amps display. To return to the Volts-Phase-Amps display, press the PHASE button.

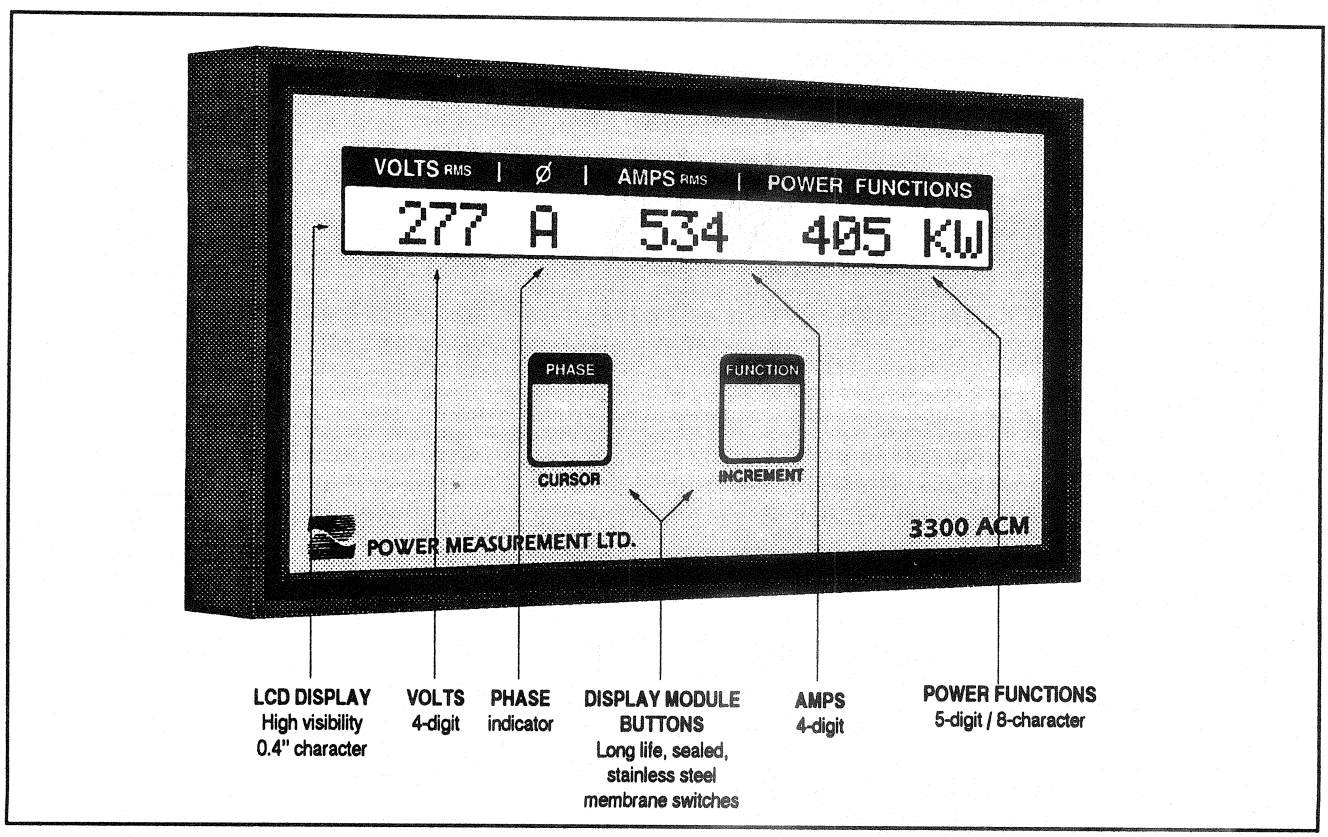


Figure 3.2.1 3300 ACM Display Module Front Panel Features

3.2.2 PHASE BUTTON

The PHASE button can be used to view Volts and Amps readings for each line-to-neutral and line-to-line phase, as well as the average readings for all phases. Simultaneous display of all three Volts phase readings, or all three Amps phase readings is also possible.

The number of different displays available depends on the VOLTS MODE currently set. Setting the VOLTS MODE parameter is described in Section 3.3.

NOTE

In circumstances where a selected power function uses the entire display (ie. Volts and Amps are not being presented), pressing the PHASE button will return to the Volts-Phase-Amps display.

3.2.3 PHASE DISPLAYS

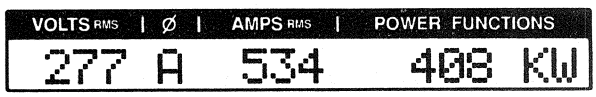
The following Volts-Phase-Amps displays are available to each VOLTS MODE. See Figure 3.2.3 for an illustration of each phase display:

a) **VOLTS MODE = 4 WIRE WYE**

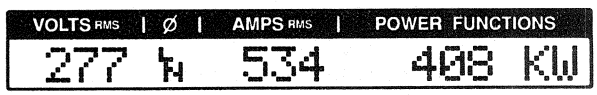
Pressing the PHASE button will first advance through each pair of ***line-to-neutral*** Volts and Amps phase readings (A, B, C), and the average for all line-to-neutral readings ($^{L}_{N}$).

Pressing the PHASE button will then advance through each pair of ***line-to-line*** Volts and Amps phase readings ($^{A}_{B}$, $^{B}_{C}$, $^{C}_{A}$) and the average for all line-to-line readings ($^{L}_{L}$).

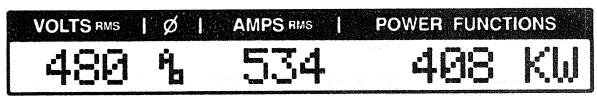
... continued



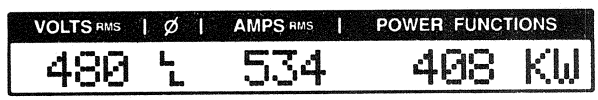
LINE-TO-NEUTRAL SINGLE PHASE DISPLAY
Volts-Phase-Amps-Power Function (Note: Phase A shown)



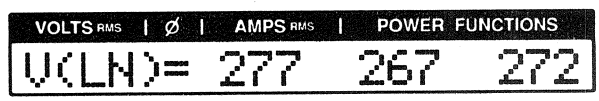
LINE-TO-NEUTRAL AVERAGE DISPLAY
Volts-Phase-Amps-Power Function (Note: $^{L}_{N}$ = LN average)



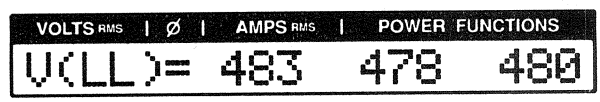
LINE-TO-LINE SINGLE PHASE DISPLAY
Volts-Phase-Amps-Power Function (Note: Phase $^{A}_{B}$ shown)



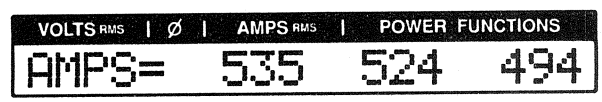
LINE-TO-LINE AVERAGE PHASE DISPLAY
Volts-Phase-Amps-Power Function (Note: $^{L}_{L}$ = LL average)



3-PHASE LINE-TO-NEUTRAL VOLTS DISPLAY
Phase A - Phase B - Phase C (Note: No Power Function)



3-PHASE LINE-TO-LINE VOLTS DISPLAY
Phase A - Phase B - Phase C (Note: No Power Function)



3-PHASE AMPS DISPLAY
Phase A - Phase B - Phase C (Note: No Power Function)

Figure 3.2.3 3300 ACM Phase Displays

Pressing the PHASE button again will advance to the ***3-phase line-to-neutral Volts*** display. This presents all three line-to-neutral Volts (**LN**) readings at once (**A, B, C**). Power functions will not be shown since this option uses the entire display to present all three phases of information.

Pressing the PHASE button again will advance to the ***3-phase line-to-line Volts*** display. This presents all three line-to-line Volts (**LL**) readings at once ($^{A}_{B}$, $^{B}_{C}$, $^{C}_{A}$). Power functions will not be shown since this option uses the entire display to present all three phases of information.

Pressing the PHASE button again will advance to the ***3-phase Amps*** display. This presents all three Amps readings at once (**A, B, C**). Power functions will not be shown since this option uses the entire display to present all three phases of information.

b) **VOLTS MODE = 3 WIRE DELTA**

The 3300 ACM will provide all the same displays for 3 WIRE DELTA mode as it does for 4 WIRE WYE (see above), except for Volts line-to-neutral readings.

c) **VOLTS MODE = SINGLE PHASE**

Pressing the PHASE button will first advance through each phase of ***line-to-neutral*** Volts and Amps phase readings (A, B), and the average for both line-to-neutral readings ($^{L}_{N}$).

3.2.4 FUNCTION BUTTON

Power functions are displayed in the POWER FUNCTION field of the display along side the Volts-Phase-Amps fields. The FUNCTION button can be used to view readings for the two standard power functions, as well as all additional power function options installed.

Pressing the FUNCTION button will advance through each available power function. After all functions have been advanced through, the display will loop back to the first function again.

FUNCTION OR PHASE DISPLAY BLANKING

The 3300 ACM display is designed to present measured data in the most effective way possible. In some circumstances Volts and/or Amps readings may not be displayed concurrently with power functions. This will occur in the following two cases:

a) When viewing ***3-phase Volts*** or ***3-phase Amps*** displays, the power function will effectively be blanked out.

b) Some power functions may use the entire display to present data when the power function name or value contains many significant digits or characters. This will effectively blank out the Volts and/or Amps data.

In both the above cases, the PHASE and FUNCTION buttons can always be used to select either the Volts and/or Amps display, or the power function display, respectively.

3.2.5 POWER FUNCTION DISPLAYS

The basic model 3300 ACM comes with two standard power functions: **KW** (total instantaneous real power flow for all phases), and **KWH TOT** (total real energy for all phases).

The complete sequence of functions available is dependant on the number of additional power function options purchased with the unit. All standard and optional functions are listed in the chart in Figure 3.2.5 with descriptions.

INDIVIDUAL PHASE, AVERAGED, & TOTALIZED READINGS

Figures 3.2.5 a & b indicate which functions provide individual phase readings, average of all phases, and/or totalized values for all phases. Functions which provide individual phase and average of all phases readings will indicate which reading is presently being displayed by having the name imbedded in the function label as follows:

a) *Phase name* (a, b, c, ab, bc, ca)
Example: KVRb DMD MIN

b) *Average* (av, LNav, LLav)
Example: VLLav MAX

Function labels which do not indicate a specific phase can generally be assumed to represent totalized values for all phases (ex. KW, KVAR, KVA, etc.).

THERMAL AND SLIDING WINDOW DEMAND

The 3300 ACM provides as optional measurements both *thermal* demand and *sliding window* demand functions. To differentiate between these two types, sliding window demand functions use an asterisk in their function names, while thermal demand values have no asterisk.

Example: KW DMD = KW *thermal* demand
KW DMD* = KW *sliding window* demand

POWER FUNCTION AUTO-RANGING UNITS

Note that some readings given in K units will automatically change to M units when values exceed 9999 K. Some functions also provide negative values, such as Reverse KW, or Reverse KVAR.

LIST OF 3300 ACM POWER FUNCTIONS

KEY TO ABBREVIATIONS

a, b, c	= Individual line-to-neutral phase	av	= Average of all phases
LNav	= Average of all line-to-neutral phases	total	= Total of all phases
ab, bc, ca	= Individual line-to-line phases		
LLav	= Average of all line-to-line phases	* (asterisk)	= *sliding window* demand (ie. not *thermal*)

LABEL	ϕ, Avg, Total	DESCRIPTION
STANDARD POWER FUNCTIONS		
KW	total	Total instantaneous real power flow for all phases. A positive number (ie. no sign) indicates real power in the forward direction (imported). A negative number (ie. negatively signed) indicates real power in the reverse direction (exported).
KWH TOT	total	Total accumulated real energy (ie. total KW Hours) for all phases. This accumulated value is incremented when real power is being *imported*, and decremented when real power is *exported*. Therefore, this accumulated value can be signed either positively (net import) or negatively (net export). Note also that its value will roll over to 0 (zero) at ± 1,999,999,999 KWH.
OPTIONAL POWER FUNCTIONS		
V MIN	a, b, c, LNav	Volts minimums line to neutral - each phase and average of all phases
	ab, bc, ca, LLav	Volts minimums line to line - each phase and average of all phases
V MAX	same as above	Maximums for above function.
V DMD	same as above	Volts *thermal* demand on each phase and average of all phases line-to-neutral, and each phase and average of all phases line-to-line.
V DMD MIN	same as above	Minimums for above function.
V DMD MAX	same as above	Maximums for above function.
I MIN	a, b, c, av	Amps minimums - each phase and average of all phases.
I MAX	same as above	Maximums for above.
I DMD	same as above	Amps *thermal* demand - each phase and average of all phases.
I DMD MIN	same as above	Minimums for above function.
I DMD MAX	same as above	Maximums for above function.
Iav DMD*	av	Amps *sliding window* demand - average of all phases.
Iav DMD MIN*	same as above	Minimums for above function.
Iav DMD MAX*	same as above	Maximums for above function.
KW	a, b, c	Instantaneous real power flow (KW) - each phase.
KW MIN	a, b, c, total	Minimums for instantaneous real power flow - each phase and total of all phases.
KW MAX	same as above	Maximums for above function.
KW DMD	same as above	Instantaneous real power *thermal* demand - each phase and total of all phases.
KW DMD MIN	same as above	Minimums for above function.
KW DMD MAX	same as above	Maximums for above function.
KW DMD*	total	Instantaneous real power (KW) *sliding window* demand - total of all phases.
KW DMD MIN*	same as above	Minimums for above function.
KW DMD MAX*	same as above	Maximums for above function.
KWH IMP	total	Imported real energy (KWH) - total of all phases. Roll over: ±1,999,999,999 KWH.
KWH EXP	total	Exported real energy (KWH) - total of all phases. Roll over: ±1,999,999,999 KWH.

Figure 3.2.5a List of 3300 ACM Power Functions - Part I

LIST OF 3300 ACM POWER FUNCTIONS

LABEL	ϕ, Avg, Total	DESCRIPTION
OPTIONAL POWER FUNCTIONS (continued)		
KVR	a, b, c, total	Instantaneous reactive power flow (KVAR) - each phase and total of all phases.
KVR MIN	same as above	Minimums for above function.
KVR MAX	same as above	Maximums for above function.
KVR DMD	same as above	Instantaneous reactive power *thermal* demand - each phase and total of all phases.
KVR DMD MIN	same as above	Minimums for above function.
KVR DMD MAX	same as above	Maximums for above function.
KVR DMD*	total	Instantaneous reactive power (KVAR) *sliding window* demand - total of all phases.
KVR DMD MIN*	same as above	Minimums for above function.
KVR DMD MAX*	same as above	Maximums for above function.
KVRH IMP	total	Imported reactive energy (KVARH) - total of all phases.
KVRH EXP	total	Exported reactive energy (KVARH) - total of all phases.
KVRH TOT	total	Total reactive energy (KVARH) for all phases. This accumulated value is incremented when reactive power is being *imported*, and decremented when reactive power is *exported*. Therefore, this accumulated value can be signed either positively (net import) or negatively (net export). Roll over: ± 1,999,999,999 KVRH.
KVA	a, b, c, total	Instantaneous apparent power flow (KVA) - each phase and total of all phases.
KVA MIN	same as above	Minimums for above function.
KVA MAX	same as above	Maximums for above function.
KVA DMD	same as above	Instantaneous apparent power *thermal* demand - each phase and total of all phases.
KVA DMD MIN	same as above	Minimums for above function.
KVA DMD MAX	same as above	Maximums for above function.
KVA DMD*	total	Instant. apparent power (KVA) *sliding window* demand - total of all phases.
KVA DMD MIN*	same as above	Minimums for above function.
KVA DMD MAX*	same as above	Maximums for above function.
KVAH TOT	total	Total apparent energy (KVAH) - total of all phases. Roll over: 1,999,999,999 KVAH.
PF	a, b, c, total	Power factor (PF) - each phase and total of all phases. A *leading* PF (current leads voltage) is indicated by the designation PF LEAD. A *lagging* PF (current lags voltage) is indicated by the designation PF LAG.
PF MIN	same as above	Minimums for above function.
PF MAX	same as above	Maximums for above function.
PF DMD	same as above	Power factor *thermal* demand - each phase and total of all phases.
PF DMD MIN	same as above	Minimums for above function.
PF DMD MAX	same as above	Maximums for above function.
HZ	a	Frequency on Volts phase A
HZ MIN	same as above	Minimums for above function.
HZ MAX	same as above	Maximums for above function.
HZ DMD	same as above	Frequency *thermal* demand on Volts phase A.
HZ DMD MIN	same as above	Minimums for above function.
HZ DMD MAX	same as above	Maximums for above function.

Figure 3.2.5b List of 3300 ACM Power Functions - Part II

3.3 PROGRAMMING MODE

Following initial installation of the 3300 ACM as described in Chapter 2, the device needs to be told a number of necessary pieces of setup information about the type of electrical system it will be monitoring. The process of giving the 3300 ACM this information is known as ***field programming.*** The 3300 ACM ***programming mode*** allows access to all of the device's setup parameters.

3.3.1 FIELD PROGRAMMING STEPS

ENTERING PROGRAMMING MODE

To enter the programming mode from display mode, press the PHASE and FUNCTION buttons at the same time and hold them down until the name 'POWER MEASUREMENT' appears on the display (see Figure 3.3.1a). This indicates that programming mode has been entered. Once in this mode, the same action will cause the unit to return to display mode.

PROGRAMMING BUTTON FUNCTIONS

In programming mode, the buttons of the display module take on new programming functions. The label below each button indicates its alternate programming function.

The CURSOR key moves the cursor left one digit. It will wrap around to the right of the number if advanced past the left-most digit.

The INCREMENT key will increment the digit under the cursor. Certain parameters have YES or NO values, such as 'CLEAR ALL HOURS?' In this case pressing the INCREMENT key will cause the YES or NO value to toggle. Other parameters, such as BAUD RATE, have a number of possible values, and pressing INCREMENT will cause the display to scroll through them.

Advancing through each setup parameter is accomplished by pressing the CURSOR and INCREMENT buttons at the same time, then releasing quickly. Do not hold down the buttons for too long, since this will return you to display mode.

ENTERING THE PASSWORD

Press and release the CURSOR and INCREMENT buttons together to advance to the first parameter of the programming mode, the 3300 ACM PASSWORD. When the 3300 ACM is shipped, the PASSWORD will be 0. This PASSWORD must be entered if any parameter values are to be changed. If the password is not entered, the programming may still be viewed, but it will be impossible to change any values. The password may be redefined, as explained in Section 3.3.4.

PARAMETER WRAP-AROUND

The parameter list wraps around. If a parameter is missed, the CURSOR/INCREMENT button combination may be pressed repeatedly until the desired parameter is on the display again.

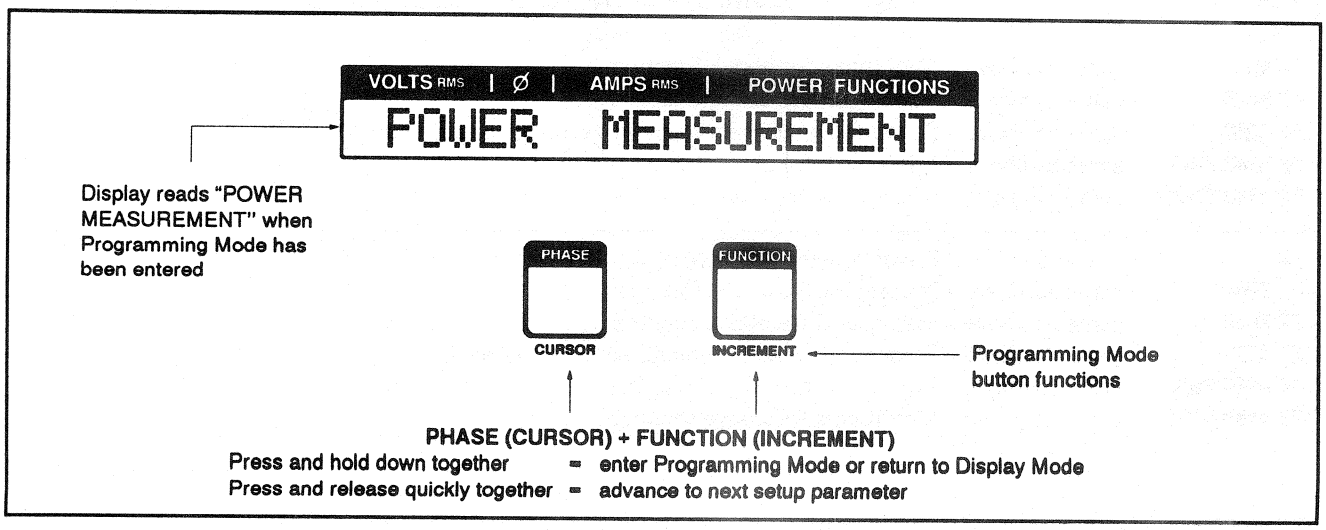


Figure 3.3.1a Programming Mode Display and Button Functions

RETURNING TO DISPLAY MODE

Once all parameters have been set to their desired values, pressing and holding down the CURSOR and INCREMENT buttons will cause the 3300 ACM to return to display mode.

PROGRAMMING EXAMPLE

Figure 3.3.1b gives a step-by-step example of how to program a 3300 ACM operating parameter from the display module. The example given shows how to set the PT PRIMARY and PT SECONDARY parameters for the device, then return to display mode. The example is given for a PT primary of 14.4 KV. The secondary is the required rating of 120 V.

STEP	ACTION:	DISPLAY READS:
1.	Press and hold down PHASE & FUNCTION buttons together to enter programming mode.	POWER MEASUREMENT
2.	Press and quickly release CURSOR & INCREMENT buttons once.	PASSWORD= 0
3.	Enter password by using INCREMENT and CURSOR buttons. If password = 0 (the default), go to step 4.	PASSWORD= 0
4.	Press and quickly release CURSOR & INCREMENT buttons once.	USING PTS?= NO
5.	Press INCREMENT button once to toggle value to YES.	USING PTS?= YES
6.	Press and quickly release CURSOR & INCREMENT buttons once.	PT PRIMARY= 1
7.	Enter new value for PT PRIMARY. To set to 14400 (14.4 KV), first set far right digit to 0 by pressing INCREMENT until display reads:	PT PRIMARY= 0
8.	Move cursor one digit left by pressing CURSOR button.	PT PRIMARY= _0
9.	Set digit required value by pressing INCREMENT.	PT PRIMARY= 00
10.	Repeat steps 8 & 9 above until all digits set.	PT PRIMARY= 14400
11.	Press and quickly release CURSOR & INCREMENT buttons once.	PT SECONDARY= 1
12.	Enter new value for PT SECONDARY. Follow steps 8 to 10 above, using INCREMENT and CURSOR buttons until display reads:	PT SECONDARY= 120
13.	Press and quickly release CURSOR & INCREMENT buttons to advance to next parameter, or press and hold down to return to display mode.	*Volts, ϕ, Amps, Power Function*

NOTE: Cursor position in the example is shown as an underscore line. In the actual display, cursor position is indicated by an underscored blinking character.

Figure 3.3.1b Field Programming Example - Setting VOLTS SCALE

3.3.2 OPERATING PARAMETER DESCRIPTIONS

Figures 3.3.2 a & b provide a brief description of each parameter that may be programmed from the front panel.

Additional information on setting each operating parameter are provided in the following sections.

3300 ACM demand functions are described in detail in Chapter 4. Communications are described in detail in Chapter 5.

FIELD PROGRAMMABLE OPERATING PARAMETERS

PARAMETER	DESCRIPTION	RANGE
PASSWORD	Must be entered correctly to allow changing the value of any setup parameter(s) or to allow clear/reset of any function.	4 digit number
USING PTS?	Selecting NO indicates the 3300 ACM voltage inputs are being connected directly to the power lines, without PTs. Selecting YES indicates PTs are being used.	NO = direct connection YES = input from PTs
PT PRIMARY	Set to PT primary voltage rating. This parameter only appears when USING PTS? parameter has been set to YES.	0 to 999,999 Volts
PT SECONDARY	Set to PT secondary voltage rating. This parameter only appears when USING PTS? parameter has been set to YES.	0 to 347 Volts
AMPS SCALE	Sets full-scale AC input current for A, B, and C phases (CT primary current rating). See Section 3.3.4.	0 to 30,000 Amps
VOLTS MODE	Sets Volts Mode for correct power system configuration. Demo mode provides preset values for all measurements based on input scales - use for demonstration purposes only.	4-WIRE WYE 3-WIRE DELTA SINGLE PHASE DEMO
UNIT ID	Sets communications identification number for 3300 ACM. Note: The number 0 may not be used for an ID as it is reserved for other purposes.	1 to 9999
COM MODE	Selects the function of the RS-485 port. See Sections 3.3.6 and 3.3.7.	RS485 = communications KWH PULSE = pulse output
KWH/PULSE	Sets number of KW hours between pulses in KWH pulse mode. Parameter only appears when COM MODE = KWH PULSE.	0.1 to 9999.9 KWH
PULSE FORMAT	Sets the KWH PULSE output format. Parameter only appears if COM PORT = KWH PULSE and KWH/PULSE is non-zero.	KYZ, PULSE
PULSE DURATION	Sets the KWH PULSE pulse width in multiples of 10 milliseconds. Parameter only appears if PULSE FORMAT = PULSE.	1 to 99
BAUD RATE	Baud Rate at which the 3300 ACM transmits and receives information via communications.	300, 1200, 2400, 4800, 9600, 19,200

Figure 3.3.2a Field Programmable Operating Parameters I

... continued

FIELD PROGRAMMABLE OPERATING PARAMETERS

PARAMETER	DESCRIPTION	RANGE
PROTOCOL	Selects the communications protocol.	PML, MODBUS
REGISTER SIZE	Selects Register Size for MODBUS communications. Parameter only appears if PROTOCOL = MODBUS.	16 BIT, 32 BIT
CLEAR ALL HOURS?	Selecting YES will set the KW Hours, KVAR Hour, and KVA Hours readings to 0.	NO, YES
RESET MIN/MAX?	Selecting YES will reset the Min/Max array.	NO, YES
DEMAND PERIOD	Sets length of the demand sub-period to be used in calculating optional demand values. See Chapter 4.	1 to 99 = minutes
# OF DMD PERIODS	Sets number of sub-periods to be averaged in calculating the sliding window demand values. See Chapter 4.	1 to 15
CONTRAST/ANGLE	Press INCREMENT to adjust contrast of the LCD display.	Contrast changes
DIAGNOSTIC MODE?	Setting this parameter to YES will allow access to the DIAGNOSTIC MODE parameter group listed below.	NO = bypass diagnostics YES = gain access
SERIAL NUMBER	The user may view the 3300 ACM factory set serial number.	5 digit #
FIRMWARE VER **REV DATE**	These two parameters indicate the current version and revision date of the operating firmware (ie. program) in the 3300 ACM.	Version = 4 digit # Date = dy/mo/yr
CHECKSUM	Checksum value on program memory. Indicates PASS or FAIL.	6 character hexadecimal #
STATUS FLAGS	Indicates status of various internal systems. Should normally read zero (0).	6 character hexadecimal #

Figure 3.3.2b Field Programmable Operating Parameters II

3.3.3 SELECTING DIRECT OR PT INPUT & SETTING PT VOLTS SCALES

The USING PTS? parameter tells the 3300 ACM if its voltage input terminals are being connected directly to the A, B, and C phase power lines, or if PTs are being used. The 3300 ACM can be connected directly to 4-wire Wye systems up to 347 VAC. Above this level, PTs must be used.

If the 3300 ACM is being connected directly, set USING PTS? to NO. The 3300 ACM will automatically select the correct scaling. This setting allows the meter to be connected directly to 120 to 347 VAC systems.

If PTs are used for connection to voltage systems higher than 347 VAC, set USING PTS? to YES. The following two parameters which appear will then be PT PRIMARY and PT SECONDARY. These are used to tell the 3300 ACM what the PT voltage ratings are, allowing the 3300 ACM to set its internal full scale input references.

... continued

Set PT PRIMARY to the primary rating of the PTs used. This should normally be equivalent to the full scale line levels which are being measured by the meter.

Set PT SECONDARY to the secondary rating of the PTs used. The maximum secondary voltage allowable is 347 VAC.

USING THE 3300 ACM -HIACC OPTION

The -HIACC (high accuracy) option of the 3300 ACM provides a preset input voltage scale of 120, 277 or 347 VAC. To ensure optimum accuracy when using a 3300 ACM with this option installed, direct connect only to systems with full scale levels equivalent to the specified 3300 ACM input voltage. For example, a 277 VAC HIACC meter should only be used with a 277 VAC system.

If PTs are used with the -HIACC option, always use PTs with secondary voltages equal to the specified 3300 ACM input voltage, and set the PT SECONDARY parameter to that value.

3.3.4 SETTING AMPS SCALE

The AMPS SCALE should be set to the primary rating of the CTs being used. This only applies if the CTs used are rated for a 5 Amp full scale output for the standard 3300 ACM, or 1 Amp full scale output for a 3300 ACM with the -1AMP option installed.

If the CTs used are not rated for these output levels, contact the PML factory for assistance.

3.3.5 SELECTING THE VOLTS MODE

The VOLTS MODE should be set according to the system connection configuration. Options include 4-WIRE WYE, 3-WIRE DELTA, and SINGLE PHASE. Refer to Sections 2.6 to 2.8 and Figures 2.6.1 to 2.8.1 to determine the appropriate setting.

The 3300 ACM also offers a DEMO mode which can be used to demonstrate the data display capabilities of the device without the need for connection to a real power system. Preset Volts, Amps, and Power Function values based on the input scales programmed can be displayed from the display module, or via the communications port.

3.3.6 SETTING THE COMMUNICATION PARAMETERS

The UNIT ID of the 3300 ACM can be set to any 4 digit number, and is shipped set to the last 4 digits of the device's serial number. Each 3300 ACM on a communications network must be set to a unique UNIT ID.

To communicate with the 3300 ACM, the COM MODE must be set to RS485.

NOTE

If the 3300 ACM has been connected to an RS-485 network, setting the COM MODE to KWH PULSE will disable all communications on the network. KWH PULSE mode is described below.

Set the BAUD RATE to the same baud rate as the Master Station and all other devices on the network. Set the PROTOCOL parameter to PML to communicate with PML's M-SCADA or PowerView software, or to MODBUS to communicate with the Modicon Modbus system.

See Chapter 5 for a more detailed description of communications. Section 2.10 describes communications connections.

3.3.7 USING THE KWH PULSE OUTPUT FUNCTION

The RS-485 port of the 3300 ACM can also be used to provide a KWH pulse output which can be used to control an external relay. This, in turn, can connect to devices which use a KWH pulse counter input, such as PML's 3750 PDC power demand controller.

To use the KWH pulse mode, COM MODE must be set to KWH PULSE. As described in Section 3.3.6, the KWH pulse output function cannot be used concurrently with RS-485 communications.

The KWH pulse output function can be programmed to generate either a KYZ (state transition) or PULSE (square wave) output. If the COM MODE has been set

to KWH PULSE, KWH/PULSE appears as the next parameter. This parameter is used to set the number of KW hours between output pulses, and is settable within a range of 0.1 to 9999.9 KWH.

If the KWH/PULSE is assigned a non-zero value, PULSE FORMAT appears as the next parameter, and allows the user to select between KYZ and PULSE.

If PULSE FORMAT = PULSE, the parameter PULSE DURATION appears next. This parameter allows the user to set the pulse width in multiples of 10 milliseconds. The valid range of this parameter is 1 to 99 (10 to 990 milliseconds).

NOTE

The operation of the KWH pulse output function described above is only valid for units equipped with firmware version **1.1.0.0** or later.

Section 2.11 describes KWH pulse output connections and relay requirements.

3.3.8 CLEAR AND RESET FUNCTIONS

Two clear/reset functions are provided with the 3300 ACM. The first allows the KWH, KVARH (optional) and KVAH (optional) counters to be cleared together. The second function allows the Min/Max array for all optional minimum/maximum readings to be reset to zero.

Both functions operate in a similar fashion. Setting either to YES will cause the clear or reset function to be performed when the user exits programming mode.

3.3.9 ADJUSTING THE DISPLAY CONTRAST

The contrast of the LCD can be adjusted for optimum readability at any given vertical viewing angle. Pressing INCREMENT changes the contrast level of the display in preset steps. Adjust until the best readability for a given installation is achieved.

3.3.10 USING THE DIAGNOSTIC PARAMETERS

The group of parameters listed under the heading DIAGNOSTICS are not typically used in the normal operation of the 3300 ACM. These parameters do, however, have a number of special functions that can be helpful in some circumstances. The diagnostic group will normally be bypassed if the DIAGNOSTIC MODE? parameter is left at NO. To view the diagnostic group, set DIAGNOSTIC MODE? to YES. Pressing CURSOR/INCREMENT together will then advance through each of the following parameters.

SERIAL NUMBER, CHECKSUM, & STATUS FLAGS

These parameters are normally for Power Measurement Ltd. internal use. If you encounter any problem with the 3300 ACM which you suspect is due to a device failure, contact PML immediately. You may then be requested to view parameter values from this group to help determine the source of the problem.

FIRMWARE VER & REV DATE

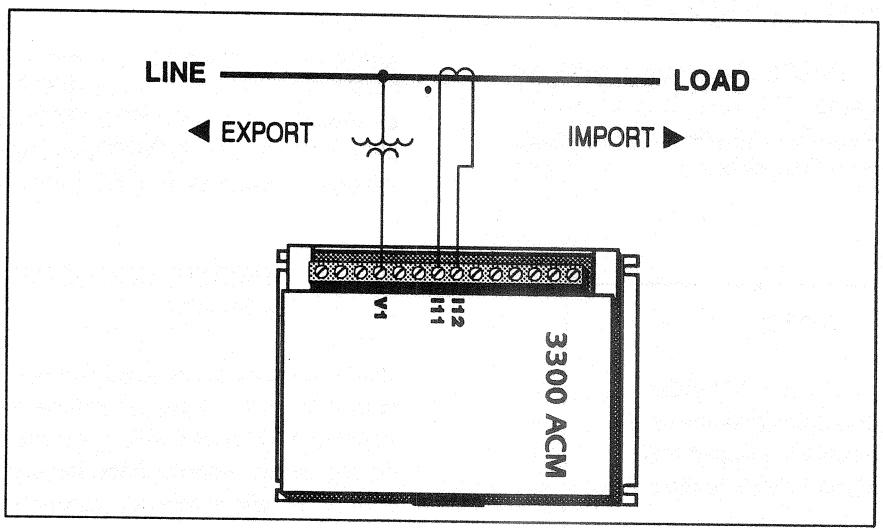
The 3300 ACM has been designed to be totally upward compatible, ensuring that any new 3300 ACM features offered by PML in the future can be easily installed into an existing device in the field. This is performed using a simple firmware upgrade operation which loads a new operating program into the device. The FIRMWARE VER and REV DATE parameters indicate which version of firmware is currently installed in the 3300 ACM. This can be checked to determine if the 3300 ACM is operating with the newest available firmware.

3.3.11 REDEFINING THE PASSWORD

To change the password enter programming mode and advance to the PASSWORD parameter. The present value of the password must first be entered (which means that the present password must be known for it to be redefined). To change the password the CURSOR/INCREMENT button combination should be pressed repeatedly until the PASSWORD parameter is displayed again. This time the new password should be entered (4 digits maximum). Once this has been done, returning to display mode will cause the password to be changed.

3.4 POWER READING POLARITIES

Figure 3.4.1 illustrates how the 3300 ACM interprets and displays signed values for power import/export, and leading or lagging indications for power factor.



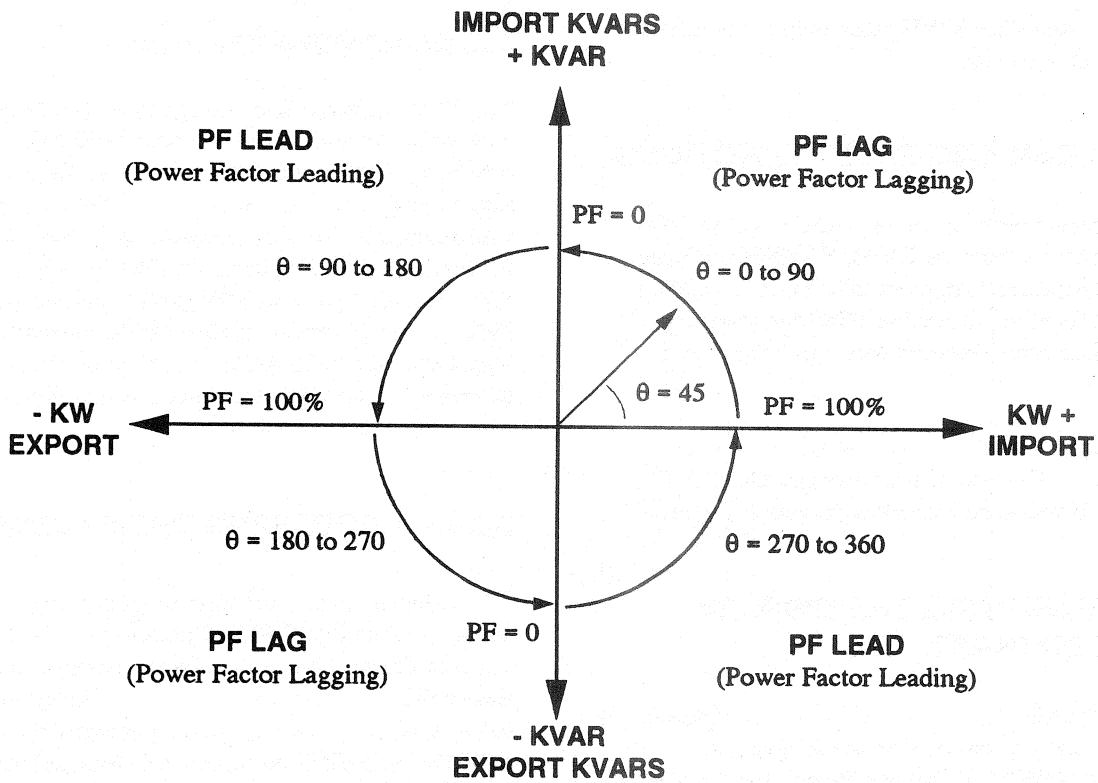


Figure 3.4 Power Reading Polarities

4. DEMAND

4.1 INDUSTRY DEMAND MEASUREMENT METHODS

Power utilities generally bill commercial customers based on both their energy consumption (in KWH) and their peak usage levels, called ***peak demand*** in KW. Demand is a measure of average power consumption over a fixed time period, typically 30 minutes. Peak demand is the highest demand level recorded over the billing period.

Demand measurement methods and intervals vary from power utility to power utility. Some common methods include: thermal averaging, sliding window, and fixed interval techniques. The 3300 ACM can perform thermal averaging and/or sliding window demand calculation.

All demand functions are available as options and must each be specified when ordering. A complete list of demand functions is provided in Chapter 3 in Figure 3.2.5.

NOTE

Sliding window demand functions are identified by an asterisk (*) used in their display labels.

Example: **KW DMD***

This differentiates sliding window demand values from those calculated using the thermal averaging method.

4.2 THERMAL DEMAND

The optional 3300 ACM *thermal demand* values (previously named *Running Demand*) are calculated using a method which is equivalent to thermal averaging. For thermal averaging, the traditional demand indicator responds to heating of a thermal element in the Watt hour meter.

The thermal demand period is determined by the thermal time constant of the element, typically 15 to 30 minutes. The demand period is the period of time it would take the demand to ramp up to about 63% of the steady-state value (see Figure 4.2.1).

... continued

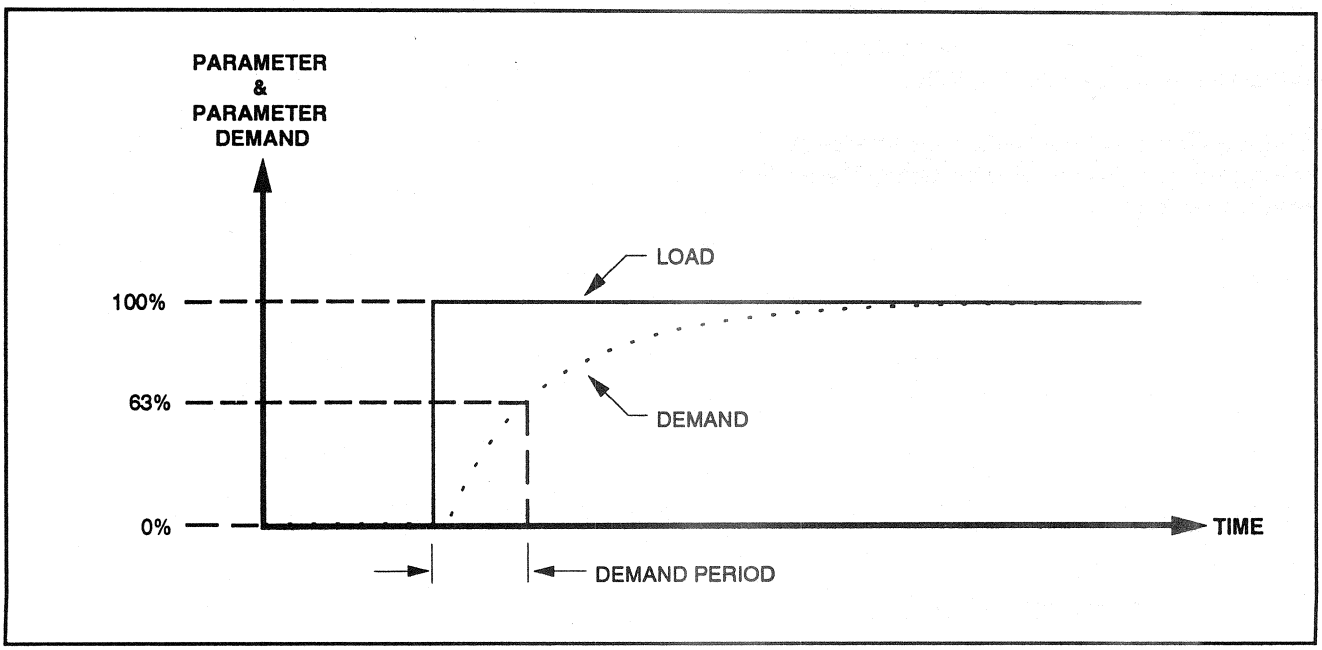


Figure 4.2.1 Thermal Demand Period Graph

For thermal demand functions, the *thermal demand period* is defined as the product of DEMAND PERIOD and # OF DMD PERIODS. For example, if DEMAND PERIOD is set to 15 minutes and # OF DMD PERIODS is set to 2, the thermal demand period will be 30 minutes.

4.3 SLIDING WINDOW DEMAND

The 3300 ACM uses the sliding window averaging technique to compute the optional *sliding window demand* values (previously named *Billing Demand*).

The sliding window technique (or *rolling interval* method) divides the demand interval into sub periods and the demand is measured electronically based on the average load level over the most recent set of sub-periods. This has the effect of improving the response time as compared to the fixed interval method.

The DEMAND PERIOD (1 to 99 minutes) and # OF DEMAND PERIODS (1 to 15) parameters are user programmable. DEMAND PERIOD represents the length of the utility's demand sub-period, while the # OF DMD PERIODS parameter represents the number of sub-periods which make up the total demand interval. For example, with a 6x5 minute (30 minutes total) sliding window method, demand will be the average power consumption over the last six 5-minute periods.

This allows the user to match virtually any type of sliding window measurement method used by the utilities (for example 15x2, 6x5, 1x30).

Using the sliding window method, the 3300 ACM readings will always be as high or slightly higher than the utility readings.

SLIDING WINDOW DEMAND SYNCHRONIZATION

The internally-timed demand period for sliding window demand measurements can be synchronized to the utility's timing through performing a manual procedure at the front panel of the 3300 ACM.

To reset the demand period, first change or toggle either the DEMAND PERIOD or the # OF DMD PERIODS setup parameter (without actually modifying it, but simply cycling the value from 5 back to 5, for example.). At the start of the utility's demand period, press both front-panel buttons simultaneously to advance to the next parameter. The 3300 ACM demand period will be reset, and all sliding window demand measurements will be cleared.

4.4 RESETTING THE REAL-TIME DEMAND PARAMETERS

The 3300 ACM demand parameters, both thermal and sliding window, are cleared when the user performs a RESET MIN/MAX function in the programming mode of the 3300 ACM. This allows the maximum demand (peak demand) and realtime accumulated demand to be cleared together.

5. COMMUNICATIONS

5.1 DESCRIPTION

The 3300 ACM is equipped with an optically isolated RS-485 communications port, providing the capability of data transfer between the remote 3300 ACM and a personal computer or other master display/control station running compatible software. This allows a user to remotely monitor and/or control either a single device, or a number of devices connected together through a common communications network.

Updates to the operating firmware inside the 3300 ACM can also be performed via the communications port, as described below.

Before communication with the host computer is possible, the user must program the communication parameters of the remote device. This may be performed via the display module of the unit. The COM MODE parameter must be set to RS485.

[CAUTION]

Setting the COM MODE parameter to KWH PULSE will disable all communications on the local RS-485 network.

The UNIT I.D. for each device must be set to a unique value (see description of RS-485 communication below). The BAUD RATE of the device must be set to correspond with the baud rate selected for the computer.

RS-485 COMMUNICATION

RS-485 communication can be used to concurrently connect up to thirty-two remote devices to one host computer, each given a unique UNIT I.D. In this way, each remote device may be monitored and controlled from one location by a single computer. The total distance limitation for RS-485 communication is 4000 feet using 22 gauge twisted pair shielded cable. Refer to Chapter 2 for connection diagrams.

[CAUTION]

It is important that the shield of each leg of RS-485 cable be grounded at <u>one end only</u>.

M-SCADA AND POWERVIEW

A host computer running PML's PC-based M-SCADA or PowerView software may communicate with one or more PML remote devices. These programs will display all data normally provided through the front panel display of each device. The user may also remotely program any set-up parameter(s) of a selected device. The PROTOCOL setup parmeter must be set to PML for operation with M-SCADA or PowerView.

COMMUNICATION WITH OTHER SYSTEMS

The standard 3300 ACM communications protocol is described in detail in Appendix F. This open protocol allows other systems to access the 3300 ACM via its communications port.

The 3300 ACM also provides direct compatibility with Modicon's Modbus system as a standard feature. Set the PROTOCOL setup parameter to MODBUS for use with the Modbus. Refer to Appendix G for information on Modbus hardware requirements and communication wiring. The 3300 ACM / MODBUS communications protocol specification can be obtained upon request from PML or your local PML representative.

PML's ongoing development program also provides communications compatibility with other third-party protocols. Contact your local PML sales representative for more information.

FIRMWARE UPDATING VIA THE COMMUNICATIONS PORT

Future 3300 ACM firmware updates, when made available by PML, can be quickly performed via the RS-485 port; therefore, <u>it is strongly recommended that all 3300 ACM devices be connected onto a communication bus when installed, even if remote communications are not initially required</u>.

... continued

Updates are performed by downloading of new firware code from a locally connected host computer, or a remote computer connected via modem or other method.

6. TROUBLESHOOTING

6.1 DESCRIPTION

A number of problems can cause the 3300 ACM not to function properly. This section lists a number of symptoms, and explains how to correct them.

1. If the display does not operate:

a) check that the correct voltage is available to the power supply (L and N connections on the terminal strip). The required voltage will depend on the power supply option of the unit (120 VAC for the standard unit).

b) confirm that the G terminal is connected directly to ground.

c) check the display cable connection between the display module and the base module.

d) turn the power off for 10 seconds, then back on.

2. If the voltage or current readings are incorrect:

a) check that the voltage mode is properly set for the given wiring.

b) check that the voltage and current scales are properly set.

c) make sure the G terminal is properly grounded.

d) check the quality of the CT's and PT's being used.

e) make the following voltage tests:

i) V1, V2, V3 to G should be reasonably balanced, and no greater than 347 VAC.

ii) G to switchgear earth ground should be 0 V.

3. If the KW or power factor readings are incorrect but voltage and current readings are correct:

a) make sure that the phase relationship between voltage and current inputs is correct by comparing the wiring with the appropriate wiring diagram.

4. If RS-485 communication does not work:

a) check that the baud rate of the PC host is the same as that of the 3300 ACM.

b) power the 3300 ACM and the PC host down, and then try again.

c) the number of data bits should be 8, with one stop bit and no parity.

d) check that the RS-232C to RS-485 Converter is configured correctly and that it is passing data.

7. WARRANTY AND REGISTRATION

7.1 WARRANTY

Power Measurement Ltd. warrants its products to be free from manufacturing defects for one year from the date of shipment from the factory. The manufacturer will repair or replace defective equipment F.O.B. point of manufacture for up to one year provided the equipment has been installed, wired, programmed, and operated in accordance with the manufacturer's instruction manual included with each unit, and the applicable sections of the Electrical Code. The warranty does not include liability for any effects caused by PML product failure.

7.2 PRODUCT RETURN PROCEDURE

The following procedure must be strictly adhered to when returning any Power Measurement Ltd. product to the factory for the purpose of repair, upgrade, recalibration, replacement, credit, or for any other reason.

1. Contact PML or your local PML Sales Representative and obtain a Return Merchandise Authorization (RMA) number prior to shipment of any unit back to the manufacturer. Be prepared to provide the product's model number, serial number, and the reason for returning the unit. Units received without prior authorization will not be accepted under any circumstances.

2. If the unit is being returned for repair or replacement, a functional description of the unit defect or failure and electrical/environmental conditions at the time of failure should be included with the unit. Inclusion of this information will significantly reduce repair time (and cost, if warranty has expired). If the unit is being returned for an upgrade, recalibration or other modification, list the requirements. The report should also include the RMA number issued by PML, the serial number of the unit, the company name and address, the name of the person filling out the report, and the date.

IMPORTANT

The report must also include the return address to which the unit is to be shipped following servicing.

3. Pack the unit safely, preferrably in the original shipping carton, and include the detailed report described above. The RMA number must be clearly marked on the outside of the box.

4. A packing slip must be attached to the outside of the box which includes the points of origin and destination, a description of contents, and the reason for return. Examples: *For Repair and Return*, or *Returned for Credit.* There should be no need to declare a value.

5. Ship PREPAID to the appropriate address below. PML will not accept C.O.D. shipments. If the unit is still under warranty, PML will pay the return shipping charges.

FOR SHIPMENTS ORIGINATING IN THE U.S.A.:
Power Measurement Ltd.
c/o VICTORIA CUSTOMS BROKERS
4131A Mitchell Way
Bellingham, WA 98226

FOR SHIPMENTS ORIGINATING OVERSEAS:
Power Measurement Ltd.
c/o LIVINGSTON CUSTOMS BROKERS
Victoria International Airport
Victoria, BC, CANADA

FOR SHIPMENTS ORIGINATING IN CANADA:
Power Measurement Ltd.
6703 Rajpur Place
Victoria, BC V8X 3X1

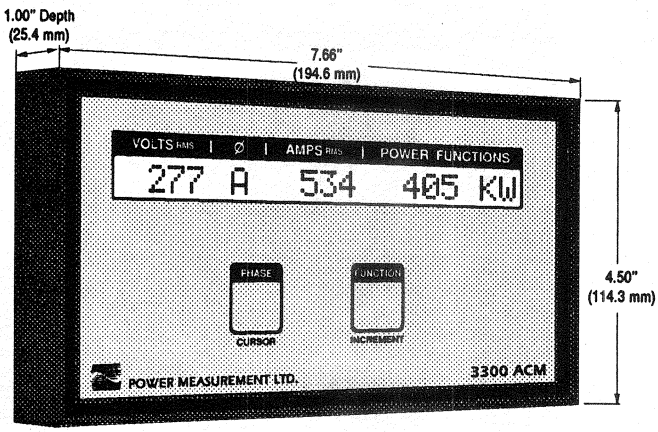
7.3 REGISTRATION

Please complete and mail the enclosed Warranty Registration Form immediately. This will allow us to add you to our mailing list, to keep you up to date on the latest product firmware releases and new feature offerings.

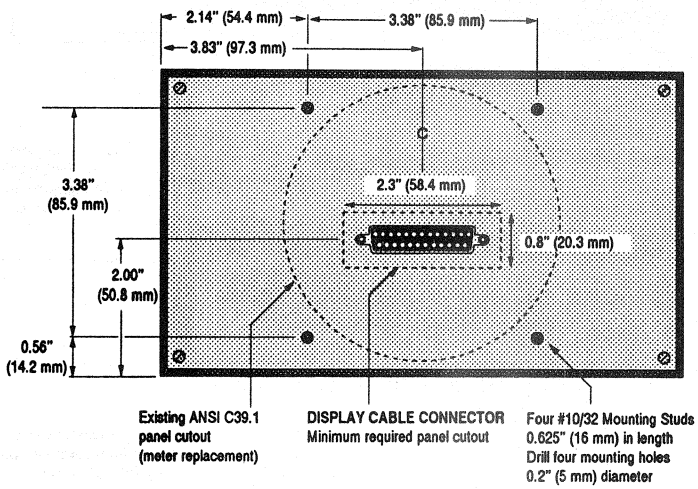
APPENDIX A

3300 ACM MECHANICAL & MOUNTING DIMENSIONS DISPLAY MODULE

FRONT VIEW



REAR VIEW



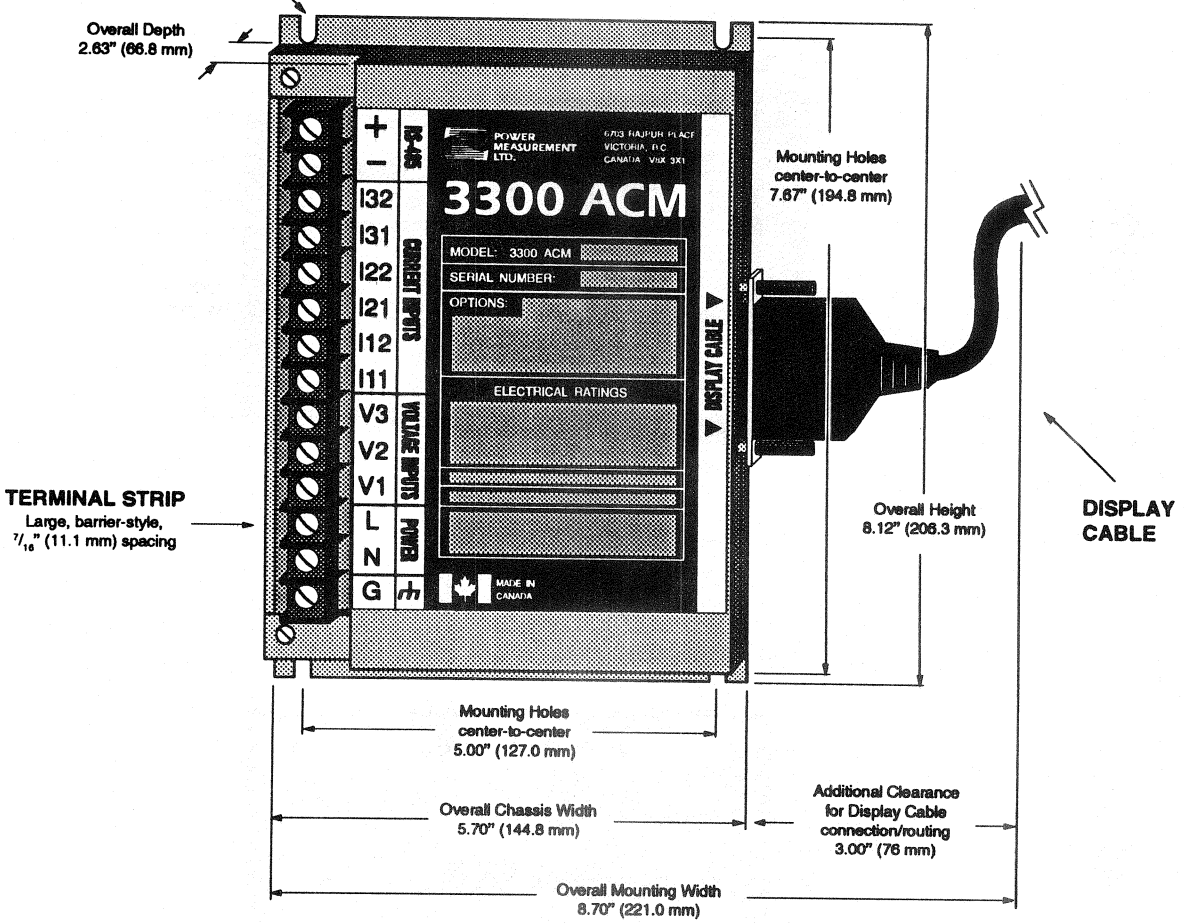
DISPLAY CABLE

The single cable which connects the Display Module to the Base Module is a standard DB25 serial communications cable, 6.0 ft. (1.8 m) in length, with approximate diameter 0.3" (7.6 mm).

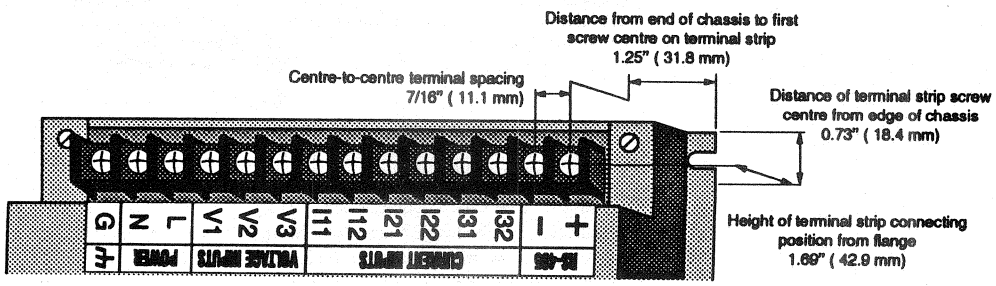
APPENDIX A

3300 ACM MECHANICAL & MOUNTING DIMENSIONS
BASE MODULE

OVERALL DIMENSIONS & MOUNTING DIMENSIONS



TERMINAL STRIP DIMENSIONS



APPENDIX B

3300 ACM FIRMWARE VERSIONS

This following table lists each firmware version release for the 3300 ACM and the new features or performance enhancements added with each release.

The version number can be identified from the display module of the 3300 ACM by entering program mode and going to the FIRMWARE REV parameter under the DIAGNOSTICS group.

If your 3300 ACM is currently using a firmware version older than the most recent version listed in the table below, you may upgrade the software in that unit by contacting your local representative or the manufacturer. Either contact will need to know the serial number of the 3300 ACM and the current firmware version installed. The serial number can also be viewed in the DIAGNOSTICS group.

Most upgrades to the 3300 ACM will require a simple download of firmware data into the on-board program memory inside the unit.

VERSION	RELEASE DATE	DESCRIPTION
V 1.0.0.1	May 1991	Initial release.
V1.1.0.0	November 1991	Sliding Window Demand functions offered as options (previously, only Thermal Demand functions available). # OF DMD PERIODS setup parameter added. RS-485 port KWH PULSE output function expanded to provide either pulse or transition output. PULSE FORMAT and PULSE DURATION setup parameters added. Modicon Modbus compatibility added as standard feature. PROTOCOL and REGISTER SIZE setup parameters added.
V1.1.0.1	January 1992	AMPS SCALE range increased to 30,000. Power factor polarity via communications modified: Leading PF = positive number, Lagging PF = negative. (Note: The above change does not affect front panel LEAD/LAG display indication.) Manual sliding window demand synchronization added. All real-time demand parameters are now reset when Min/Max reset.

APPENDIX C

3300 ACM TECHNICAL SPECIFICATIONS

PARAMETER	ACCURACY (% of Full Scale) STANDARD	-HIACC Option	RESOLUTION	RANGE
Volts & Volts Demand[1]	0.5 %	0.25 %	0.1 %	0 - 999,999[2]
Amps & Amps Demand[1]	0.5 %	0.25 %	0.1 %	0 - 30,000
KW & KW Demand[1]	1.0 %	0.5 %	0.1 %	0 - 999,999
KVAR[1] & KVAR Demand[1]	1.0 %	0.5 %	0.1 %	0 - 999,999
KVA[1] & KVA Demand[1]	1.0 %	0.5 %	0.1 %	0 - 999,999
Power Factor[1] & PF Demand[1]	2.0 %	1.0 %	1.0 %	-0.6 to 1.0 to +0.6
Frequency[1] & Freq. Demand[1]	0.2 Hz	0.2 Hz	0.1 Hz	45 to 70 Hz
KWH, KVARH[1] & KVAH[1]	1.0 %	0.5 %	1 KWH, KVARH, or KVAH	0 - 999,999,999

NOTES

[1] Optional measurement.
[2] Reads in K (ie. x 1000) for readings over 9,999.

INPUT RATINGS

Voltage Inputs:	Standard:	120 to 347 VAC nominal full scale input (programmable).
	Overload withstand:	600 VAC continuous, 1500 VAC for 1 Sec
	Input impedance:	1 Megohm
Current Inputs:	Standard:	5.000 Amps AC nominal full scale input
	-1AMP Option:	1.000 Amp AC nominal full scale
	Overload withstand for all options:	15 Amps continuous, 300 Amps for 1 second
	Input impedance:	0.002 ohm
	Burden:	0.05 VA
Power Supply:	Standard:	95 - 145 VAC / 0.1 Amps / 47 to 66 Hz
	-P240 Option:	190 - 290 VAC / 0.1 Amps / 47 to 66 Hz
Operating Temperature:	Standard: 0°C to 50°C (32°F to 122°F) ambient air	
Storage Temperature:	-30°C to +70°C (-22°F to +158°F)	
Humidity:	5 to 95 percent, non-condensing	

E95810

LR 57329

Voltage, Current, and Power inputs all pass the ANSI/IEEE C37.90A-1989 surge withstand and fast transient tests.
Complies with FCC/DOC emmisions standard.

APPENDIX D
3300 ACM MODEL/ORDERING INFORMATION

BASIC MODEL FEATURES

Standard Hardware Features:

- 347 Volt full scale voltage inputs
- 5 Amp full scale current inputs
- Powered by 95 to 145 VAC
- Display / keypad module
- RS-485 comm. port

Standard Measured Parameters:

- 3-phase Volts, per phase and average, line-to-neutral
- 3-phase Volts, per phase and average, line-to-line
- 3-phase Amps, per phase and average
- KW Total of all phases
- KWH Total of all phases

HARDWARE OPTIONS

TRAN	Without display module (*transducer* version)
P240	Powered by 190 to 290 VAC
1AMP	1 Amp nominal full scale current inputs
TROP	Tropicalization (conformal coating) treatment
HIACC:	☐ High accuracy version (see data sheet for accuracy specifications).

For HIACC option, specify input voltage: 120, 277, or 347 VAC nominal full scale. (Example: HIACC:277)

MEASUREMENT OPTIONS

MEASUREMENT	TOTAL PARAMETERS PER OPTION	INSTAN-TANEOUS	MINIMUM INSTANT.	MAXIMUM INSTANT.	THERMAL DEMAND	MIN. THERMAL DEMAND	MAX. THERMAL DEMAND
* V an, bn, cn (per phase)	3	01	02	03	04	05	06
* V average, line-to-neutral	1	07	08	09	10	11	12
V ab, bc, ca (per phase)	3	13	14	15	16	17	18
V average, line-to-line	1	19	20	21	22	23	24
I a, b, c (per phase)	3	25	26	27	28	29	30
I average	1	31	32	33	34	35	36
* KW a, b, c (per phase)	3	37	38	39	40	41	42
KW total	1	43	44	45	46	47	48
* KVAR a, b, c (per phase)	3	49	50	51	52	53	54
KVAR total	1	55	56	57	58	59	60
* KVA a, b, c (per phase)	3	61	62	63	64	65	66
KVA total	1	67	68	69	70	71	72
* PF a, b, c (per phase)	3	73	74	75	76	77	78
PF total	1	79	80	81	82	83	84
Frequency	1	85	86	87	88	89	90

MEASUREMENT	IMPORT	EXPORT	TOTAL
KW Hours	91	92	93
KVAR Hours	94	95	96
KVA Hours	n/a	n/a	97
Volt Hours	n/a	n/a	110

MEASUREMENT	SLIDING WIN. DEMAND	MIN. SLIDING WIN. DEMAND	MAX. SLIDING WIN. DEMAND
I avg	98	99	100
KW total	101	102	103
KVAR total	104	105	106
KVA total	107	108	109

ORDERING MEASUREMENT OPTIONS

1. Measurement options shown in reverse print in the chart come standard with the 3300 ACM.
2. A maximum of 20 additional optional measured parameters may be ordered. Note that some options represent per phase groupings of 3 measured parameters. Specify each option using the associated number code.
3. Measurements marked by an asterisk (*) are not available when using the 3300 ACM in a 3-wire Delta configuration.

ORDERING EXAMPLE

3300ACM	-P240 -HIACC: 277	-37 -80 -85 -103
Basic Model	Hardware Options	Measurement Options

APPENDIX E

TRAN OPERATION

INTRODUCTION

The **TRAN** (transducer) version of the 3300 ACM provides all the functions of the 3300 ACM, except that it comes without the display/keypad module. All front panel display and keypad functions described in the 3300 ACM Operation Manual should be disregarded for this version.

The mounting requirements for the TRAN version consist of mounting of the base module only. These are described in Section 2.2.

The user interface for the -TRAN differs slightly from the standard 3300 ACM. This are described below.

COMMUNICATIONS

All information and measured data is extracted from the TRAN version via its RS-485 communications port. All setup parameters are also accessed via the communications port.

The data collected by the device can be displayed on an IBM-PC/AT, PC/386 or compatible computer running PML's M-SCADA or PowerView software. These PC based software packages allow the user to remotely configure, monitor or control one or more devices.

The 3300 ACM can also be accessed by third-party software or devices whose communications conform to the protocol outlined in Appendix F.

To initiate communications with the device, the factory-set UNIT I.D. and BAUD RATE must be used. The device is shipped with its UNIT I.D. and BAUD RATE set as follows:

a) **UNIT I.D.** The UNIT I.D. of the TRAN version is set at the factory to be the last 4 digits of the unit's serial number, which can be found on the rear cover of the unit. For example, a unit with serial number 71317 will be preset to UNIT I.D. of 1317.

b) **BAUD RATE.** The BAUD RATE of the device is set at the factory to 9600 baud.

PROGRAMMING

Once communication has been established using the factory defaults, the device's operating parameters may be changed through use of the utilities provided by M-SCADA or PowerView, or through any communications following the 3300 ACM protocol. The user may also set the UNIT I.D. of the device to any other desired value, as well as resetting the BAUD RATE.

APPENDIX F

3300 ACM SERIAL COMMUNICATIONS PROTOCOL

The information contained in this document is believed to be accurate at the time of its publication; however, CD Power Measurement Ltd. assumes no responsibility for any errors which may appear here and reserves the right to make changes without notice.

1 INTRODUCTION

This document details the serial communications protocol used to pass commands, information and data into and out of the model 3300 ACM Power Meter.

This document provides the information necessary for a 3rd party OEM to develop in-house software to communicate with the model 3300 ACM Power Meter.

Additional information concerning 3300 ACM operation can be found in the main chapters of this manual.

1.1 PURPOSE OF THE COMMUNICATIONS PROTOCOL

The purpose of the communications protocol is to allow information and data to be efficiently transferred between a central data collection station (Master Station) and a 3300 ACM Power Meter. This includes:

1) Allowing configuration and interrogation of all 3300 ACM power meter set-up parameters from the Master station.

2) Allowing interrogation of all data measured by a 3300 ACM power meter.

1.2 COMMUNICATIONS PROTOCOL REVISIONS

May 24, 1991 Initial release.

2 DETAILED DESCRIPTION OF THE RS-485 COMMUNICATIONS PROTOCOL

2.1 PROTOCOL GROUND RULES

The following rules define the protocol for information transfer between the RS-485 loop controller and other components of the RS-485 serial communications loop.

1) All communications on the RS-485 loop conforms to a MASTER/SLAVE scheme. In this scheme, information and data is transferred between a single MASTER loop controller and up to 32 SLAVE monitoring devices.

2) The MASTER will initiate and control all information transfer on the RS-485 communications loop.

3) Under no circumstances will a SLAVE device initiate a communications sequence.

4) All communication activity on the RS-485 loop occurs in the form of "PACKETS", a packet being simply a serial string of 8 bit bytes. The maximum number of bytes contained within one packet is 255.

   The bytes that comprise a packet consist of standard asynchronous serial data transmitted with 8-bits per data byte, no parity and one stop bit. The serial data streams are generated using equipment similar to that used for RS-232C.

... continued

5) All transmissions on the RS-485 loop can be divided into two types of packet activity:

   i) Master to Slave transmissions

   ii) Slave to Master transmissions

   These two packet types are distinguished via a "sync" byte that is transmitted as the first byte of every packet.

   For Master to Slave transmissions,
   sync = 00010100B = 14H

   For Slave to Master transmissions,
   sync = 00100111B = 27H

6) In the case where the Master or any Slave device receives a packet that contains an unknown command, the packet shall be ignored and no further response will be made by the receiving unit.

2.2 DESCRIPTION OF THE PACKET STRUCTURE

Every packet is composed of five fields:

1) The Message Establishment Field
2) The Control Information Field
3) The Address Information Field
4) The Data Field
5) The Message Termination Field

2.2.1 MESSAGE ESTABLISHMENT FIELD

The Message Establishment field is fixed in length and contains two sub-fields, the SYNC SUB-FIELD and the DEVICE TYPE SUB-FIELD.

1) THE SYNC SUB-FIELD (1 Byte)

   The sync sub-field contains a single byte to indicate whether the packet is being transmitted from the Master loop controller to a Slave device or from a Slave device to the Master loop controller.

   For a Master to Slave transmission, sync = 14 Hex
   For a Slave to Master transmission, sync = 27 Hex

2) THE DEVICE TYPE SUB-FIELD (1 Byte)

   The Device Type sub-field contains a single byte to indicate the make and model of the Slave device used.

   For packets sent to/by the model 3300 ACM power meter, the Device Type sub-field is always set to 253 decimal = FD Hex.

2.2.2 CONTROL INFORMATION FIELD

The Control Information field is fixed in length and contains two sub-fields, the MESSAGE TYPE SUB-FIELD and the PACKET LENGTH SUB-FIELD.

1) THE MESSAGE TYPE SUB-FIELD (1 Byte)

   This byte is used to distinguish between the various types of messages, commands and data that are contained by the packet.

2) THE PACKET LENGTH SUB-FIELD (1 Byte)

   This byte indicates the number of bytes that are contained within the Address Information and Data fields of the packet.

2.2.3 ADDRESS INFORMATION FIELD

The Address Information field is fixed in length and contains two sub-fields, the SOURCE ADDRESS SUB-FIELD and the DESTINATION ADDRESS SUB-FIELD.

1) THE SOURCE ADDRESS SUB-FIELD (2 Bytes)

   These two bytes contain the address of the device from which the packet originated.

2) THE DESTINATION ADDRESS SUB-FIELD (2 Bytes)

   These two bytes contain the address of the device to which the packet is being sent.

2.2.4 DATA FIELD (0 up to 251 Bytes)

The Data Field will vary in length according to the type of message contained within the packet.

DATA REGISTERS

All information passed to and from the meter within the data field is in the form of ***registers***. Each register is represented by 4 bytes. Three of the bytes contain the metering data or setup data. Byte 4 of each data register represents the low order byte of the 16 bit address where the register is located.

BYTE 1	BYTE 2	BYTE 3	BYTE 4
Data Bits 0 to 7	Data Bits 8 to 15	Data Bits 16 to 23	Low order register address byte

For example, a 4 byte value of 3C,06,00,21 hex would indicate that register 0021hex (which is total KW) has a value of 00063C hex (or 1596 KW in decimal).

REGISTER ADDRESSES

Each piece of metering data, as well as each setup parameter, is assigned a unique 16 bit ***register address***. For example, total KW is located at register address 0021 hex (or 33 decimal). The current scale parameter is located at 0A03 hex (or 2563 decimal).

The low order byte of the register address is represented by Byte 4 of the register. The high order byte of the address represents the register ***page***.

REGISTER PAGES

Data registers are grouped in ***pages***. The most significant (high order) byte of the register address indicates the ***page*** within which the register resides. The page in which a register is located is an indication of the nature of that register:

Page 0: real time metering data
Page 1: minimum values
Page 2: maximum values
Page 10: meter setup parameters

A complete list of register addresses is provided in Figures F-3 and F-4.

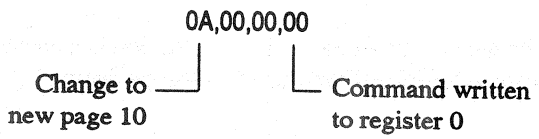
The data register contains only the least significant (low order) register address byte. A special command is used to access registers on different pages. In this way, the entire data field will be composed of specific register values interspersed with page change commands.

REGISTER PAGING: REGISTER WRITE COMMANDS

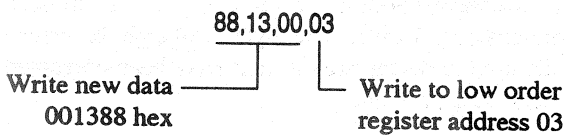
The write command will always begin writing on page 0 (zero). Register writes from the Master Station to the 3300 ACM registers contain the low order register address byte in Byte 4 of the register.

In order to change pages, the new page number must be written into Byte 1 of register 0 of the current page. The only registers which can be written to are on page 10 (meter setup parameters), so the first data write command must always be a *page change* to page 10.

For example, to change the current input scale of a meter the address 0A03 hex must be written to. To select page 10 (0A hex), the first data command must be:



Once page 10 has been selected to change the current scale to a value of 001388 hex (or 5000Amps decimal), the second data command must be:



REGISTER PAGING: REGISTER READ COMMANDS

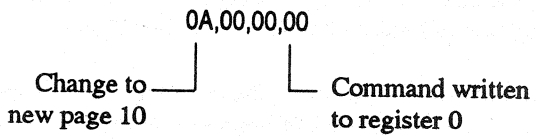
The 3300 ACM response to a read command will always begin on page 0 (zero). If the first valid requested register is not on page 0, a *page change* will occur immediately. Similar to the page change command described above, the new page number is written into Byte 1 of register 0 of the current page.

The response data fields will contain the low order register address byte in Byte 4 of the register. All

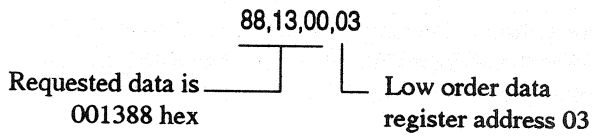
valid registers on that page will be sent, then the 3300 ACM will change to the next page by sending a *page change* command.

This will repeat until all requested data has been sent, or the packet is full.

For example, if the 3300 ACM is responding to a read command for which the requested register is the current input scale of the meter at address 0A03 hex, the first command in the data field from the 3300 ACM will be to select page 10 (0A hex):



Once page 10 has been indicated, the requested data on that page will be sent:



The data received by the Master Station is a current scale value of 001388 hex (5000Amps decimal).

2.2.5 MESSAGE TERMINATION FIELD (1 Byte)

The Message Termination Field is fixed in length and contains only 1 byte. This byte is an eight bit error code used to detect packets that have been corrupted during transmission.

The error code is an eight bit Longitudinal Redundancy Check (LRC) which is complemented prior to transmission.

The LRC is calculated by a simple arithmetic sum over all preceding message bytes contained within the packet with the exception of the eight bit sync subfield. The sum is then complemented to yield the LRC byte.

2.3 BROADCAST PACKETS

Provisions have been made for the use of broadcast commands within the RS-485 data transfer protocol. The purpose of this is to allow all Slave devices to receive the same command from the Master station. This feature is very useful in situations such as initial setup where all 3300 ACM meters have the same setup parameters.

When broadcast packets are transmitted by the Master loop controller, all Slave devices will receive and perform the packet command but will not send a response packet. This is to avoid the possibility of having more than one Slave Device respond at one time. The Master Station must ensure that commands sent via the broadcast mode do not attempt to invoke a response from the Slave Devices.

To send broadcast commands to all 3300 ACM units on an RS-485 loop, the Device Type Sub-field must be 253 decimal or FD hex, and the destination unit address of the ADDRESS INFORMATION field must be set to 0000 Hex.

Only when the destination address is set to zero will broadcast command packets be performed by the receiving 3300 ACM unit.

2.4 NETWORK TIMING CONSIDERATIONS

Network timing for the transfer of packets between units on the RS-485 loop must conform to the following rules.

1) The time between the end of a MASTER STATION message request packet and the beginning of a SLAVE STATION message response packet must not be less than 5 milliseconds.

   T response min = 5 milliseconds

   This is to provide the MASTER STATION with enough time to prepare for reception of the message response packet from the SLAVE STATION.

2) The time between the end of a MASTER STATION message request packet and the beginning of a SLAVE STATION message response packet must not exceed 500 milliseconds.

   T response max = 500 milliseconds

   Note that this is typically 100 milliseconds for the 3300 ACM.

3) The minimum time between the end of any MASTER STATION message packet and the beginning of the next MASTER STATION packet is device dependent.

   T master min = [device dependent]

   This is equal to 100 milliseconds for the 3300 ACM.

4) The minimum time between the end of a SLAVE STATION response packet and the beginning of the next MASTER STATION message packet is device dependent.

   T slave min = [device dependent]

   Note that this is equal to 100 milliseconds for the 3300 ACM.

5) The maximum time between any two data bytes within a packet must not exceed 50 milliseconds.

   T byte max = 50 milliseconds.

   Note that this is typically less than 1 millisecond for the 3300 ACM.

6) It is recommended that all Master station packet transmissions be prefixed with two null bytes to ensure that the RS-485 data bus is stable before the sync byte is transmitted.

3 RS-485 PACKET COMMUNICATIONS

This section details all packet communications into and out of the model 3300 ACM power meter. There are only two different packet types: one for reading the registers and the other for writing them.

Section 3.1 discusses the command packet to read the registers, and the response packet issued by the meter.

Section 3.2 discusses the command packet to write data to the registers, and the acknowlegement packet issued by the meter.

3.1 READ REGISTERS PACKET

This request packet is sent by the Master Station(the PC) to request that the 3300 ACM respond with all valid registers within the range given by Start register and End register. Typically no password is required to read the registers. In this case any number may be placed in the password location of the packet. There are, however, two cases where the correct password is required.

1) To read a protected register. Presently the only protected register is the register where the meter password is held.

2) If the PROTECTED READ ONLY register (address 0A10 hex) has been set. In this case the password must be correct to read any register.

Only valid registers will be sent in the response packet. Registers for which the meter is not equiped, or do not exist for a given voltage mode will not be sent.

READ REGISTER PACKET (Master to 3300 ACM)

14	(1 byte)
FD	(1 byte)
83 (Read Registers command)	(1 byte)
Length	(1 byte)
Master address	(2 bytes)
3300 address	(2 bytes)
Password	(2 bytes)
Start Register requested	(2 bytes)
End Register requested	(2 bytes)
LRC Checksum	(1 byte)

READ RESPONSE PACKET (3300 ACM to Master)

27	(1 byte)
FD	(1 byte)
83 (Read Registers command)	(1 byte)
Length	(1 byte)
3300 address	(2 bytes)
Master address	(2 bytes)
Device Type	(2 bytes)
Number of Registers sent	(2 bytes)
1st Register in Range	(4 bytes)
2nd Register in Range	(4 bytes)
...	...
...	...
LRC Checksum	(1 byte)

NOTES

1) Registers are 4 bytes with 1 byte register address LSB field and 3 bytes data field.
2) A register address value of 0 indicates a page change to the page given in the data field.
3) The maximum number of registers in a response packet is 61. If there are more valid registers in the requested range the last register will be change to page FF.

Figure F-1 Read Registers Packet

3.2 WRITE REGISTERS PACKET

This packet allows the master to program the setup parameters of a 3300 ACM meter. In order to write to a meter the meter password must be known and placed in the password location of the write registers packet.

4 3300 ACM REGISTER LIST

Each 3300 ACM comes standard with the following registers:

10,11,12,13,14,15,16,17,20,21,22,23,33,54,55

These represent Van, Vbn, Vcn, Vln average, Vab, Vbc, Vca, Vll average, Ia, Ib, Ic, I average, total KW, total KW hours and total GW hours. In addition, the 3300 ACM may be equipped with any of the parameters listed as optional in Figures F-3a to F-3e. A 3300 ACM may contain up to 40 different parameters.

The page 10 setup registers are common to all 3300 ACM meters and are not counted as part of the maximum 40 possible parameters. Figures F-3a to F-3e list all possible data registers. Figure F-4 lists the 3300 ACM setup registers.

WRITE REGISTER PACKET (Master to 3300 ACM)

14	(1 byte)
FD	(1 byte)
81 (Protected write command)	(1 byte)
Length	(1 byte)
Master address	(2 bytes)
3300 address	(2 bytes)
Password	(2 bytes)
Number of Registers in Packet	(2 bytes)
1st Register	(4 bytes)
2nd Register	(4 bytes)
.	
...	
.	
...	
nth Register	
...	
LRC	(1 byte)

WRITE RESPONSE PACKET (3300 ACM to Master)

27	(1 byte)
FD	(1 byte)
81 ((Protected) write command)	(1 byte)
Length	(1 byte)
3300 address	(2 bytes)
Master address	(2 bytes)
Device Type	(2 bytes)
Ack/Nack	(1 byte)
LRC	(1 byte)

NOTES

1) There is no requirement to specify all registers, or to assign them in any particular order. For example, if you wish to change only the Amp scale, a packet may be sent with only that constant.

2) A write to a protected Read/Write register requires that the password stored in the device be sent in the write packet or the write command will be ignored. For a write to an unprotected Read/Write register the password is not required. At present, all 3300 registers are protected.

3) The device responds with an acknowledge packet. If all registers were successfully written to the device will respond with 0xFFH in the Ack/Nack byte otherwise it will respond with 0x00H in the Ack/Nack byte.

Figure F-2 Write Registers Packet

3300 ACM DATA REGISTERS

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
REAL TIME PARAMETERS: PAGE 0				
0	0	WO	PAGE Register	YES
			3300 ACM Internal Clock	
0	1	RO	Milli seconds	NO
0	2	RO	Minutes	NO
0				
0				
0				
0	10	RO	Van	YES
0	11	RO	Vbn	YES
0	12	RO	Vcn	YES
0	13	RO	Vln average	YES
0	14	RO	Vab	YES
0	15	RO	Vbc	YES
0	16	RO	Vca	YES
0	17	RO	Vaverage (l-l)	YES
0	20	RO	Ia	YES
0	21	RO	Ib	YES
0	22	RO	Ic	YES
0	23	RO	Iaver	YES
0				
0	24	RO	I4 Neutral current	NO
0	30	RO	KW Phase A	OPT (a)
0	31	RO	KW Phase B	OPT (a)
0	32	RO	KW Phase C	OPT (a)
0	33	RO	KW TOTAL	YES
0	34	RO	KVAR Phase A	OPT (a)
0	35	RO	KVAR Phase B	OPT (a)
0	36	RO	KVAR Phase C	OPT (a)
0	37	RO	KVAR Total	OPT
0	38	RO	Power Factor A	OPT (a)
0	39	RO	Power Factor B	OPT (a)
0	40	RO	Power Factor C	OPT (a)
0	41	RO	Power Total	OPT
0	42	RO	KVA Phase A	OPT (a)
0	43	RO	KVA Phase B	OPT (a)
0	44	RO	KVA Phase C	OPT (a)
0	45	RO	KVA Total	OPT
0	46	RO	Auxiliary voltage I/P	NO
0	47	RO	Freq on V1	OPT

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
REAL TIME PARAMETERS: PAGE 0 (continued)				
0	50	RO	KWH Import	OPT
0	51	RO	GWH Import	OPT
0	52	RO	KWH Export	OPT
0	53	RO	GWH Export	OPT
0	54	RO	KWH Total (kWH imp+exp)	YES
0	55	RO	GWH Total	YES
0	60	RO	KVARH Import	OPT
0	61	RO	GVARH Import	OPT
0	62	RO	KVARH Export	OPT
0	63	RO	GVARH Export	OPT
0	64	RO	KVARH Total	OPT
0	65	RO	GVARH Total	OPT
0	70	RO	KVAH	OPT
0	71	RO	GVAH	OPT
THERMAL DEMAND VALUES				
The Thermal demand values are a running average of the real time parameter over a user specified time period from 1 min. to 9999 min., calculated using thermal averaging.				
0	110	RO	Van Dmd	OPT
0	111	RO	Vbn Dmd	OPT
0	112	RO	Vcn Dmd	OPT
0	113	RO	Vln aver Dmd	OPT
0	114	RO	Vab Dmd	OPT
0	115	RO	Vbc Dmd	OPT
0	116	RO	Vca Dmd	OPT
0	117	RO	Vaverage (l-l) Dmd	OPT
0	120	RO	Ia Dmd	OPT
0	121	RO	Ib Dmd	OPT
0	122	RO	Ic Dmd	OPT
0	123	RO	Iaver Dmd	OPT
0	124	RO	Ineutral Dmd	NO
0	130	RO	KW a Dmd	OPT (a)
0	131	RO	KW b Dmd	OPT (a)
0	132	RO	KW c Dmd	OPT (a)
0	133	RO	KW total Dmd	OPT

... continued

Figure F-3a 3300 ACM Data Registers - Part I

3300 ACM DATA REGISTERS (continued)

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
THERMAL DEMAND VALUES (continued)				
0	134	RO	KVAR a Dmd	OPT (a)
0	135	RO	KVAR b Dmd	OPT (a)
0	136	RO	KVAR c Dmd	OPT (a)
0	137	RO	KVAR total Dmd	OPT
0	138	RO	PF a Dmd	OPT (a)
0	139	RO	PF b Dmd	OPT (a)
0	140	RO	PF c Dmd	OPT (a)
0	141	RO	PF total Dmd	OPT
0	142	RO	KVA a Dmd	OPT (a)
0	143	RO	KVA b Dmd	OPT (a)
0	144	RO	KVA c Dmd	OPT (a)
0	145	RO	KVA total Dmd	OPT
0	146	RO	Vaux Dmd	NO
0	147	RO	Frequency Dmd	OPT
SLIDING WINDOW DEMAND VALUES				
Sliding window demand is a calculation of the demand as measured and billed by the power utility, using either a fixed or rolling window technique.				
0	180	RO	Amps Demand Average	OPT
0	181	RO	KW Demand Total	OPT
0	182	RO	KVAR Demand Total	OPT
0	183	RO	KVA Demand Total	OPT
MINIMUM VALUES: PAGE 1				
1	0	WO	PAGE Register	YES
			3300 ACM Internal Clock	
1	1	RO	Milli seconds	NO
1	2	RO	Minutes	NO
MINIMUM REAL TIME VALUES				
1	10	RO	Van	OPT
1	11	RO	Vbn	OPT
1	12	RO	Vcn	OPT

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
MINIMUM REAL TIME VALUES (continued)				
1	13	RO	Vln average	OPT
1	14	RO	Vab	OPT
1	15	RO	Vbc	OPT
1	16	RO	Vca	OPT
1	17	RO	Vaverage (l-l)	OPT
1	20	RO	Ia	OPT
1	21	RO	Ib	OPT
1	22	RO	Ic	OPT
1	23	RO	Iaver	OPT
1	24	RO	Ineutral	NO
1	30	RO	KW a	OPT (a)
1	31	RO	KW b	OPT (a)
1	32	RO	KW c	OPT (a)
1	33	RO	KW total	OPT
1	34	RO	KVAR a	OPT (a)
1	35	RO	KVAR b	OPT (a)
1	36	RO	KVAR c	OPT (a)
1	37	RO	KVAR total	OPT
1	38	RO	PF a	OPT (a)
1	39	RO	PF b	OPT (a)
1	40	RO	PF c	OPT (a)
1	41	RO	PF total	OPT
1	42	RO	KVA a	OPT (a)
1	43	RO	KVA b	OPT (a)
1	44	RO	KVA c	OPT (a)
1	45	RO	KVA total	OPT
1	46	RO	Vaux	NO
1	47	RO	Frequency	OPT
MINIMUM THERMAL DEMAND VALUES				
1	110	RO	Van Dmd	OPT
1	111	RO	Vbn Dmd	OPT
1	112	RO	Vcn Dmd	OPT
1	113	RO	Vln aver Dmd	OPT

... continued

Figure F-3b 3300 ACM Data Registers - Part II

3300 ACM DATA REGISTERS (continued)

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
MINIMUM THERMAL DEMAND VALUES (continued)				
1	114	RO	Vab Dmd	OPT
1	115	RO	Vbc Dmd	OPT
1	116	RO	Vca Dmd	OPT
1	117	RO	Vaver (l-l) Dmd	OPT
1	120	RO	Ia Dmd	OPT
1	121	RO	Ib Dmd	OPT
1	122	RO	Ic Dmd	OPT
1	123	RO	Iaver Dmd	OPT
1	124	RO	Ineutral Dmd	NO
1	130	RO	KW a Dmd	OPT (a)
1	131	RO	KW b Dmd	OPT (a)
1	132	RO	KW c Dmd	OPT (a)
1	133	RO	KW total Dmd	OPT
1	134	RO	KVAR a Dmd	OPT (a)
1	135	RO	KVAR b Dmd	OPT (a)
1	136	RO	KVAR c Dmd	OPT (a)
1	137	RO	KVAR total Dmd	OPT
1	138	RO	PF a Dmd	OPT (a)
1	139	RO	PF b Dmd	OPT (a)
1	140	RO	PF c Dmd	OPT (a)
1	141	RO	PF total Dmd	OPT
1	142	RO	KVA a Dmd	OPT (a)
1	143	RO	KVA b Dmd	OPT (a)
1	144	RO	KVA c Dmd	OPT (a)
1	145	RO	KVA total Dmd	OPT
1	146	RO	Vaux Dmd	NO
1	147	RO	Frequency Dmd	OPT
MINIMUM SLIDING WINDOW DEMAND VALUES				
1	180	RO	Amps Demand Average	OPT
1	181	RO	KW Demand Total	OPT
1	182	RO	KVAR Demand Total	OPT
1	183	RO	KVA Demand Total	OPT

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
MAXIMUM VALUES: PAGE 2				
2	0	RW	PAGE Register	YES
			3300 ACM Internal Clock	
2	1	RO	Milli seconds	NO
2	2	RO	Minutes	NO
MAXIMUM REAL TIME VALUES				
2	10	RO	Van	OPT
2	11	RO	Vbn	OPT
2	12	RO	Vcn	OPT
2	13	RO	Vln average	OPT
2	14	RO	Vab	OPT
2	15	RO	Vbc	OPT
2	16	RO	Vca	OPT
2	17	RO	Vll average	OPT
2	20	RO	Ia	OPT
2	21	RO	Ib	OPT
2	22	RO	Ic	OPT
2	23	RO	Iaver	OPT
2	24	RO	Ineutral	NO
2	30	RO	KW a	OPT (a)
2	31	RO	KW b	OPT (a)
2	32	RO	KW c	OPT (a)
2	33	RO	KW total	OPT
2	34	RO	KVAR a	OPT (a)
2	35	RO	KVAR b	OPT (a)
2	36	RO	KVAR c	OPT (a)
2	37	RO	KVAR total	OPT
2	38	RO	PF a	OPT (a)
2	39	RO	PF b	OPT (a)
2	40	RO	PF c	OPT (a)
2	41	RO	PF total	OPT

... continued

Figure F-3c 3300 ACM Data Registers - Part III

3300 ACM DATA REGISTERS (continued)

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
MAXIMUM REAL TIME VALUES (continued)				
2	42	RO	KVA a	OPT (a)
2	43	RO	KVA b	OPT (a)
2	44	RO	KVA c	OPT (a)
2	45	RO	KVA total	OPT
2	46	RO	Vaux	NO
2	47	RO	Frequency	OPT
MAXIMUM THERMAL DEMAND VALUES				
2	110	RO	Van Dmd	OPT
2	111	RO	Vbn Dmd	OPT
2	112	RO	Vcn Dmd	OPT
2	113	RO	Vln aver Dmd	OPT
2	114	RO	Vab Dmd	OPT
2	115	RO	Vbc Dmd	OPT
2	116	RO	Vca Dmd	OPT
2	117	RO	Vll aver Dmd	OPT
2	120	RO	Ia Dmd	OPT
2	121	RO	Ib Dmd	OPT
2	122	RO	Ic Dmd	OPT
2	123	RO	Iaver Dmd	OPT
2	124	RO	Ineutral Dmd	NO

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
MAXIMUM THERMAL DEMAND VALUES (continued)				
2	130	RO	KW a Dmd	OPT (a)
2	131	RO	KW b Dmd	OPT (a)
2	132	RO	KW c Dmd	OPT (a)
2	133	RO	KW total Dmd	OPT
2	134	RO	KVAR a Dmd	OPT (a)
2	135	RO	KVAR b Dmd	OPT (a)
2	136	RO	KVAR c Dmd	OPT (a)
2	137	RO	KVAR total Dmd	OPT
2	138	RO	PF a Dmd	OPT (a)
2	139	RO	PF b Dmd	OPT (a)
2	140	RO	PF c Dmd	OPT (a)
2	141	RO	PF total Dmd	OPT
2	142	RO	KVA a Dmd	OPT (a)
2	143	RO	KVA b Dmd	OPT (a)
2	144	RO	KVA c Dmd	OPT (a)
2	145	RO	KVA total Dmd	OPT
2	146	RO	Vaux Dmd	NO
2	147	RO	Frequency Dmd	OPT
MAXIMUM SLIDING WINDOW DEMAND VALUES				
2	180	RO	Amps Demand Average	OPT
2	181	RO	KW Demand Total	OPT
2	182	RO	KVAR Demand Total	OPT
2	183	RO	KVA Demand Total	OPT

NOTES

a. Available in Wye mode only

b. Register types: RO = Read Only
WO = Write Only
RW = Read/Write

Figure F-3d 3300 ACM Data Registers - Part IV

3300 ACM SETUP REGISTERS

PG #	REG #	REG TYPE (b)	DESCRIPTION	EQUIPPED ON 3300 ACM ?
10	0	WO	Page Register	YES
10	1	RW	PT primary voltage	YES
10	2	RW	PT secondary voltage	YES
10	3	RW	CT primary voltage	YES
10	4	RW	Voltage input mode (0,1,2 or 3)	YES
10	5	RW	Unit ID number	YES
10	6	RW	Baud rate (300,1200,2400, 4800,9600,19200)	YES
10	7	RW	Demand period time constant	YES
10	8	RW	Contrast/viewing angle adjustment	YES
10	9	RW	Password	YES
10	10	WO	Reset all min/max values (if equipped)	YES
10	11	WO	Reset all hour counters (KW hours Etc.)	YES
10	12	RO	Firmware revision number	YES
10	13	RO	Date the last firmware revision was performed	YES
10	14	RO	Feature code	YES
10	15	RO	Device type (will equal 3300)	YES
10	16	RW	Allow protected reads only (yes or no)	YES
10	17	RW	Number of demand periods (yes or no)	YES

DESCRIPTION OF SPECIAL PURPOSE REGISTERS

RESET ALL MIN/MAX VALUES

Any write to this register will result in any min/max values being set to the present real time values.

RESET ALL HOURS COUNTER

Any write to this register will result in any hour counters (KW hours import, KVAR hours total, Etc.) being set to zero.

FIRMWARE REVISION NUMBER

A four digit decimal representation of the firmware revision number. For example a value of 0004D2 hex = 1234 decimal would represent a hypothetical firmware revision of 1.2.3.4.

FEATURE CODE

Reserved for future use. Presently this will return zero.

DEVICE TYPE

Will return 3300. This will be used in future to differentiate different devices using this same protocol format.

ALLOW PROTECTED READS ONLY

boolean value (0 or 1) that determines whether a password is required to read data from the meter. If a 1 is written to this location, any read request packet must contain a correct password or the packet will be ignored. If a 0 is written, no password is required for normal register reads. Zero is the default.

Figure F-4 3300 ACM Setup Registers

5.0 PACKET EXAMPLES

The following two sections contain examples of actual packets sent to a 3300 ACM meter, and the response packets issued by that meter. To make the packets easier to read the bytes have been blocked into groups of 4.

5.1 READ REGISTERS EXAMPLE

This is an example of a request from a Master Station to unit 100. The request is for all registers in the range 0000 to 00FF hex, which is a request for all real-time and demand parameters. The Master Station has ID number 0.

Request from Master:

14 FD 83 0A	00 00 64 00	00 00 00 00	FF 00 12

Response from 3300ACM:

27 FD 83 90	64 00 00 00	E4 0C 22 00	
64 00 00 0A	64 00 00 0B	64 00 00 0C	64 00 00 0D
AD 00 00 0E	AD 00 00 0F	AD 00 0010	AD 00 00 11
88 13 00 14	88 13 00 15	88 13 00 16	88 13 00 17
F4 01 00 1E	F4 01 00 1F	F4 01 00 20	DC 05 0021
00 00 00 22	00 00 00 23	00 00 00 24	00 00 00 25
E8 03 00 26	E8 03 00 27	E8 03 00 28	E8 03 00 29
F4 01 00 2A	F4 01 00 2B	F4 01 00 2C	DC 05 00 2D
AE 0F 00 2F	DA 2F 01 36	00 00 00 37	93 0E 00 40
00 00 00 41	1F 05 00 85	55	

5.2 WRITE REGISTERS EXAMPLE

This is an example of a register write to set the voltage scales, current scale and voltage mode of a meter with unit ID 100 and a password of 0. The Master will write the following information to the 3300 ACM:

PT primary voltage 1200
PT secondary voltage 120
CT primary current 5000
Voltage mode 0

Write command from Master:

14 FD 81 1C	00 00 64 00	00 00 05 00	
0A 00 00 00	B0 04 00 01	78 00 00 02	88 13 00 03
00 00 00 04	21		

Response from 3300ACM:

27 FD 81 07	64 00 00 00	E4 0C FF 27	

APPENDIX G

MODICON MODBUS COMPATIBILITY

GENERAL DESCRIPTION & COMMUNICATIONS WIRING REQUIREMENTS

INTRODUCTION

The 3300 ACM provides compatibility with the ***Modicon MODBUS*** system as a standard feature, selectable from the front panel. The Modbus communications protocol allows setup parameters and measured data to be efficiently transferred between a Modicon Programmable Controller and multiple 3300 ACMs. The 3300 ACM performs Modbus communications by emulating a Modicon 984 Controller.

All measured data for the 3300 ACM can be accessed via the Modbus, including all real-time, thermal (running) or sliding window demand, and minimum/maximum registers. Polarity of power measurements can be determined through six polarity registers. All setup parameters are also accessible. Password protection is provided via a special password register location.

The 3300 ACM Modbus protocol supports standard 16 bit registers, as well as 32 bit extended registers. 32 bit registers would typically be required only for large energy values (ex. KWH, etc.) Register size is selectable from the front panel.

NOTE

A 3300 ACM operating in Modbus mode will not be compatible with PML's M-SCADA or PowerView PC-based software.

HARDWARE REQUIREMENTS AND COMMUNICATIONS WIRING

Mechanical mounting, electrical wiring (other than communications), and general operation of units communicating on the Modbus are similar to that of the standard 3300 ACM.

The 3300 ACM is connected on an RS-485 network that is interfaced to the Modbus via an RS-232C to RS-485 converter, such as PML's COM32™. A Modicon BM85 Bridge/Multiplexer is required between the Modbus and Modicon Controller.

A *multi-drop* topology allows up to thirty-two 3300 ACMs on an RS-485 network to be connected to each of the four BM85 Bridge/Mux ports. This allows for up to 128 power meters to be connected to each BM85 (refer to Figure G-1).

The cable connecting the Bridge/Mux to the converter is a 9-pin male to 25-pin male serial cable. Refer to the 3300 ACM Installation Manual for required RS-485 network connections.

SETTING COMMUNICATIONS PARAMETERS

When using Modbus communications, the range of possible UNIT ID designations for the 3300 ACM is limited to between 1 and 247.

The COM MODE parameter must be set to RS-485 as described in Section 3.3.6 of the 3300 ACM Manual.

A setup parameter named PROTOCOL has been provided to select between PML and MODBUS communications standards. If the 3300 ACM is to be connected to a Modbus communications network, the PROTOCOL parameter should be set to MODBUS.

If PROTOCOL is set to MODBUS, the next parameter that appears is REGISTER SIZE. This parameter determines whether a 16-bit or an extended 32-bit register is passed in communications for each function. The default setting is 16 BIT.

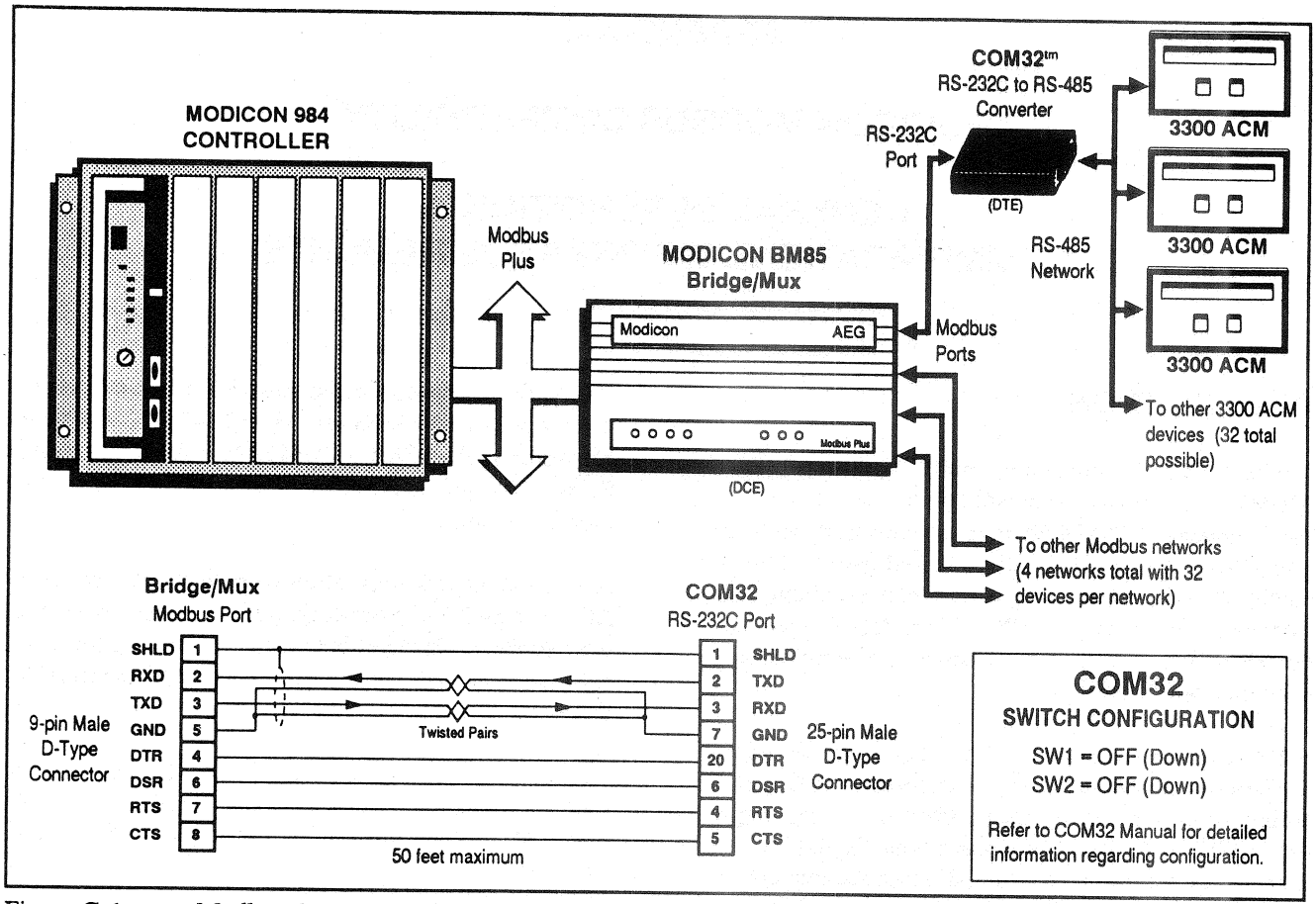


Figure G-1 Modbus Communications Connections

COMMUNICATIONS PROTOCOL

Communications occurs from the Controller via the Modbus Plus network (using MSTR block), across the BM85 to the Modbus, and on to the 3300 ACM(s) via the RS-232C / RS-485 converter.

All communications between the BM85 and 3300 ACM(s) conform to a ***master/slave*** scheme with the BM85 as the master and the 3300 ACM(s) as slave(s).

MESSAGE PACKETS SUPPORTED

All registers within the 3300 ACM are accessible as PLC 4xxxx holding registers. The following Modbus commands are supported:

Preset Multiple Registers (10h) – allows the Modicon Controller to define all the user-programmable setup parameters in the 3300 ACM. Registers are also provided to allow the Controller to clear the KW Hour, KVA Hour, or KVAR Hour counters of the 3300 ACM.

Read Holding Registers (03h) – allows the Controller to read 16-bit or 32-bit real-time measured data or setup parameters from the 3300 ACM.

For a detailed specification describing the 3300 ACM Modbus communications protocol, refer to the Power Measurement Ltd. document:

3300 ACM / MODICON MODBUS
SERIAL COMMUNICATIONS PROTOCOL

This document is available upon request from PML or your local PML representative.

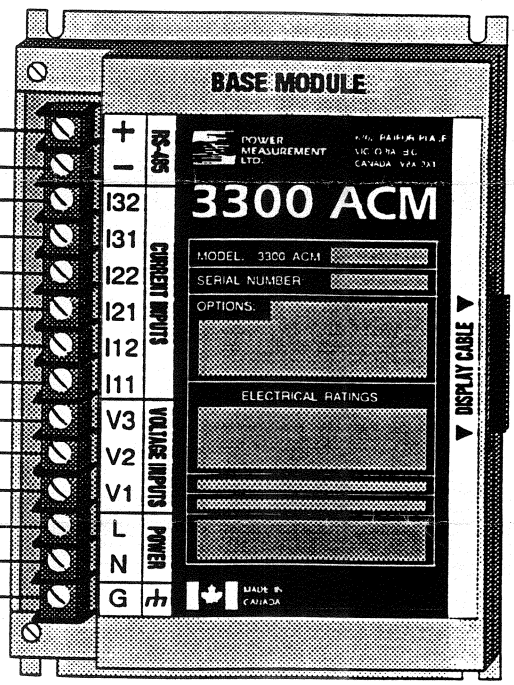
IMPORTANT : PLEASE READ THIS FIRST

3300 ACM INSTALLATION

It is extremely important that the 3300 ACM installation instructions provided below and in the accompanying *3300 ACM Installation and Operation Manual* be followed exactly. Failure to do so **may result in irreparable damage to the 3300 ACM and/or the system it is monitoring**. The diagram here provides only basic connection information. For complete detailed connection diagrams and operating instructions refer to the enclosed manual. Failure to install, wire, program, and operate the 3300 ACM in strict accordance with the instructions provided by the manufacturer **may void any warranty applicable to the unit**.

RS-485 COMMUNICATIONS WIRING

Communications wiring should be made to the RS-485 port of every 3300 ACM being installed, and extended to a location which is easily and safely accessible. All field service work including running diagnostics, testing, software upgrades, feature upgrades, etc., are performed **via the communications link**. Refer to Section 2.10 in Operation Manual for communications wiring.



CT SHORTING SWITCH OR TEST BLOCK

CURRENT SENSE LEADS

Connect directly to CTs.

[WARNING]

These are **low-potential inputs**. Application of voltages over 5 V_{ac} to these inputs will permanently damage the 3300 ACM.

VOLTAGE SENSE LEADS

Direct connection to lines up to 347 VAC. Connection to line voltages above 347 VAC must be performed via PTs. All connections should be fused (2A rating on 3300 ACM side).

SUPPLY POWER

The standard 3300 ACM is powered from a 120 VAC dedicated fused feed or from the voltage source it is monitoring, if it is a 120 VAC system. -P240 option is powered from 240 VAC.

G (GROUND) REFERENCE TERMINAL

Connect directly to nearest earth ground.

[ADDITIONAL WARNINGS]

1. Do not "HI-POT" or "MEGGER" test this unit directly or indirectly.
2. Components are static sensitive. Take standard precautions.

Refer to 3300 ACM Installation & Operation Manual for complete instructions regarding installation and connections not shown.

91/5/3

ADDENDUM TO 3300 ACM INSTALLATION AND OPERATION MANUAL

FIRMWARE VERSION 1.2.0.0 FEATURES

September 3, 1992

The following is a list of new features provided by firmware version 1.2.0.0 for the 3300 ACM.

PASSWORD DISPLAY

When the user enters the programming mode of the 3300 ACM via the front panel, "****" is now displayed in the password field instead of 0 (zero). Parameter modification is disallowed if the user does not enter any password or if the password entered is incorrect.

FORMAT

Phase label and decimal point delimiter are now programmable through the front panel. The phase labels available on the 3300 ACM are: ABC, XYZ, RYB, RST, and 123. The decimal point delimiter is selectable between period and comma. This delimiter only affects the Power Factor display if so equipped.

These two parameters can be modified under the FORMAT setup parameter in the programming mode. CURSOR key selects either phase label or decimal point delimiter parameter. INCREMENT key selects options for the chosen parameter.

CONTRAST/ANGLE

A number corresponding to the present contrast level of the LCD display is now shown as the user adjusts the CONTRAST/ANGLE parameter.

CLEAR STATUS FLAGS

The status flags in the diagnostic mode can now be cleared from the front panel of the 3300 ACM by selecting "YES" with the CLEAR STATUS ? parameter.

AUTO FUNCTION CYCLING MODE

If the user presses the PHASE button for longer than 3 seconds, the display will enter the *Auto Function Cycling* mode. This mode automatically cycles through the following four displays:

3-phase Line-to-Neutral Volts
3-phase Line-to-Line Volts
3-phase Amps
Frequency, KW Total

The cycle rate is one display every two seconds.

NOTES

1. The Frequency parameter will be displayed only if the 3300 ACM is so equipped.

2. The *Frequency-KW* display is only available in the *Auto Function Cycling* mode and cannot be found in the regular display modes.