SBM 300

MULTIFUNCTION
3-PHASE ENERGY SUBMETER
WITH ENERGY AND DEMAND

Instruction Manual

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"The Leader in Web Accessed Power Monitoring and Control"

Customer Service and Support

Customer service and support is available 9:00 am to 4:30 pm EST, Monday through Friday. Please have the model, serial number and a detailed problem description available. If the problem concerns a particular reading, please have all meter readings available. When returning any merchandise to EIG, a return authorization number is required. For customer or technical assistance, repair or calibration, call: 516-334-0870 or fax 516-338-4741.

Product Warranty

Electro Industries/GaugeTech warrants all products to be free from defects in material and workmanship for a period of four years from the date of shipping. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, fax or call our customer service department. You will receive prompt assistance and return instructions. Send the instrument, transportation prepaid, to EIG at 1800 Shames Drive, Westbury, NY 11590. Repairs will be made and the instrument will be returned.

Limitation of Warranty

This warranty does not apply to defects resulting from unauthorized modification, misuse or use for any reason other than electrical power monitoring.

OUR PRODUCTS ARE NOT TO BE USED FOR PRIMARY OVER-CURRENT PROTECTION. ANY PROTECTION FEATURE IN OUR PRODUCTS IS TO BE USED FOR ALARM OR SECONDARY PROTECTION ONLY.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ELECTRO INDUSTRIES/GAUGETECH SHALL NOT BE LIABLE FOR ANY PENAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING FROM ANY AUTHORIZED OR UNAUTHORIZED USE OF ANY ELECTRO INDUSTRIES/GAUGETECH PRODUCT. LIABILITY SHALL BE LIMITED TO THE ORIGINAL COST OF THE PRODUCT SOLD.

Statement of Calibration

Our instruments are inspected and tested in accordance with specifications published by Electro Industries/GaugeTech. The accuracy and a calibration of our instruments are traceable to the National Institute of Standards and Technology through equipment that is calibrated at planned intervals by comparison to certified standards.

Disclaimer

The information presented in this publication has been carefully checked for reliability; however, no responsibility is assumed for inaccuracies. The information contained in this document is subject to change without notice.

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CHAPTER 1
AC POWER MEASUREMENT

The economics of electric power distribution networking dictated several configurations of AC power transmission. These configurations are characterized by the number of phases and voltage levels.

1.1 SINGLE PHASE SYSTEM

SINGLE PHASE SYSTEM: A basic two wire system used in low power distribution applications, such as residential communities or offices. Typically, the voltage is 120V AC.

For higher power requirements, such as residential houses or small commercial facilities, the typical power configuration is two lines of 120V AC opposite in phase (See figure **1.1 B**).

This system produces 120 volts from line to neutral for lighting and small appliances use. The line to line voltage is 240V AC, used for higher loads such as water heaters, electric dryers, ranges, and machinery.

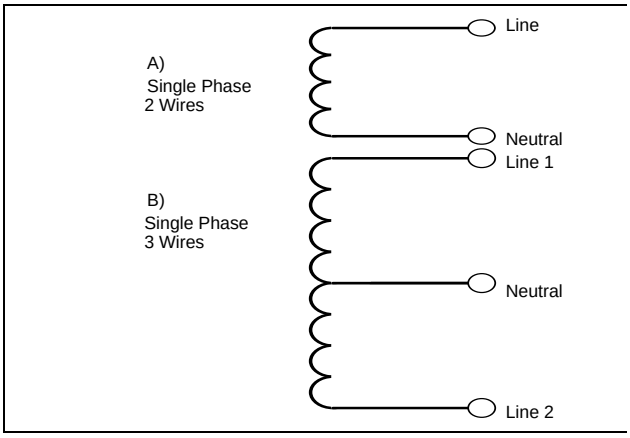


Figure 1.1
Single Phase System: (A) Two Wire
(B) Three Wire

The power (**W**) in a single phase system is: $W = E \cdot I \cdot \cos\Theta$
E = potential, **I** = current, and **cosΘ** = phase difference between the potential and the current.

Power in a 120/240V AC system is: $W = (E_{Line1} \cdot I_{Line1} \cdot \cos\Theta) + (E_{Line2} \cdot I_{Line2} \cdot \cos\Theta)$

Phase differential between the potential and the current results from a non-resistive load, either reactive or capacitive.

Reactive power **VAR**: The additional power consumed, that does not produce any work, but must be delivered to the load: $VAR = E \cdot I \cdot \sin\Theta$. This is a measure of the inefficiency of the electrical system.

Apparent power **VA**: The total power delivered to the load, and the vector sum of real power and reactive power. Figure 1.2 shows a triangle which is a graphic representation of the relationships between apparent, real, and reactive power.

Power Factor **PF**: The ratio between real power and apparent power: $PF = \frac{W}{VA} = \frac{W}{\sqrt{W^2 + VAR^2}}$

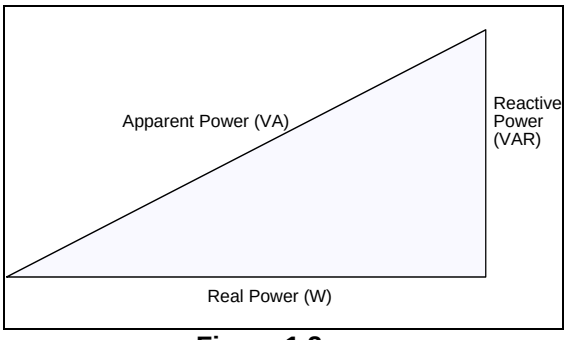


Figure 1.2

Ideal power distribution should have a PF of 1. This condition could be met only if there are no reactive power loads throughout the system. In real life applications, many loads are inductive loads. Often, corrective capacitors are installed to correct poor Power Factor.

1.2 THREE PHASE SYSTEM

THREE PHASE SYSTEM: Delivers higher levels of power for industrial and commercial applications; the three phases correspond to three potential lines. A 120° phase shift between the three potential lines.

A typical configuration has either a Delta connection or a Wye connection. (See in Figure 1.3).

$$E_{an} = E_{bn} = E_{cn} = \frac{E_{ab}}{\sqrt{3}} = \frac{E_{bc}}{\sqrt{3}} = \frac{E_{ac}}{\sqrt{3}}$$

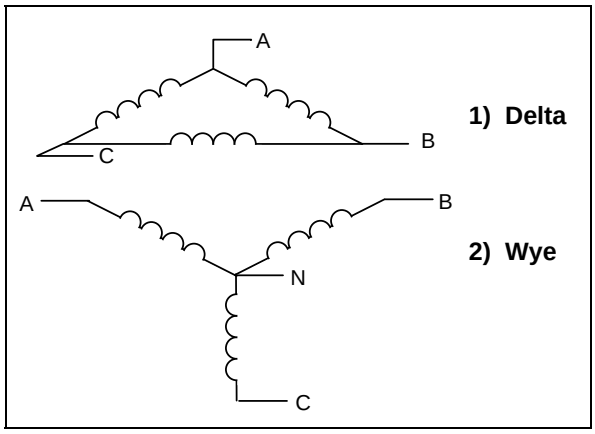


Figure 1.3
Three Phase System: 1) Delta
2) Wye

Voltages between the phases vary depending on loading factors and the quality of the distribution transformers. The three phase system is distributed in different voltage levels: 208V AC, 480V AC, 2400V AC, 4160V AC, 6900V AC, 13800V AC, and so on.

Power measurement in a poly phase system is governed by Blondel's Theorem. **BLONDEL'S THEOREM** states that in a power distribution network which has N conductors, the number of measurement elements required to determine power is N-1.

A typical configuration of poly phase system has either a Delta connection or a Wye connection. (See **Figure 1.4**).

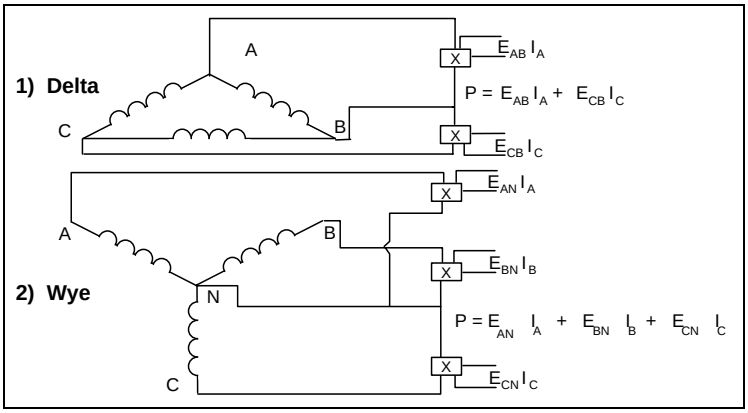


Figure 1.4
Poly Phase System: 1) Delta
2) Wye

1.3 CONSUMPTION, DEMAND, AND POWER FACTOR LOSSES

The total electric energy usage over a period of time is the consumption **WH**.

CONSUMPTION: $H = W \cdot T$ **W** = instantaneous power **T** = time in hours

Typically, the unit in which consumption is specified is the kilowatt-hour (KWH). **KILOWATT-HOUR** : one thousand watts consumed over one hour. Utilities use the **WH** equation to determine the overall consumption in a billing period.

DEMAND: Average energy consumed over a specified time interval. The interval is determined by the utility; typically, 15 or 30 minutes. The utility measures the maximum demand over a billing period. This measurement exhibits a deviation from average consumption that may force the utility to provide generating capacity to satisfy a high maximum consumption demand. The highest average demand is retained in the metering until the demand level is reset.

POOR POWER FACTOR: Results in reactive power consumption. Transferring reactive power over a distribution network causes energy loss. To force consumers to correct their Power Factor, utilities monitor reactive power consumption and penalize the user for poor Power Factor. This is becoming an increasing problem.

1.4 WAVEFORM AND HARMONICS

Ideal power distribution has sinusoidal wave forms on voltages and currents. In real life application, where inverters, computers, and motor controls are used, distorted wave forms are generated. Those distortions consist of harmonics of the fundamental frequency.

SINUSOIDAL WAVEFORM: $A \cdot \sin(\omega \cdot t)$

DISTORTED WAVEFORM: $A \cdot \sin(\omega \cdot t) + A_1 \cdot \sin(\omega_1 \cdot t) + A_2 \cdot \sin(\omega_2 \cdot t) + A_3 \cdot \sin(\omega_3 \cdot t) + ...$

TOTAL HARMONIC DISTORTION (THD):

$$\%ofTHD = \frac{RMSofTotalHarmonicDistortionSignal}{RMSoftheFundamentalSignal} \cdot 100$$

HARMONIC DISTORTION: A destructive force in power distribution systems. It creates safety problems, shortens the life span of distribution transformers, and interferes with the operation of electronic devices.

CHAPTER 2
MECHANICAL INSTALLATION

These diagrams display the SBM 300 mechanical installation.

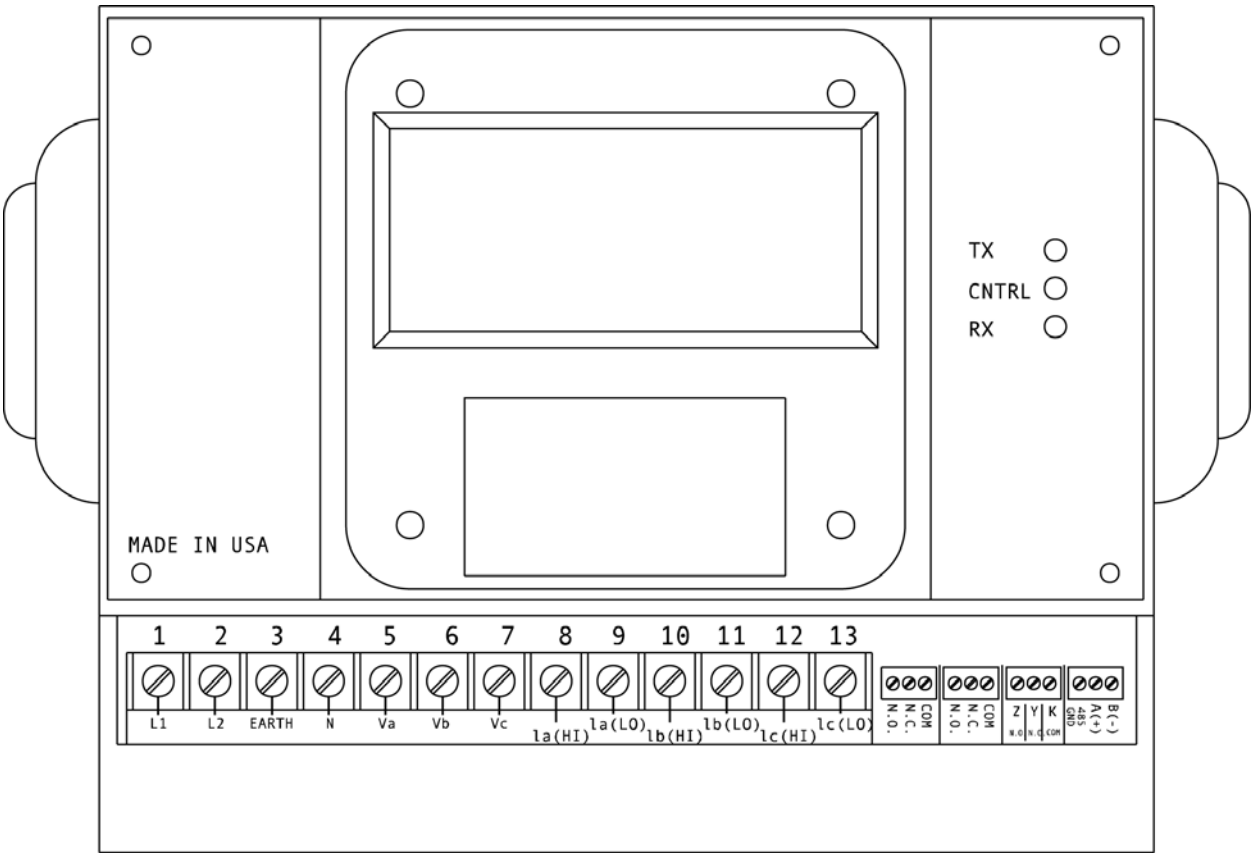


Figure 2.1 Face of the SBM 300 with lower cover removed.

NOTE: Mounting of the SBM 300 is very easy, because it requires no cutting. The meter is mounted with five screws and all wiring can be done through the front panel just below the face of the meter. Wiring can also be done through the back of the meter, if desired. The wiring will be described in the next chapter, Chapter 3.

NOTE: Dimensions of the meter are: 8.375"W x 7.125"H x 4.25"D.

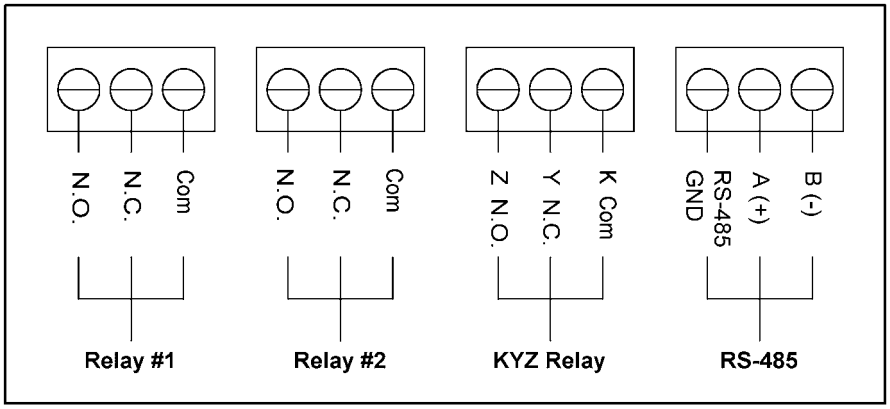


Figure 2.2 Relay Detail

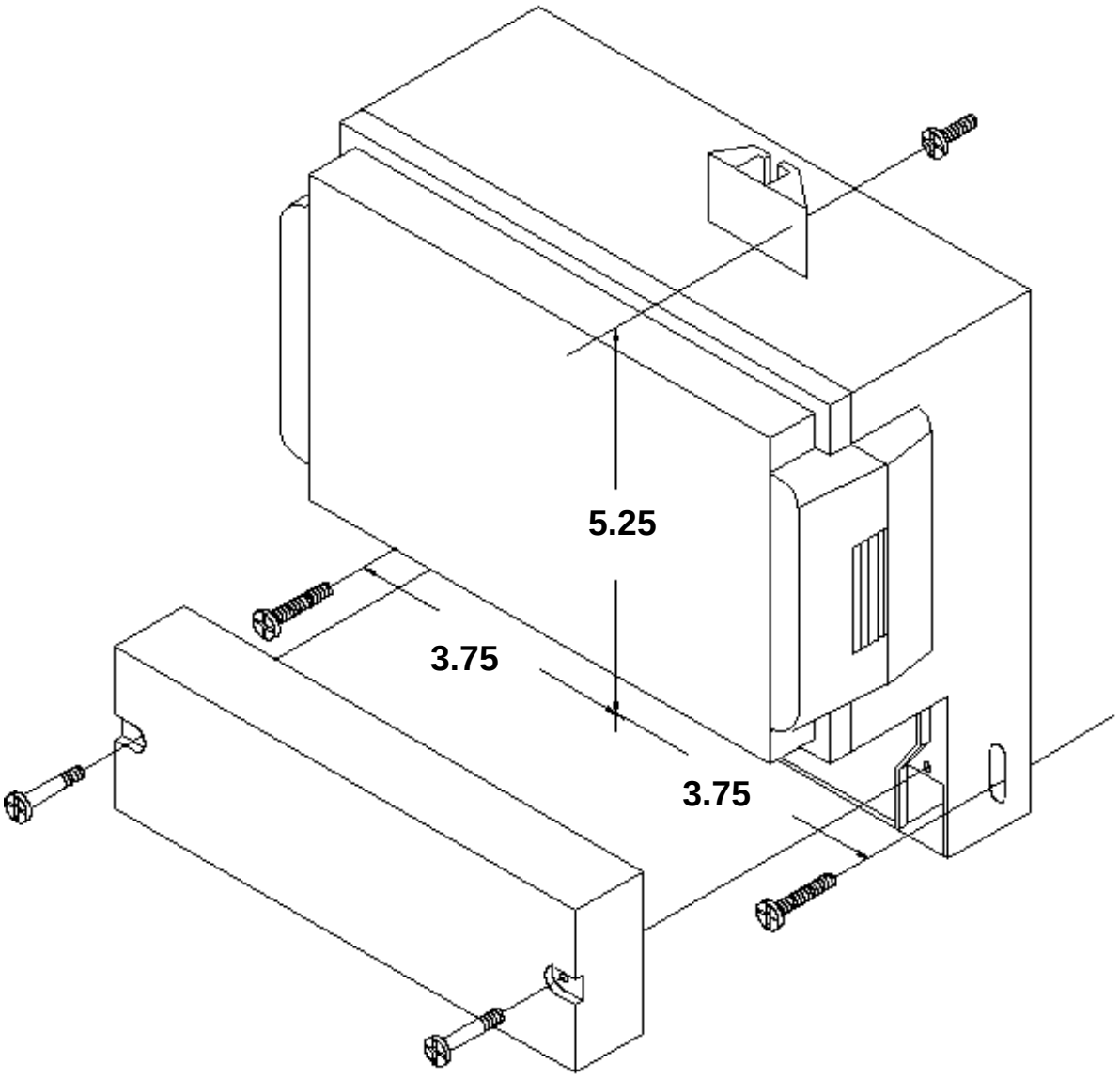


Figure 2.3 Mounting Detail for SBM 300.

NOTE: Mounting of the SBM 300 is very easy, because it requires no cutting. The meter is mounted with five screws as shown and all wiring can be done through a front panel just below the face of the meter.
All dimensions in the diagram above are in inches.

CHAPTER 3
ELECTRICAL INSTALLATION

3.1 CONNECTING THE CURRENT CIRCUIT

Install the cable current at 600V AC minimum. The cable connector should be rated at 6 Amps or greater and have a cross-sectional area of 16 AWG.

Mount the current transformers as close as possible to the meter. The following table illustrates the maximum recommended distances for various CT sizes, assuming the connection is via 16 AWG cable.

CT SIZE (VA)	MAXIMUM DISTANCE (CT TO SBM 300)
2.5 VA	10 FEET
5.0 VA	15 FEET
7.5 VA	30 FEET
10.0 VA	40 FEET
15.0 VA	60 FEET
30.0 VA	120 FEET

WARNING: DO NOT LEAVE SECONDARY OF CT WHEN PRIMARY CURRENT IS FLOWING. THIS MAY CAUSE HIGH VOLTAGE WHICH OVERHEATS THE SECONDARY OF THE CT. IF THE CT IS NOT CONNECTED, PROVIDE A SHORTING BLOCK ON THE SECONDARY OF THE CT.

3.2 CT CONNECTION

If the SBM 300 is connected directly, maintain the exact connection to avoid incorrect polarity.

When the SBM 300 is connected using the CTs, it is imperative to maintain the correct CT polarities. CT polarities are dependent upon correct connections of CT leads and the direction that the CTs are facing when they are clamped around the conductors. The dot on the CT must face the line side and the corresponding secondary connection must connect to the appropriate pin. Failure to connect CTs properly results in incorrect Watt readings.

3.3 CONNECTING THE VOLTAGE CIRCUIT

For proper meter operation, the voltage connection *must* be maintained. The voltage must correspond to the correct terminal.

The cable required to terminate the voltage sense circuit should have an insulation rating greater than 600V AC and a current rating greater than 0.1 A.

3.4 SELECTING THE VOLTAGE FUSES

We recommend using fuses, although connection diagrams do not show them. Slow blow, 200 mA rated fuses should be used.

3.5 CONNECTION TO THE MAIN POWER SUPPLY

The SBM 300 requires a separate power supply. Listed are the 5 different power supply options and corresponding suffixes.

CONTROL POWER	OPTION
120V AC	NO SUFFIX
240V AC	A
24V DC	D
48V DC	D[1]
125V DC	D[2]

NOTE: FOR DC-POWERED UNITS, POLARITY MUST BE OBSERVED. CONNECT THE NEGATIVE TERMINAL TO L1 AND POSITIVE TERMINAL TO L2. AN EARTH GROUND CONNECTION TO CHASSIS IS MANDATORY FOR NORMAL OPERATION (TERMINAL 3). DO NOT GROUND THE UNIT THROUGH THE NEGATIVE OF THE DC SUPPLY. SEPARATE GROUNDING IS REQUIRED.

3.6 ELECTRICAL CONNECTION INSTALLATION

Choose the diagram that best suits your application and maintain the polarity. Follow the outlined procedure to verify correct connection.

NOTE: THIS PROCEDURE IS ONLY SUITABLE WHEN POWER FLOW IS SINGLE DIRECTION.

HELPFUL DEBUGGING TOOLS

ISOLATING A CT CONNECTION REVERSAL

(1.) ⇨ Remove potential connections to terminals 6 and 7. Observe the KW reading. It should be positive (unless you are generating power).

⇨ If negative, reverse the CT wires on terminals 8 and 9.

(2.) Connect terminal number 6 potential. If KW decreases to about zero, reverse CT wires on terminals 10 and 11.

(3.) Connect terminal number 7 potential. If KW is low, reverse CT wires to terminals 12 and 13.

LISTING OF CONNECTION DIAGRAMS

I Three-Phase, Three-Wire System Delta with Direct Voltage and CTs.

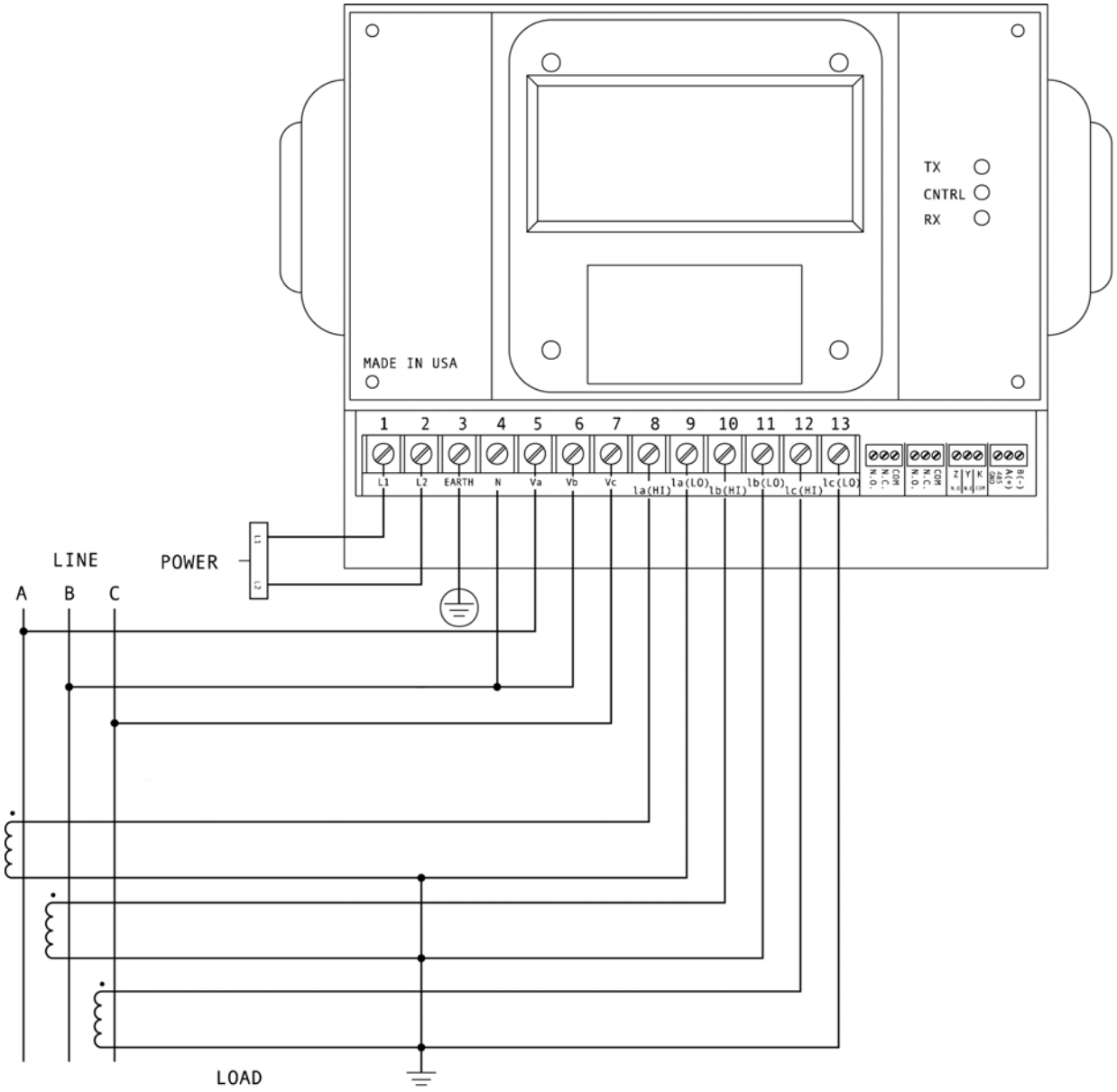
II Three-Phase, Three-Wire Open Delta with two CTs and two PTs.
(*Open Delta System should only be used if the electrical system is a 3-wire OPEN DELTA. Open Delta can be enabled or disabled in Programming Group 0, Function 3).*

III Three-Phase, Three-Wire Open Delta with three CTs and two PTs.

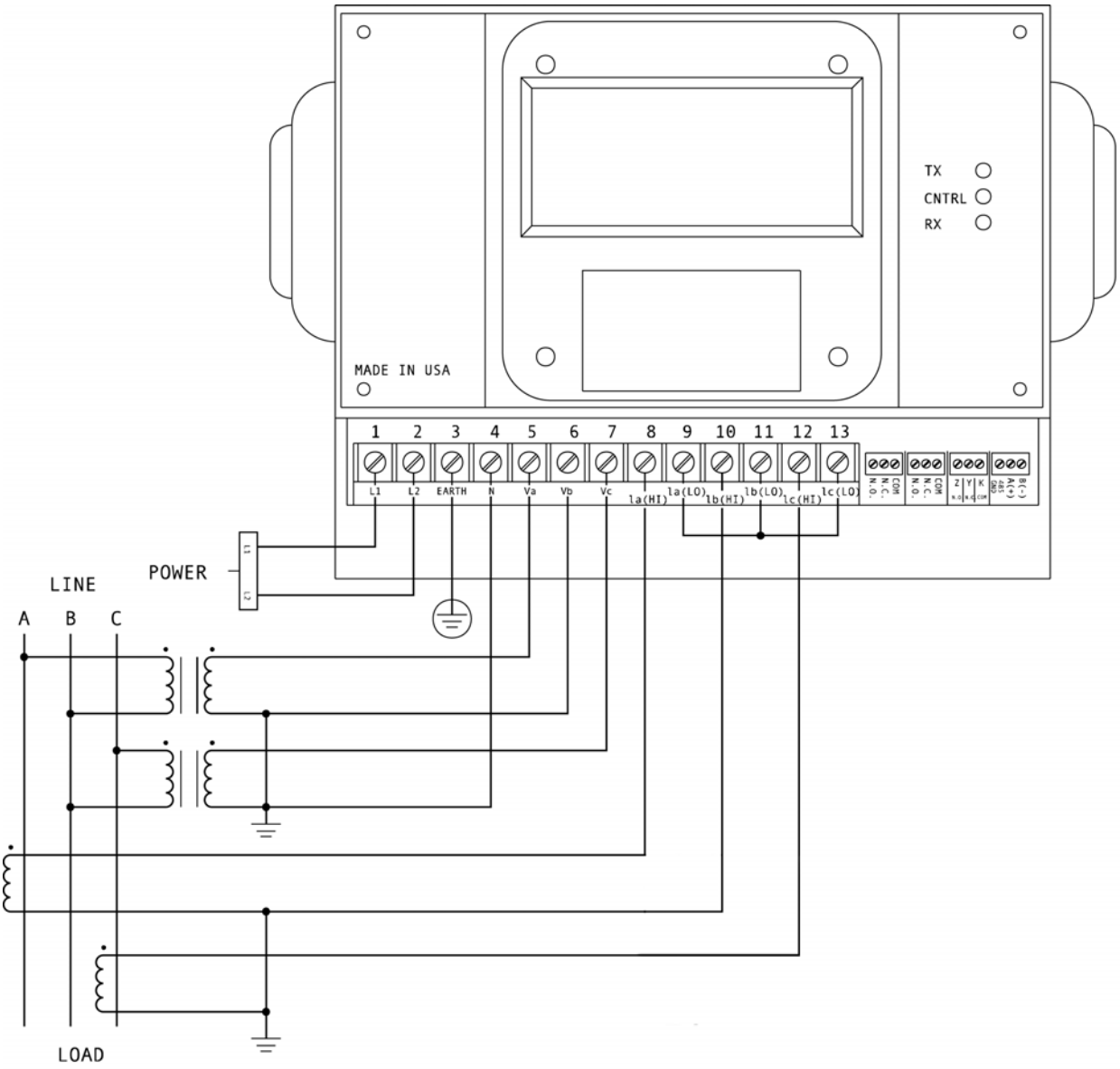
IV Three-Phase, Four-Wire System Wye with Direct Voltage and CTs.

V Three-Phase, Four-Wire System Wye with CTs and PTs.

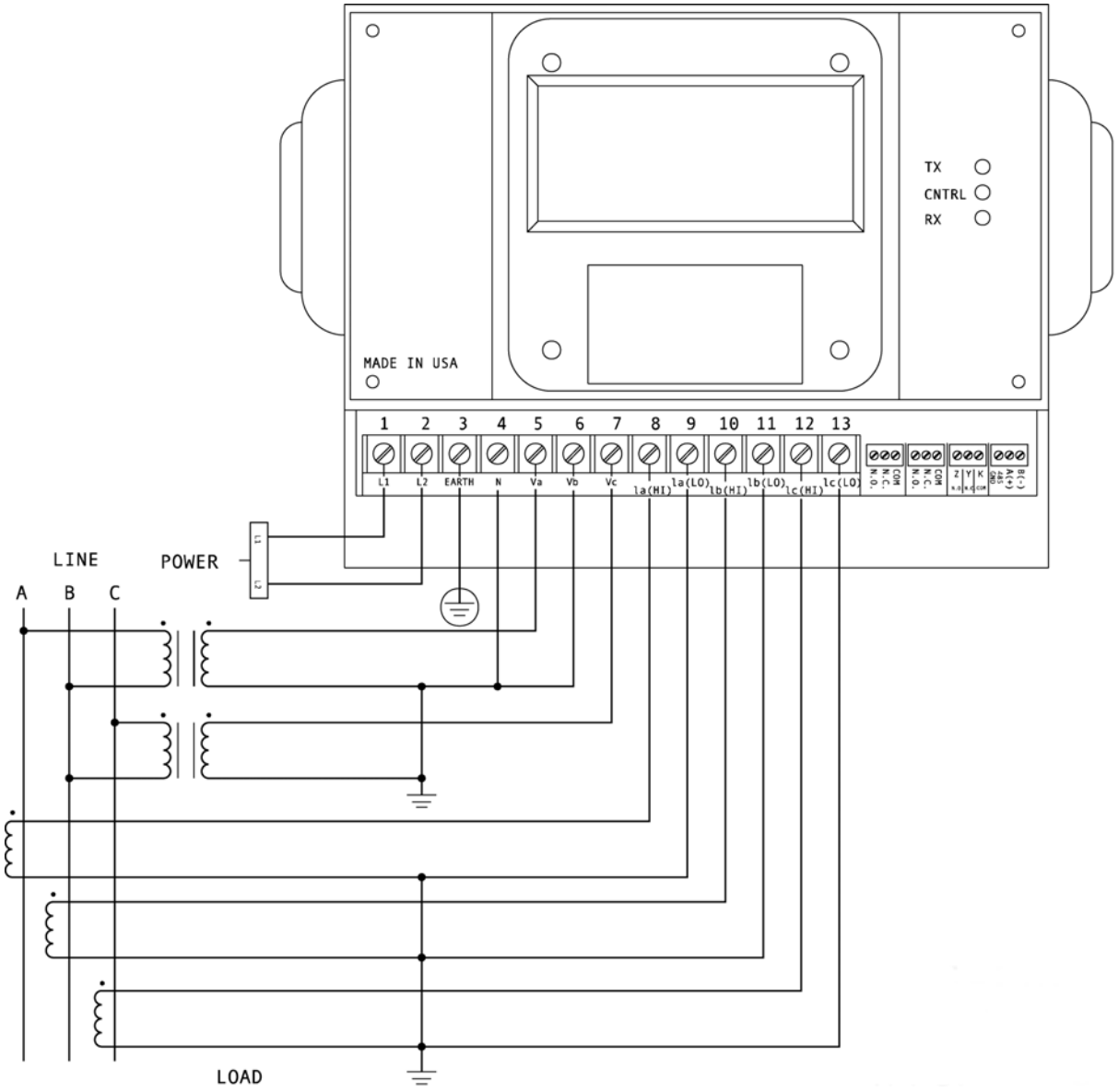
VI Three-Phase, Four-Wire System Wye 2.5 Element with CTs and PTs.



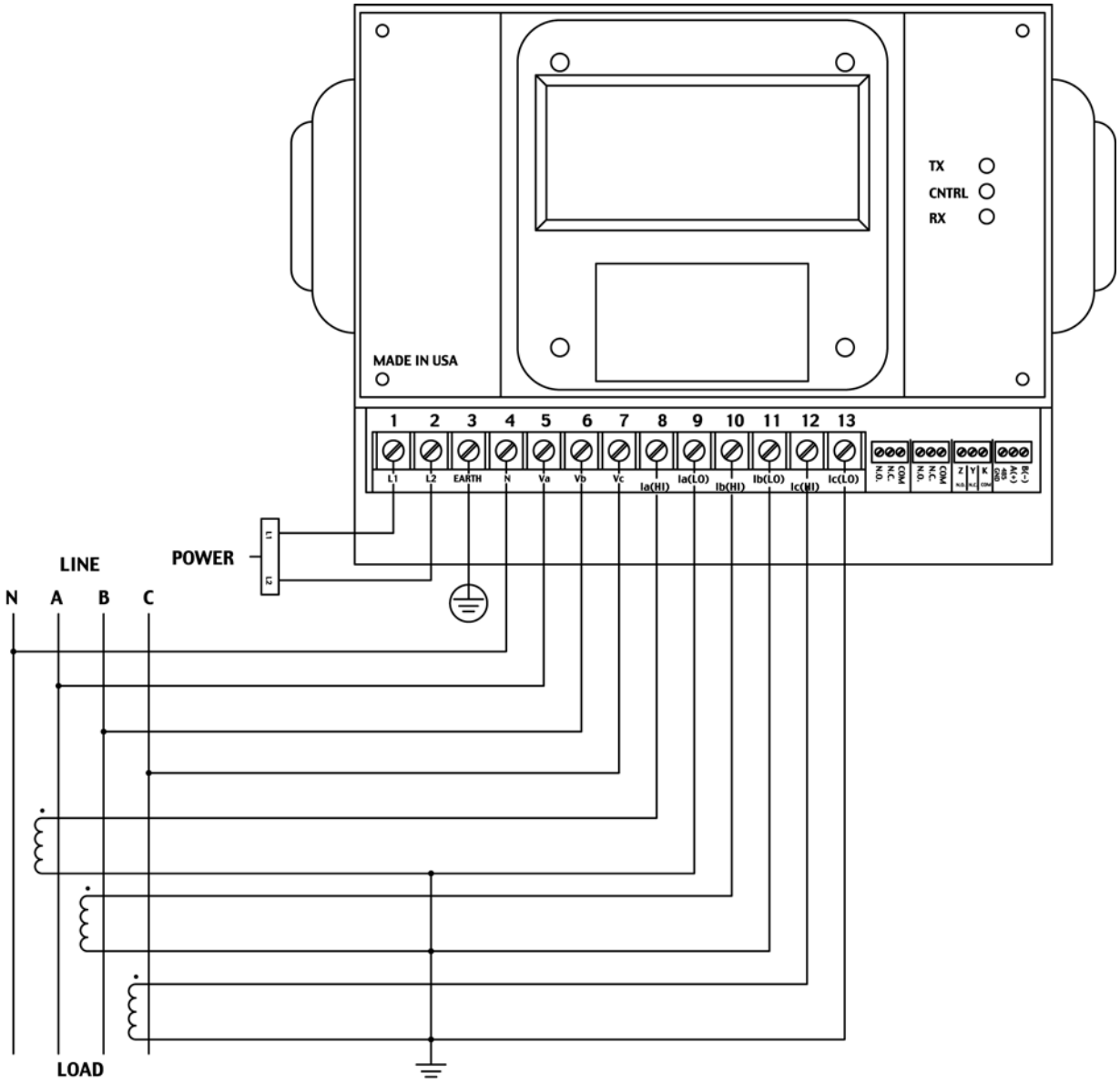
I. Three Phase, Three-Wire System Delta with Direct Voltage and three CTs.



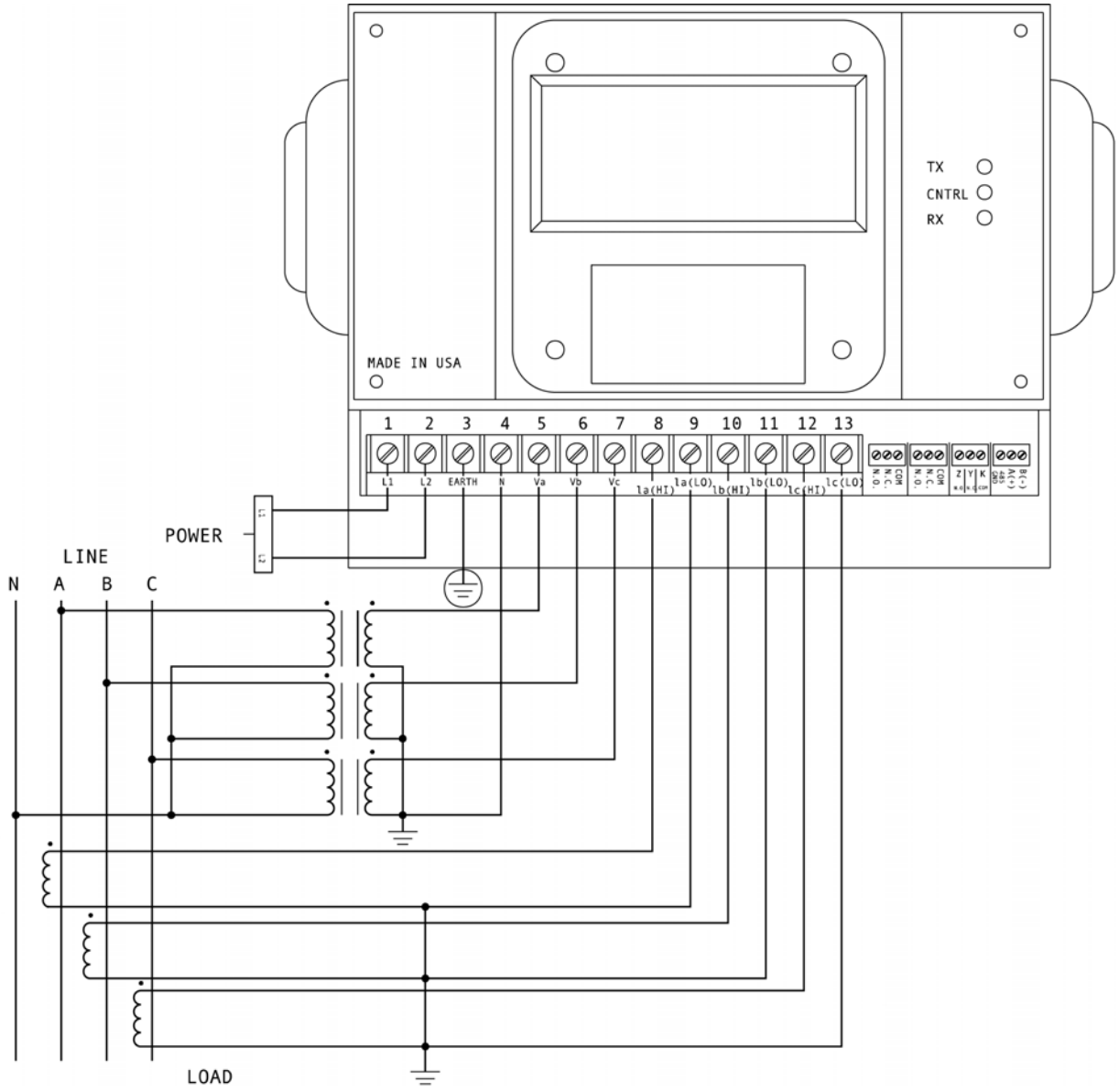
II. Three-Phase, Three-Wire Open Delta with two CTs and two PTs.



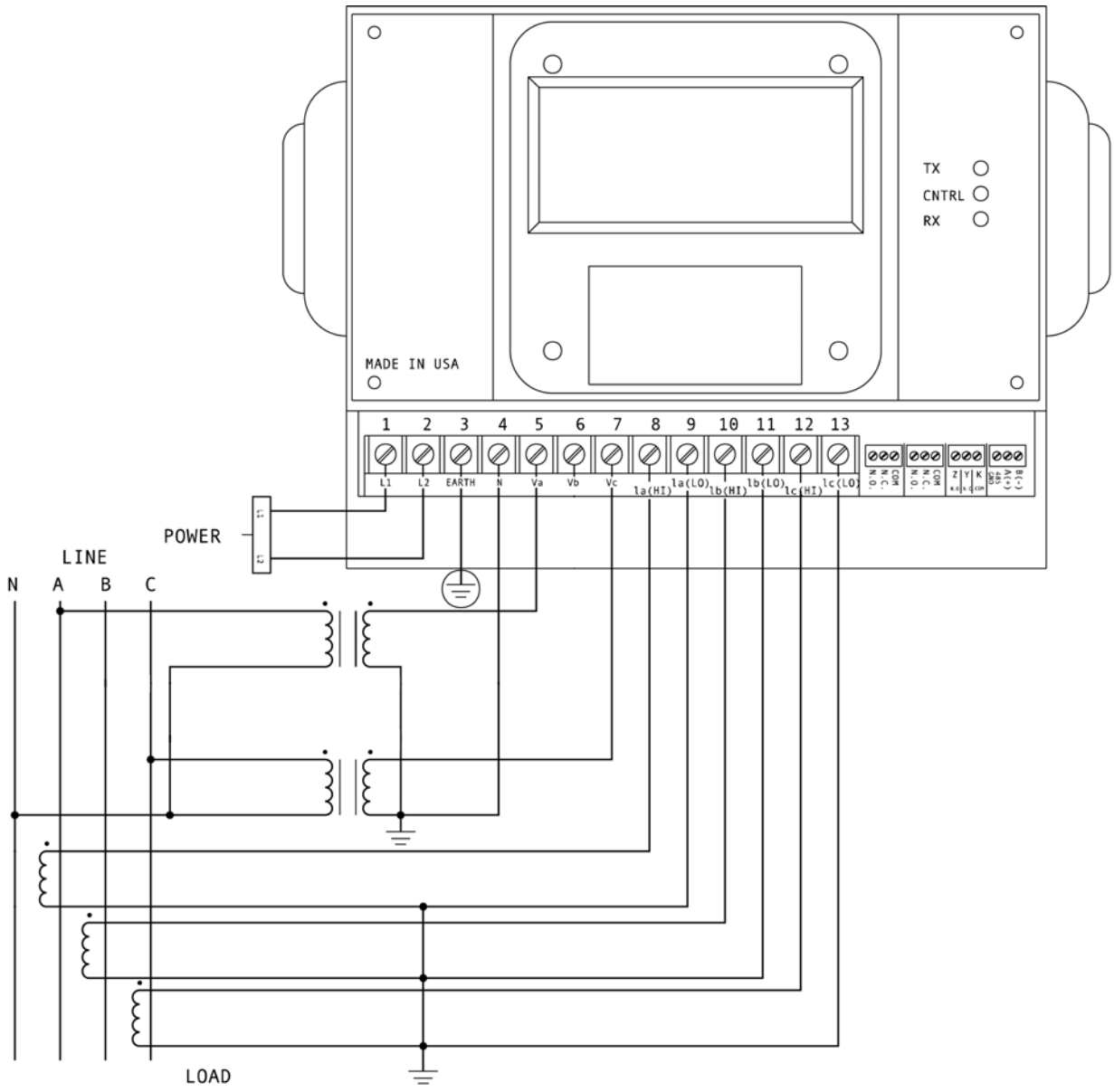
III. Three-Phase, Three-Wire Open Delta with three CTs and two PTs.



IV. Three-Phase, Four-Wire System Wye with Direct Voltage and three CTs.



V. Three-Phase, Four-Wire System Wye with three CTs and three PTs.



VI. Three-Phase, Four-Wire System Wye 2.5 Element with three CTs and two PTs.
For this installation, SBM300-2.5E (Only) must be specified when ordering.

3.7 RELAYS, PROTECTION AND PULSE OUTPUT

This section is applicable only if the -NL Relay Option was ordered.

The SBM 300 accesses a variety of relay options through the Programming Mode. The relay option package consists of two relays with two contacts. One is normally open and one is normally closed (either to alarm or communication, or both), and one is KYZ pulse output.

TIME DELAY: Sets the alarm off, alerting the user an out-of-limit condition occurred over the user-defined time limit. The time delay can be programmed for any desirable duration.

If the relays are dedicated to communication, there are two different modes:

- Lock ON Relay will not be affected by any alarm condition.
- Lock OFF Relay will not be affected by any alarm condition.

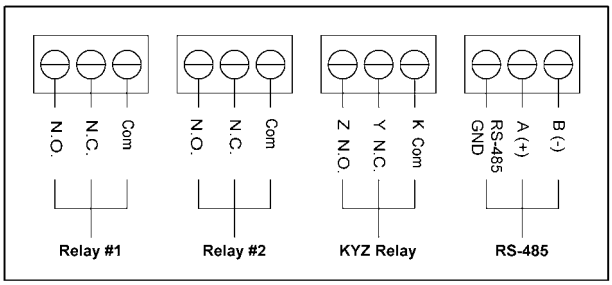
If the relays are used for communication and alarm, there are four different modes:

- Lock ON Relay stays on regardless of any alarm condition.
- Lock OFF Relay stays off regardless of any alarm condition.
- Free ON Relay turns on unless other conditions force it off.
- Free OFF Relay turns off unless other conditions force it on.

Relay connection (See **Figure 3.1**).

Form C relays, rated 250V, 5A, 2 each.

Figure 3.1
Close-up of the relays and KYZ pulse output on the rear panel. The relays shown are in the NOT energized state.



The SBM 300 can be programmed to detect two alarm levels for Over and Reverse Power.

KYZ RELAYS: Provides pulses for energy management systems or any other type of recording device. These pulses represent accumulated positive watt-hour, or negative watt-hour. Accomplish this assignment through Programming Mode. The pulse value is determined by the decimal increment of the power function assigned to the pulse.

kW Meter The scale factor for wattage (selectable in Programming Mode Group 0, Function 3, Pack 1) is set on kW. Follow the Decimal Point Placement corresponding to the Change in Level.

DECIMAL POINT PLACEMENT (KW)	CHANGE IN LEVEL
9999.	1 kW Per Pulse
999.9	0.1 kW Per Pulse
99.99	0.01 kW Per Pulse
9.999	0.001 kW Per Pulse

MW Meter The scale factor for wattage (selectable in Programming Mode Group 0, Function 3, Pack 1) is set on MW. Follow the Decimal Point Placement corresponding to the Change in Level.

DECIMAL POINT PLACEMENT (MW)	CHANGE IN LEVEL
9999.	1 MW Per Pulse
999.9	0.1 MW Per Pulse
99.99	0.01 MW Per Pulse
9.999	0.001 MW Per Pulse

CHAPTER 4
COMMUNICATION INSTALLATION

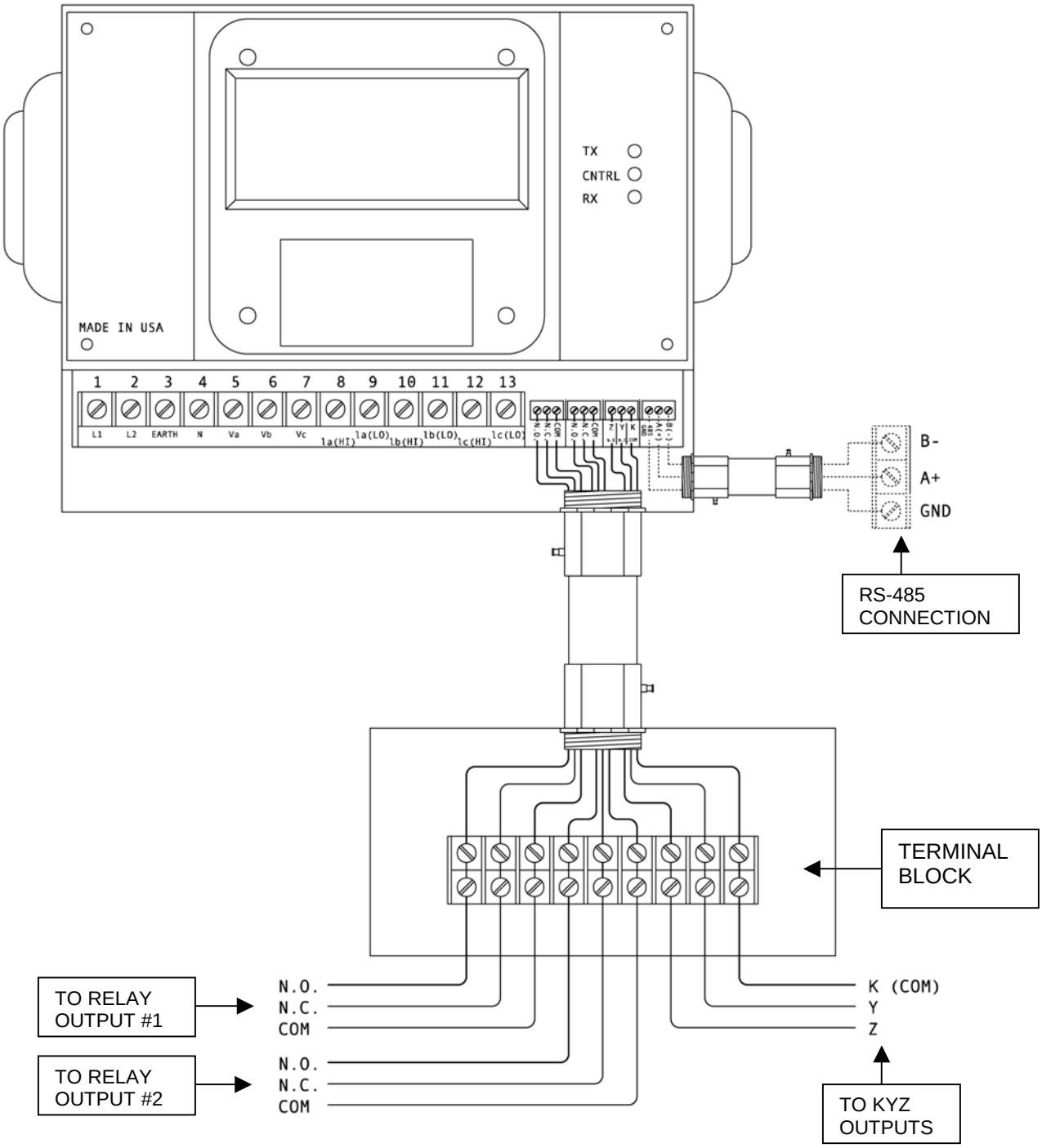
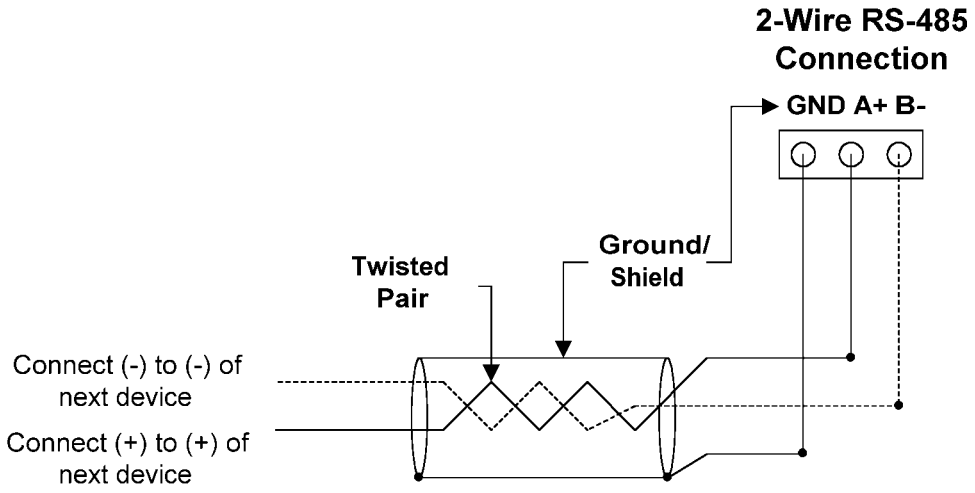


Figure 4.1 Wiring Diagram of SBM 300
RS-485 Communication and Relay Output Installation.

Figure 4.2 RS-485 Communication Connection



4.1 RS-485

Each SBM 300 instrument has an unique address up to four digits. Available standard baud rates are available up to 4800 baud. To select the proper baud rate, apply the following rules:

For a smaller number of instruments over a long distance, use a lower baud rate. Optimal recommended baud rate is 1200 baud.

RS-485 parallels multiple instruments on the same link. Its operating capability is up to 4000 feet.
When using only 2 wires (on the RS-485), the link can include up to 30 instruments.

4.2 NETWORK OF INSTRUMENTS AND LONG DISTANCE COMMUNICATION

Use modems (dedicated or dial-up) when the instruments are located at great distances. However, set the modem to auto answer at the recommended value of 1200 baud rate, if noise conditions exist. Also, flow control must be disabled.

I. MODEM CONNECTED TO COMPUTER (ORIGINATE MODEM)

PROGRAMMING THE MODEM

Comply with the modem's instruction manual and follow these instructions:

RESTORE MODEM TO FACTORY SETTINGS:
- Erases all previously programmed settings.

SET MODEM TO DISPLAY RESULT CODES:
- The device uses the result codes.

SET MODEM TO VERBAL RESULT CODE:
- The device uses the verbal codes.

SET MODEM TO IGNORE DTR SIGNAL:
- Necessary for the device to ensure connection with originate modem.

SET MODEM TO DISABLE FLOW CONTROL:
- Necessary to communicate with remote modem connected to device.

TELL MODEM TO WRITE THE NEW SETTINGS TO ACTIVATE PROFILE:
- Places these settings into nonvolatile memory; the settings take effect after the modem powers up.

II. MODEM CONNECTED TO THE DEVICE (REMOTE MODEM)

PROGRAMMING THE MODEM

Comply with the modem's instruction manual and follow these instructions:

RESTORE MODEM TO FACTORY SETTINGS:
- Erases all previously programmed settings.

SET MODEM TO AUTO ANSWER ON **N** RINGS:
- Sets the remote modem to answer the call after **N** rings.

SET THE MODEM TO AUTO NEGOTIATE MODE:
- Sets the remote to auto-negotiate to communicate successfully with the Futura+ Series and other devices in the modem.

SET MODEM TO RETURN NUMERIC RESULT CODES:
- Increases speed connection with the Futura+ Series.

SET MODEM TO IGNORE DTR SIGNAL:
- Necessary for device to ensure connection with originate modem.

SET MODEM TO DISABLE FLOW CONTROL:
- Necessary to communicate with remote modem connected to the Futura+ Series

TELL THE MODEM TO WRITE THE NEW SETTINGS TO ACTIVATE PROFILE:
Places new settings into nonvolatile memory; settings take effect after the modem powers up.

CHAPTER 5
SBM 300 OVERVIEW

The SBM 300 displays 17 instantaneous electrical parameters. Values for each parameter are accessed through the keypad on the meter's front panel (see **Figure 5.1**).

VOLTS	AMPS	POWER A, B, C
A-N	A	± KW
B-N	B	± KVAR
C-N	C	KVA
A-B	N	± PF
B-C		FREQ
C-A		± TOTAL KWH

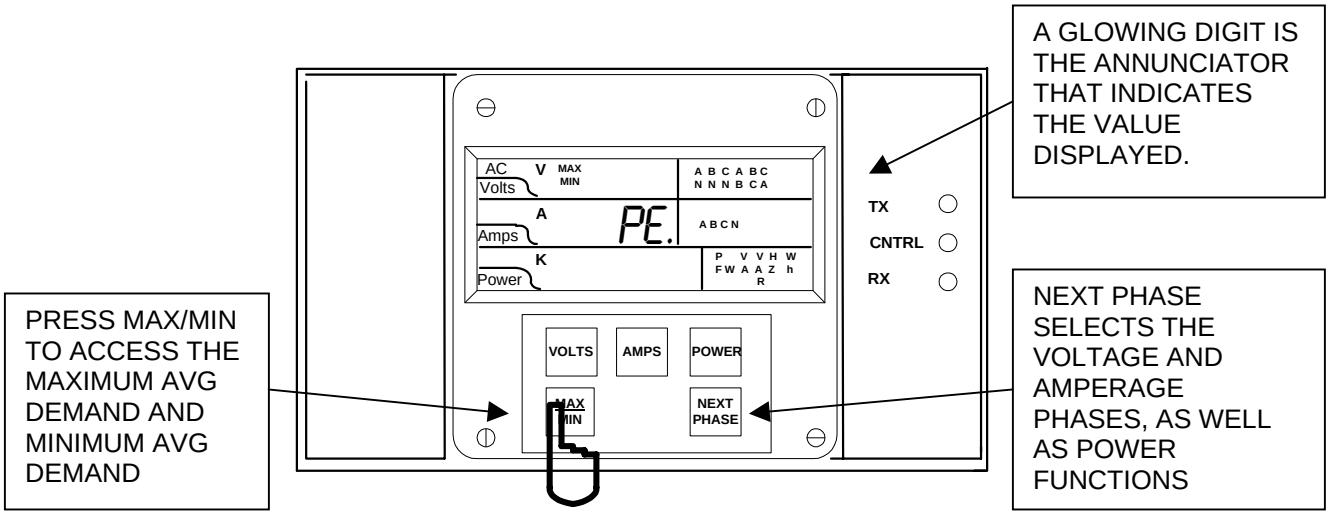


Figure 5.1: The SBM 300 front panel with display and keypad

NOTE: The actual digit, or group of digits, is the annunciator on the face of the SBM 300.

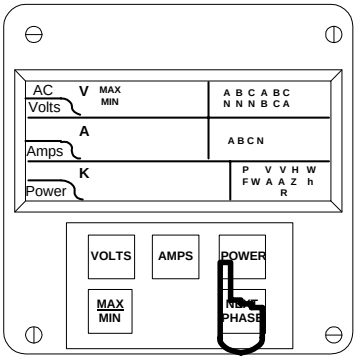
5.1: The SBM 300 Meter System

The SBM 300 provides revenue grade energy and power readings (like the SBM 100). And, it also includes all phase voltage and current readings. It features open Modbus communication to simplify integration. It fits easily on any surface to minimize installation problems. The digital interface is easy to use; there are no complex menus to learn. This meter is ideal for submetering, energy management and branch circuit monitoring.

5.2: Product Features

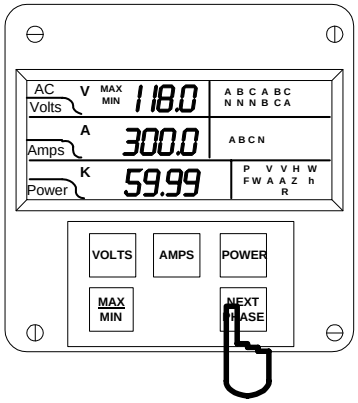
- True RMS measurements of over 80 electrical parameters including voltage, current, power (Watts, VARs, VA), bidirectional energy, power factor, frequency and demand.
- Max/Min for each voltage, current and power value.
- ANSI C-12 revenue metering accuracy.
- Three programmable KYZ pulse output channels.
- Extremely long life, bright LED display.
- Digital Communication (RS-485) with Modbus RTU protocol.
- Surface mount design for easy installation.
- Designed for harsh temperature conditions (–20 to +70)°C.
- Dimensions: 8.375”W x 7.125”H x 4.25”D.

5.3: Accessing the Power Functions



Step 1:
a. Press ***POWER*** to select the power category.

⇨The display blanks and all annunciators in the power section glow, confirming selection.



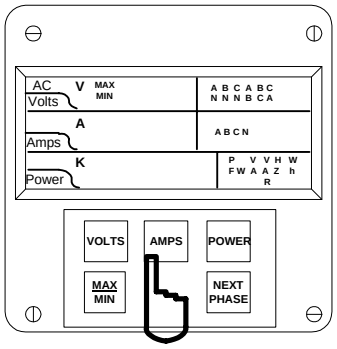
Step 2:
a. Press ***NEXT PHASE*** for the desired power function.

⇨The functions are accessed in a clockwise sequence.

Note: ***For KWH readings: The first digit on the left of the KWH counter will blank out on the display when rollover at 199999 KWH occurs. The actual value of the first digit can only be viewed through digital communications. Or, reset the KWH counter to zero to avoid confusion.***

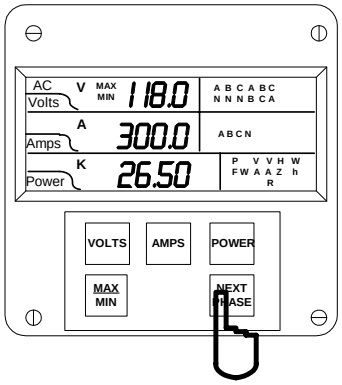
5.4: Accessing Voltage and Current Phases

The SBM 300 displays four current measurements (phases A, B, C, and Neutral) and six voltage measurements (phase-to-phase: A-B, B-C, C-A and phase-to-neutral: A-N, B-N, C-N).



Step 1:
a. To select the Amps (or Volts) category, press ***AMPS*** (or ***VOLTS***).

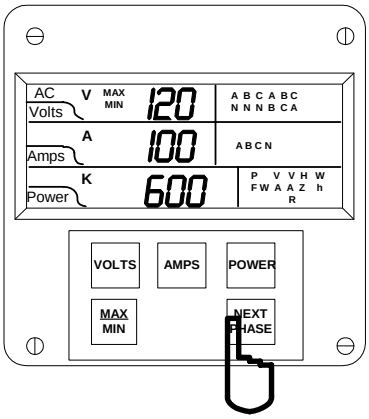
⇨ The display blanks and all annunciators in the section glow, confirming selection.



Step 2:
a. Press ***NEXT PHASE*** for the desired phase.

5.5: Viewing Individual Phase Indication for Power Functions

The SBM 300 normally displays a three-phase indication for PF, KW, KVAR and KVA readings. To view the individual phase A, B and C for those power functions follow the procedure below. This procedure is particularly useful for detecting a current transformer (CT) polarity reversal. A CT polarity reversal will result in a low or negative KW indication, while the KVA will be unaffected.

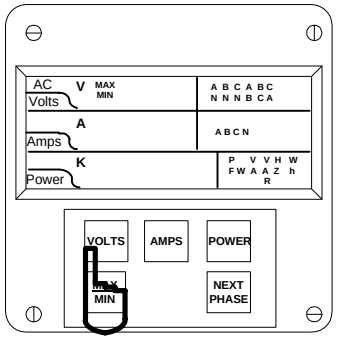


Step 1:
a. Press ***POWER*** to select power readings. Press ***NEXT PHASE*** to select a specific power function (PF, KW, KVAR, KVA).

5.6: Accessing Max/Min Values

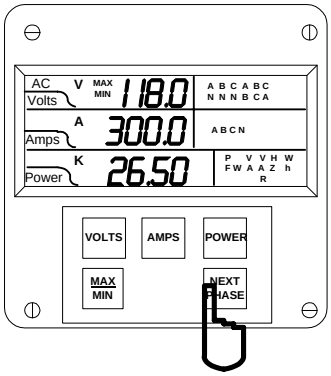
Max/min values represent the highest and lowest average demand over a user programmable time period known as the **Integration Interval**. The readings are calculated using a rolling average technique. Each second, a new reading is used to calculate the max/min; the last reading of the interval is dropped off. The highest max during an averaging period is stored until the user resets the max/min. This is similar to amp demand meters. It is commonly referred to as Thermal Demand.

To access a max/min value while displaying a desired measurement, press ***MAX/MIN***—once for the max value; twice for the min. Examples given below are for voltage and current phases. Use the same procedure for all other parameters.

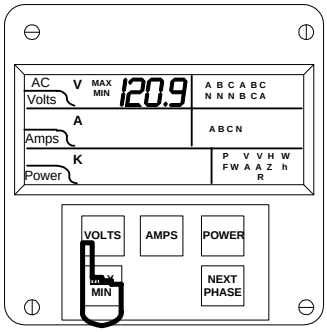


Step 1:
a. To select the Volts category, press ***VOLTS***.

⇨ The display blanks and all annunciators glow, confirming selection.



Step 2:
a. Press ***NEXT PHASE*** for the desired phase.



Step 3:
a. Press ***MAX/MIN*** once to view the maximum reading for Volts B-N.

⇨ The display blanks and momentarily indicates the max value.

To access KW, KVAR and PF negative measurements indicating leading current, press ***MAX/MIN*** five times for negative max and six times for negative min.

5.7: Resetting Values

Use the reset function if a new value is desired. It is available in two different modes.

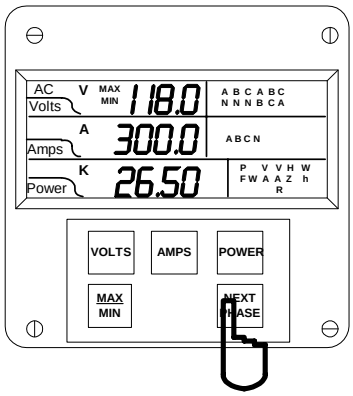
1.**UNPROTECTED MODE**: Allows quick and easy resetting of max/min values.

2.**PROTECTED MODE**: Prevents unauthorized resetting the max/min and totaled power functions.

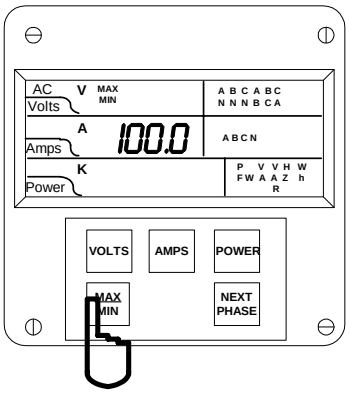
Note: Even if the unprotected mode is selected during programming, the KWH and negative KWH are always in protected mode. The following examples are for the max/min.

UNPROTECTED RESET

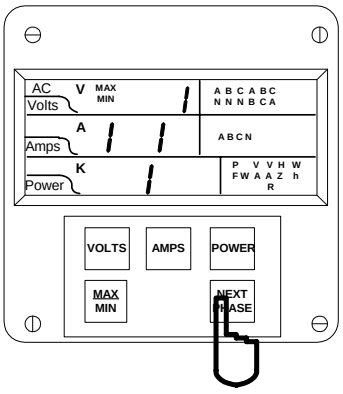
To reset the min of Amps A:



Step 1:
a. If not already in the Amps category press ***AMPS***, then ***NEXT PHASE*** until desired phase is indicated.



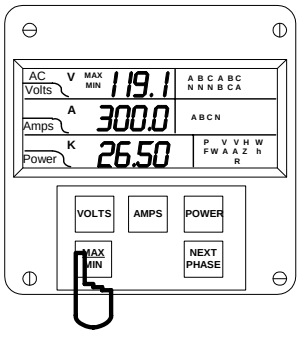
Step 2:
a. Press ***MAX/MIN*** twice to access the min value for Amps A.



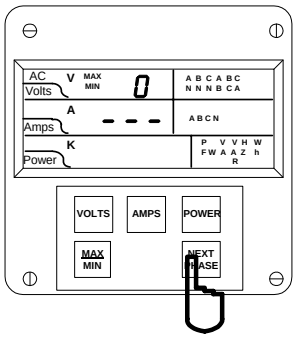
Step 3:
a. While the min value is displayed, press ***NEXT PHASE*** to reset it.

⇨The display blanks; a large checkmark appears confirming reset.
⇨Repeat this procedure for each value you wish to reset.

PROTECTED RESET

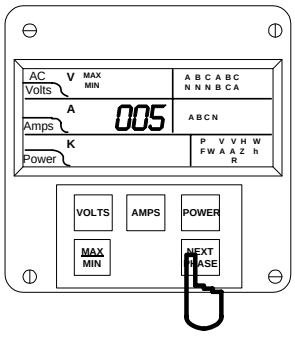


Step 1:
a. Press ***MAX/MIN*** once to access max value; twice to access min value.

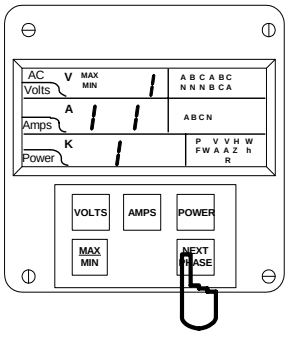


Step 2:
a. While the value is display, press ***NEXT PHASE*** to commence protected reset.

⇨The display blanks, three dashes appear in middle display and digits begin scrolling in upper display.
⇨ The password is ***005***.

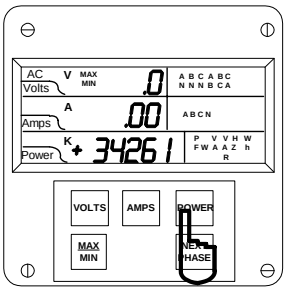


Step 3:
a. Press ***NEXT PHASE*** each time a password digit appears.



⇨ When the correct password is entered, a large checkmark appears, confirming reset.

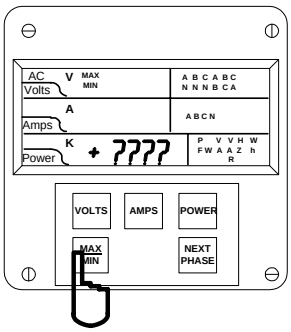
5.8: Resetting Hour Readings



Step 1:
a. Press ***POWER*** once.

b. Press ***NEXT PHASE*** for the desired hour function.

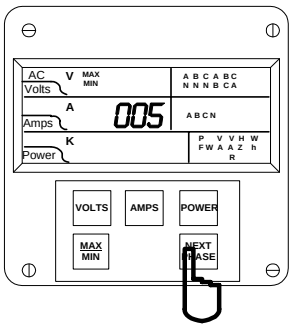
⇨This example uses KWH function.



Step 2:
a. Press ***MAX/MIN***

- once for positive hour reset
- three times for negative hour reset.

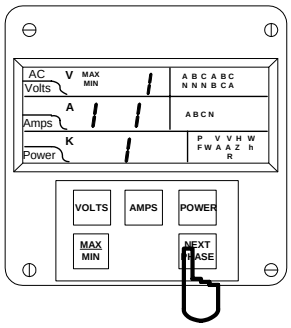
⇨ Four question marks appear in lower display.



Step 3:
a. While the question marks are displayed, press ***NEXT PHASE***. A password entry is now required.

⇨The password is ***005***.

b. Press ***NEXT PHASE*** each time a password digit appears.



⇨ A large checkmark appears, indicating a successful reset.

5.9: Access Modes

The following access commands allow the user to perform specific operations.

ACCESS COMMANDS	OPERATION
1	Print Operating Data
2	Print Programming Data
3	Enter Programming Mode (see Programming Section)
4	Firmware Version/LED Test

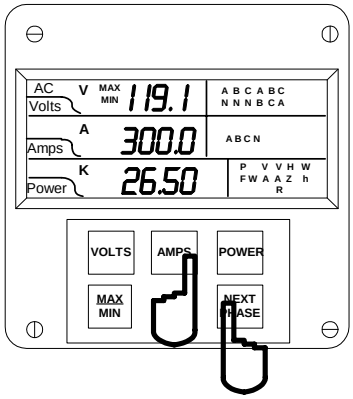
Note**: **Print commands 1 and 2 are only available if enabled in the programming mode; they are not recommended when using the multimeter connection RS-485.

5.10: Print Operating Data

This function sends data to a serial printer, creating a hard copy of the instantaneous and max/min data of all functions and the WH, VAH and WH counters.

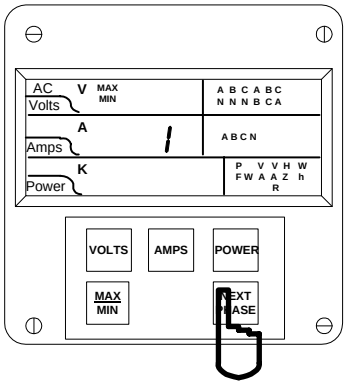
Note: This function applies only if a serial printer is connected to the SBM 300 via an RS-232C Communication Converter.

To print the operating data:



Step 1:

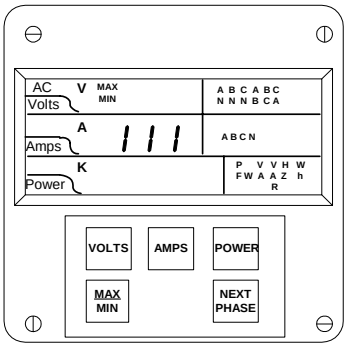
a. Press and hold ***NEXT PHASE***.
b. Press ***AMPS*** until a **0** appears in the middle display.
c. Release both buttons.



Step 2:

a. Press ***AMPS*** until a **1** appears.

b. Press ***PHASE/ NEXT*** to select.

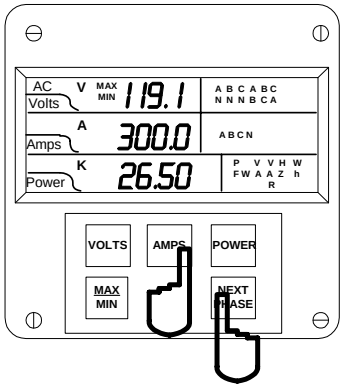


⇨ ***111*** appears, confirming a successful print command.

5.11: Print Programming Data

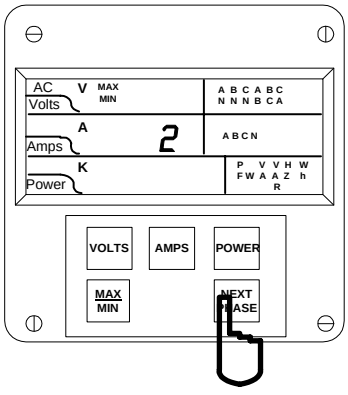
This function sends the programming data (or the meter setup) to a serial printer for verification and quick reference.

To print the programming data:



Step 1:

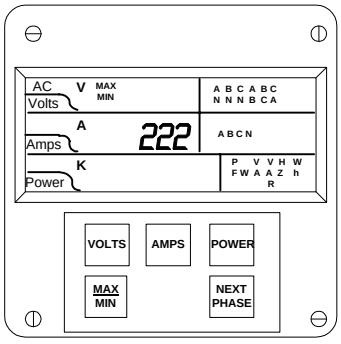
a. Press and hold ***NEXT PHASE***.
b. Press ***AMPS*** until a **0** appears in the middle display.
c. Release both buttons.



Step 2:

⇨ The display blanks.

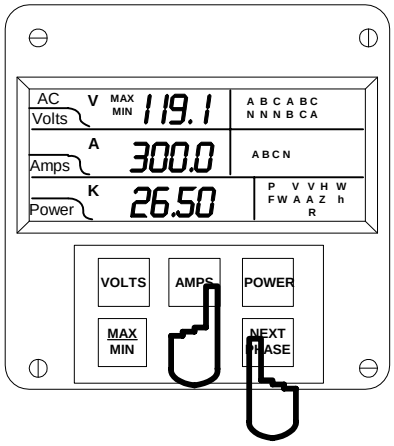
a. Press ***AMPS*** until a **2** appears.
b. Press ***NEXT PHASE*** to select.



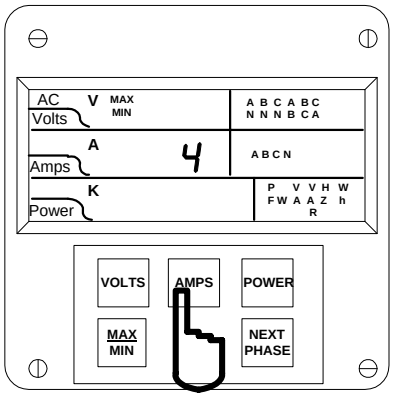
⇨ ***222*** appears, confirming a successful print command.

5.12: Accessing Firmware Version/LED Test

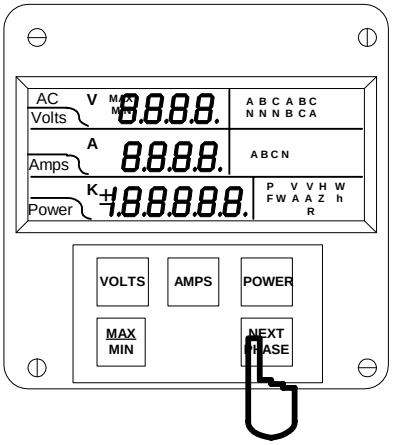
The SBM 300 accesses the firmware version number of the analog and digital microprocessors. It also performs an LED test to check if the LEDs and annunciators are functioning properly.



Step 1:
a. Press and hold ***NEXT PHASE***.
b. Press ***AMPS*** until a **0** appears in the middle display.
c. Release both buttons

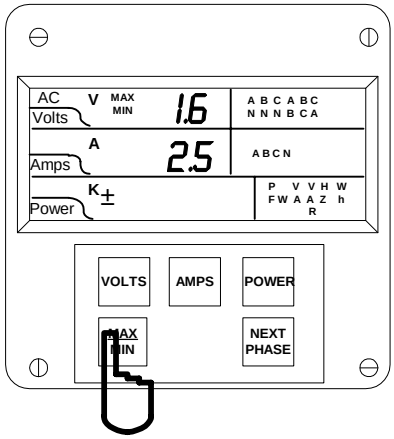


Step 2:
a. Press ***AMPS*** until ***4*** appears.



Step 3:
a. Press ***NEXT PHASE*** for the LED test.

⇨ All segments and annunciators glow.



Step 4:
a. Follow Steps 1 and 2, then press ***MAX/MIN*** for the firmware versions.

Firmware versions:
- Upper display—analog processor version
- Middle display—digital processor

CHAPTER 6
PROGRAMMING OVERVIEW

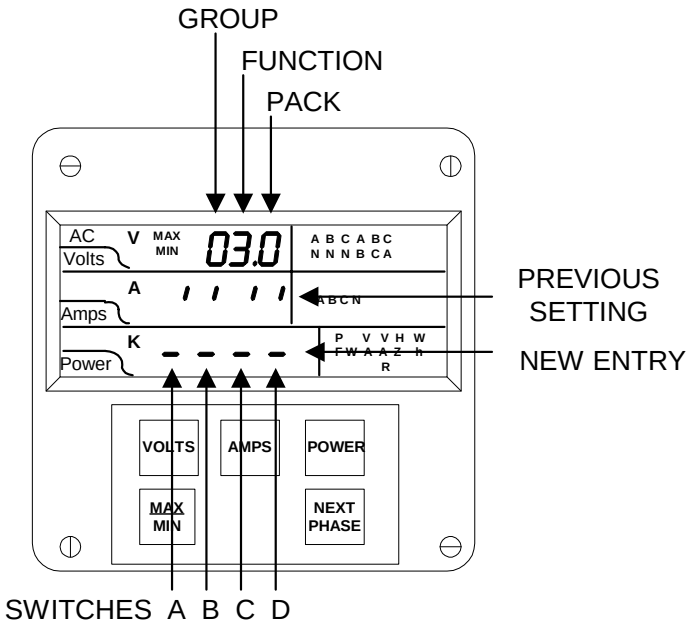
6:1: General Procedure

Programming tasks are arranged into nine major GROUPS. Within each GROUP are the specific meter FUNCTIONS. Outlined is the general approach to alter programming mode values.

1. Enter the Programming Mode.
2. Select the desired GROUP.
3. Once the desired GROUP is selected, select a FUNCTION within the GROUP. For GROUP 0, some functions are further divided into PACKS containing four switches referred to as switches A, B, C and D (left to right).
4. After the FUNCTION selection, proceed with DATA ENTRY of the new value for the desired parameter.
5. Proceed to program another location and/or exit the programming mode.

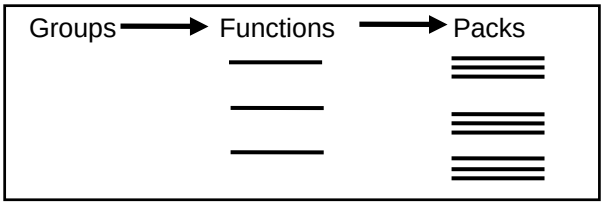
IMPORTANT: The full exiting procedure must be followed to store any new programming.

6.2: Switch Packs



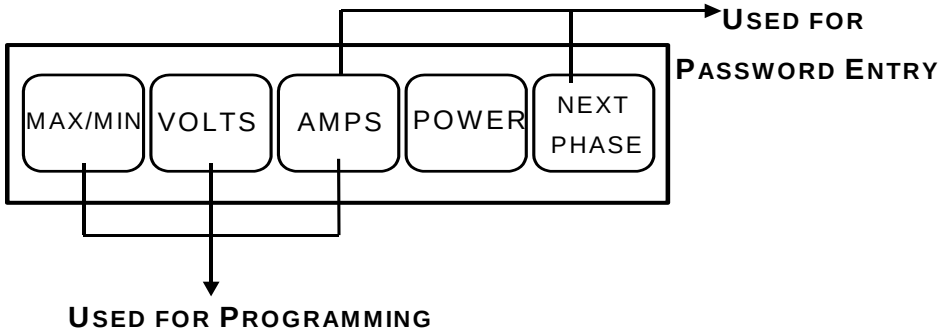
GROUPS, Functions, and Switch PACKS

- GROUPS are the main category.
- Functions are sub categories of GROUPS.
- Switch PACKS are sub categories of FUNCTIONS.



6.3: Programming Mode Data Entry

The SBM 300 programming mode utilizes only three out of the five-keypad buttons: the ***MAX/MIN***, ***VOLTS*** and ***AMPS*** buttons.



BUTTON	FUNCTION	DESCRIPTION
MAX/MIN	ADVANCES	Scrolls GROUPS, FUNCTIONS and advances to exit point from FUNCTION and GROUP level.
VOLTS	CHANGES VALUE	Scrolls PACKS, digit counters and changes switch PACK position UP or DOWN.
AMPS	STORES	Activates new data entry and enters or exits from GROUP or FUNCTION level.

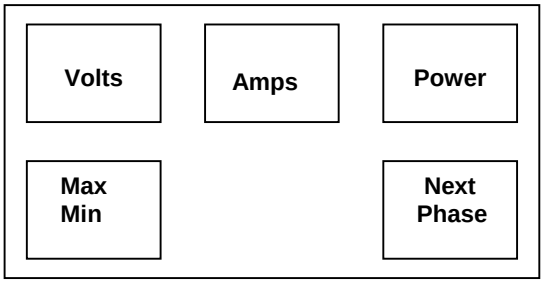
6.4: Standard Numeric Data Entry

Programmable FUNCTION values are always four digit numerical fields designed to accept any value between 0000 and 9999 (a blank signifies a zero). When entering the value of a FUNCTION, enter all four digits, leading zeros included. For instance, to enter the number 25, enter 0025.

CHAPTER 7
SBM 300

The SBM 300 is similar to the regular DMMS 300+-H with the following exceptions:

1. The size of the display digits is smaller (0.300" instead of 0.560").
2. The following features are not available:
   - The energy readings: VA/H, VAR/H.
   - The limits: Lim1 and Lim2 and dry contact relay outputs.
   - The harmonics readings: %THD and K-factor.
3. The layout of the keypad is slightly different (although the keys have exactly the same functions).



The Keypad

4. The unit's legend values are jumper-selectable: the user, if necessary, needs to open the cover and choose between V and KV, A and KA, Kilo (k) and Mega (M) for power relays.
5. The annunciators are the values themselves and are highlighted one at a time.
6. The SBM 300 is the same as the DMMS 425 but is manufactured in its convenient mounting case and wiring can be done through the front panel.

NOTE: An Ethernet model, **DMMS 350**, with similar features, but without the mounting case, is also available. See p. 32 for a comparison of the three similar models.

DMMS 300+-H vs. SBM 300 vs. DMMS 350

Feature	DMMS 300+-H	SBM 300	DMMS 350
Voltage 3-Phase	✔	✔	✔
Voltage Accuracy	0.2%	0.3%	0.2%
Current 3-Phase and Neutral	✔	✔	✔
Current Accuracy	0.2%	0.3%	0.2%
Watts, VARS, VA, PF	✔	✔	✔
Watts Accuracy	0.4%	0.6%	0.4%
Frequency	✔	✔	✔
Watt/HR	✔	✔	✔
VAR/HR (Optional)	✔		✔
VA/HR	✔		✔
Harmonics to 31st Order	✔		✔
Feature	**DMMS 300+-H**	**SBM 300**	**DMMS 350**
Max/Min Demand	✔	✔	✔
Limits	✔		✔
Relays and Logic	✔		✔
Pulse Outputs	✔	✔	✔
Digital Communication	✔	✔	✔
Modbus RTU	✔	✔	
Modbus ASCII	✔	✔	
Analog Outputs	✔		
Modbus TCP			✔
Ethernet			✔

CHAPTER 8
ENTERING PROGRAMMING MODE

8.1: Checksum Error—Protective Self-Checking Algorithms

This checksum error is a protective self-checking wealth algorithm designed to alert the user when a procedure has not been correctly followed, ensuring that the meter does not display inaccurate readings.

If the control power is interrupted while in Programming Mode or the user does not completely exit, the meter enters a checksum mode. The max LED flashes. Press ***AMPS*** and ***NEXT PHASE*** simultaneously and the unit recovers. Follow the procedure to enter Programming Mode to check program data. If the data is correct, then exit.

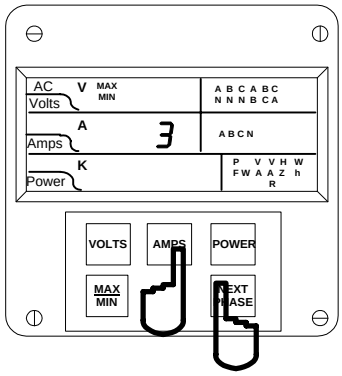
8.2: Password Entry

The SBM 300 is password protected. To enter the Programming Mode, key in the following password: ***555***.

The password entry may seem awkward at first. It is designed to be difficult to use initially. This secures unauthorized tampering. After you become familiar with password entry, you will find it quick and easy to accomplish.

NOTE*: The meter will not store any programming unless properly exited (see Chapter 12 to Exit).*

Entering Programming Mode:



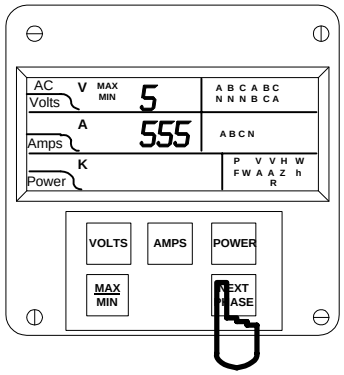
Step 1:
a. Press and hold ***NEXT PHASE***.

b. While holding ***NEXT PHASE***, press ***AMPS*** until a number appears in middle display. Then **release *NEXT PHASE***.

c. Continue to press ***AMPS*** until ***3*** appears.

d. Press ***NEXT PHASE*** to multiply the ***3*** to ***333***.

⇨ ***333*** flashes momentarily in middle display.

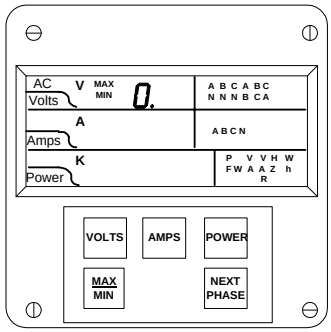


Step 2:
⇨ Digits begin scrolling in upper display.

⌦ The password is **555**.

a. Press ***NEXT PHASE*** each time the digit **5** appears.

⇨ Selected digits appear in middle display.



⇨ Display blanks and ***PPP*** flashes in upper display, confirming a correctly entered password.

⇨ ***PPP*** is replaced by ***0.*** and the meter is now in Programming Mode, GROUP 0.

⇨ You are now in the Programming Mode. CONGRATULATIONS!

***NOTE: AUTO SCROLLING** will automatically show all of the readings on the face of the meter except LIMITS. To **enter Auto Scrolling mode**, follow the above steps except use the numbers **666** as the password. To **exit Auto Scrolling mode**, use the same procedure as described above.*

CHAPTER 9
PROGRAMMING GROUP 0 – GLOBAL METER SETUP

The Global Meter Setup includes FUNCTIONS 0 through 7 that control configuration and basic operation. FUNCTION *3* System Configuration contains Switch PACKS with various options, including Open Delta installation, communications or DC Output setup. Global Meter Setup is the section in which general features are programmed.

FUNCTION NUMBER	Function
0.	Integration Interval
1.	Meter Address for Communication
2.	Baud Rate for Communication
3.	System Configuration (see Table 9-2)
4.	Relay 1 Set-up / Time delay
5.	Relay 2 Set-up / Time delay
6.	KYZ Parameter Selection
7.	Number of Phases
E.	Exit Programming GROUP 0

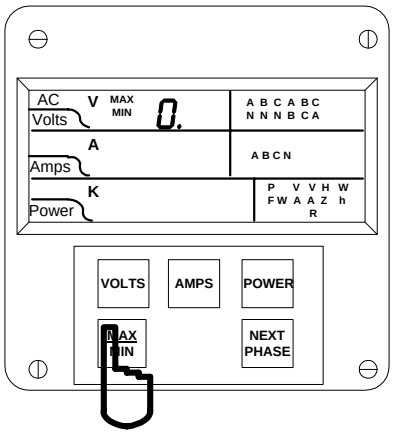
Table 9-1: Group 0 Programming Format

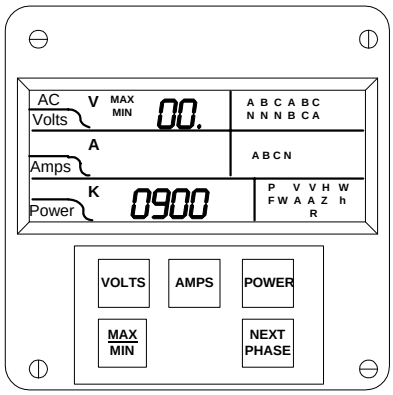
9.1: Group 0, Function 0—The Integration Interval

INTEGRATION INTERVAL: A space in time in which all instantaneous readings are averaged to obtain a max and min demand. The Integration Interval is entered in seconds. When entering 15 minutes, enter: 0900 seconds. The default value is 900 seconds.

To change the Integration Interval:

NOTE: *Press* ***MAX/MIN*** *at any time to cancel before storing the last digit or switch.*





Step 1:

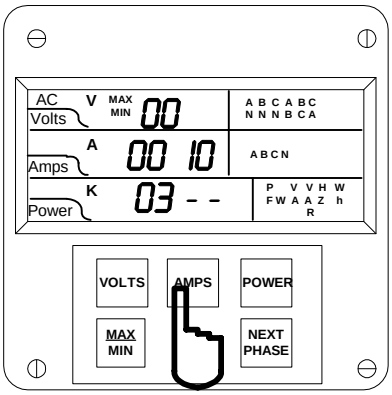
a. Enter Group Level of Programming Mode (see Chp. 8).

⇨ Function ***00.*** appears in upper display. The second ***0*** indicates Function 0

b. Press ***MAX/MIN*** until ***0.*** appears in upper display.

⇨ Lower display indicates current Interval setting.

c. Press ***AMPS*** to activate the Group.



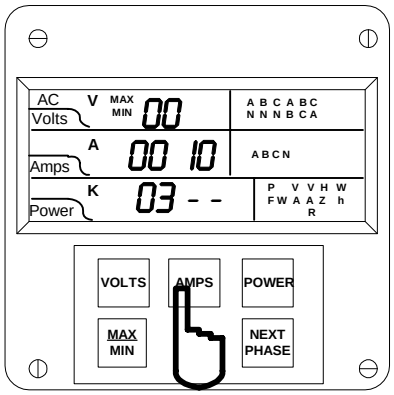
Step 2:

a. Press ***AMPS*** once to begin Data Entry Sequence.

⇨The previous value shifts to middle display and four dashes appear in lower display.

b. Press ***VOLTS*** for desired number.

c. Press ***AMPS*** to store.



⇨Repeat this procedure until new Integration Interval is entered.

d. Press ***AMPS*** to save.

⇨ When complete, middle display blanks and lower display indicates new Integration Interval.

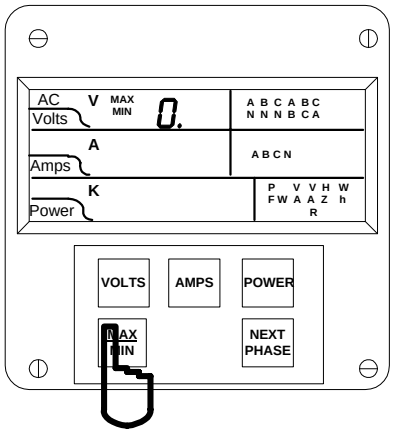
See Chapter 12 to Exit.

9.2: Group 0, Function 1—The Meter Address

METER ADDRESS: Identifies the meter when communicating with digital communications. When numerous meters are at one site, it is essential that each meter have its own address. Otherwise, all meters speak at the same time and communication is useless.

To change the Meter Address:

NOTE: *Press* ***MAX/MIN*** *at any time to cancel before storing the last digit or switch.*

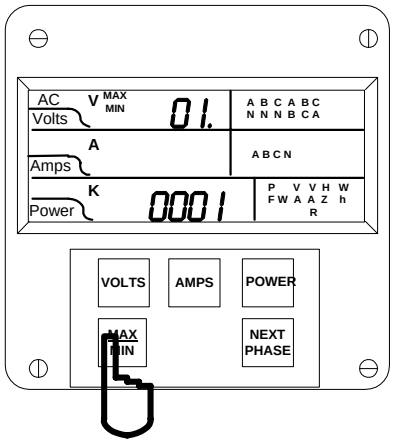


Step 1:

a. Enter Group Level of Programming Mode (see Chp. 8).

b. Press ***MAX/MIN*** until ***0.*** appears.

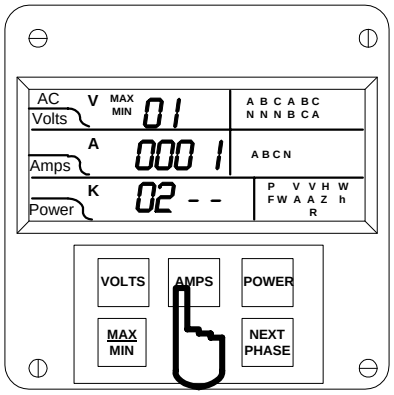
c. Press ***AMPS*** to activate the Group.



Step 2:

a. Press ***MAX/MIN*** until Function ***01.*** appears in upper display.

⇨ Lower display indicates the current Meter Address.



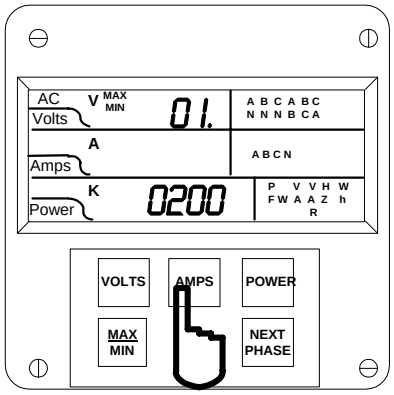
Step 3:

a. Press ***AMPS*** once to begin Data Entry Sequence.

⇨ The previous value shifts to middle display and four dashes appear in lower display.

b. Press ***VOLTS*** for desired number.

c. Press ***AMPS*** to store each digit.



⇨ Repeat this procedure until new Address is entered.

⇨ When complete, middle display blanks and lower display indicates new Address.

d. Press ***AMPS*** to save.

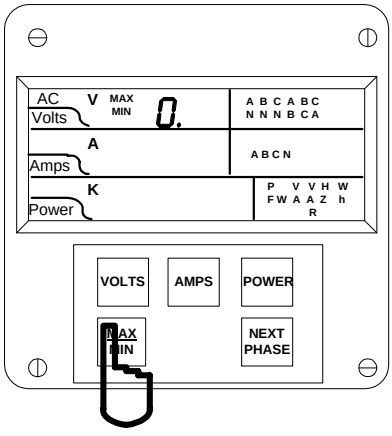
See Chapter 12 to Exit.

9.3: Group 0, Function *2*—BAUD RATE

BAUD RATE: Speed at which data is transmitted between meter and remote computer or serial printer. The rate programmed into the meter must match the rate used by the remote device. Valid Baud Rates are 1200, 2400, 4800 and 9600.

To change the Baud Rate:

NOTE: *Press* ***MAX/MIN*** *at any time to cancel before storing the last digit or switch.*

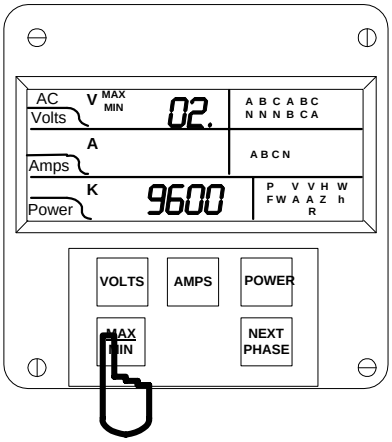


Step 1:

a. Enter Group Level of Programming Mode (see Chp. 8).

b. Press ***MAX/MIN*** until ***0.*** appears.

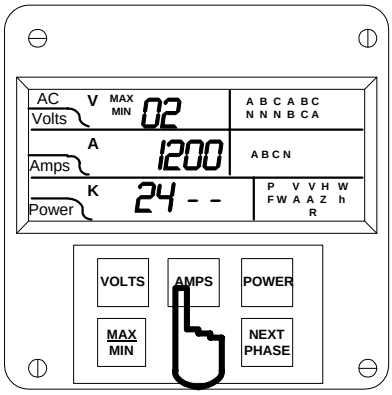
c. Press ***AMPS*** to activate the Group.

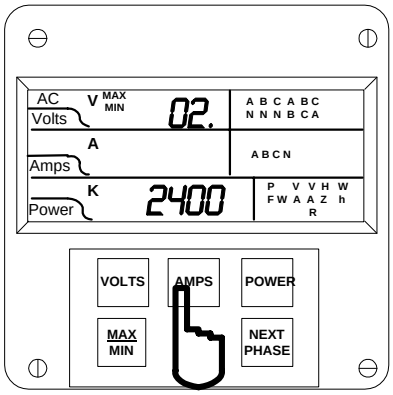


Step 2:

a. Press ***MAX/MIN*** until Function ***02.*** appears in upper display.

⇨ Lower display indicates current Baud Rate.





Step 3:

a. Press ***AMPS*** to begin Data Entry Sequence.

⇨ The previous value shifts to middle display and four dashes appear in lower display.

b. Press ***VOLTS*** for desired number.

c. Press ***AMPS*** to store each digit.

⇨ Repeat this procedure until new Communication Baud Rate is entered.

⇨ When complete, middle display blanks and lower display indicates new Baud Rate.

d. Press ***AMPS*** to save.

See Chapter 12 to Exit.

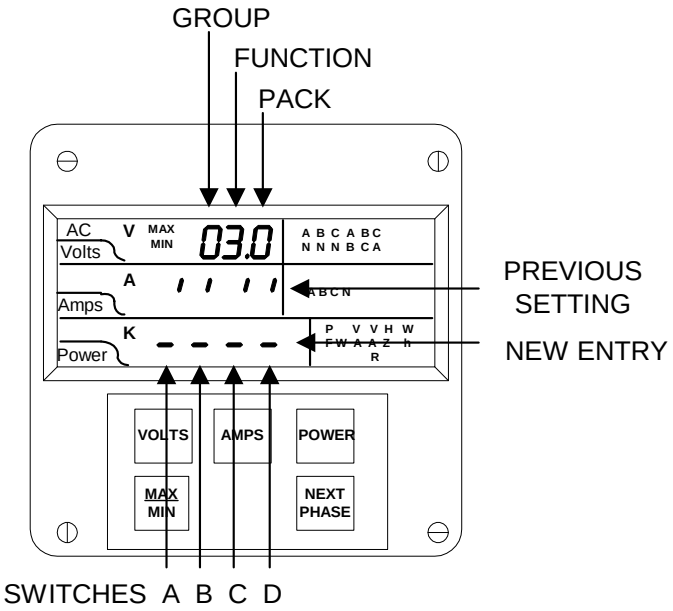
9.4: Group 0, Function 3—System Configuration

The System Configuration sets the SBM 300's basic operational parameters. This Function utilizes Switch PACKS.

FUNCTION *3* contains four different Switch PACKS: *0–3*. Each PACK contains four individual UP/DOWN segments.

- Toggling the segment between UP and DOWN, toggles the switch ON or OFF, or chooses between two options.
- The meter displays one Switch PACK at a time.

⇨Press ***VOLTS*** to scroll from PACK to PACK.



PACK	SWITCH	FEATURE	SEGMENT POSITION
0	A	Reserved	—
	B	Reserved	—
	C	Reserved	—
	D	Phase Reversal Limit Detection	UP: Enable DOWN: Disable
1	A	Non-significant will blank leading zero	UP: Enable DOWN: Disable
	B	Reset Protection (see Part I: Installation and Operation)	UP: Enable DOWN: Disable
	C	Phase Reversal Rotation Selection	UP: CBA Rotation DOWN: ABC Rotation
	D	Open Delta Installation (see Part I: Installation and Operation)	UP: Enable DOWN: Disable
2	A	Limit/Relay Control	UP: Average DOWN: Instantaneous
	B	Power Factor Polarity Indicates + (voltage referenced) or - (current referenced)	UP: -PF DOWN: +PF
	C, D	For EI-BUS protocol: Switch C is DOWN, Switch D is DOWN. For MODBUS protocol, ASCII framing: Switch C is UP, Switch D is UP. For MODBUS protocol, RTU framing: Switch C is DOWN Switch D is UP. For DNP 3.0 protocol: Switch C is UP, Switch D is DOWN.	
3	A	Trip Relay Computer Control 1 (Relay Control 1 and 2 apply only if Relay Option -NL was ordered.)	UP: Enable DOWN: Disable
	B	Trip Relay Computer Control 2 (Relay Control 1 and 2 apply only if Relay Option -NL was ordered.)	UP: Enable DOWN: Disable
	C	RS-232 or RS-485 Communications or Print	UP: Enable Communications DOWN: Enable DC Output

Table 9-2: System Configuration—Switch Packs for Group 0, Function 3

OPEN DELTA SYSTEM INSTALLATION PROGRAMMING

A special switch is used to indicate that the electrical system being monitored is a Three-phase WYE or Three-Wire Open Delta System using the connection installation (see Chapter 3). The switch is located in GROUP 0, FUNCTION *3*, Pack 1, Switch D.

WARNING: *This switch should be set to UP only if the electrical system is a Three-Wire Delta or Open Delta, using 2 PTs. Otherwise, the switch should be set to DOWN. Failure to select this switch results in Phase-to-Neutral readings, as well as incorrect power readings, with the 2PT connection.*

Special Open Delta Connection Installation should be followed in the Installation and Operation section (Chapter 3).

SWITCHING COMMUNICATION PROTOCOLS, EI-BUS, MODBUS RTU/ASCII, DNP 3.0

- For EI-BUS protocol: PACK *2,* Switch C is DOWN, Switch D is DOWN.
- For MODBUS protocol, ASCII framing: PACK *2,* Switch C is UP, Switch D is UP.
- For MODBUS protocol, RTU framing: PACK *2,* Switch C is DOWN Switch D is UP.
- For DNP 3.0 protocol: PACK 2, Switch C is UP, Switch D is DOWN.

NOTE*: When programming for MODBUS protocol configuration of LIPA (Long Island Power Authority) mapping options may be performed through communication.*

9.5: Modbus Plus Capability

When using the MPI Modbus Plus adapter, the meter values should be set to speak to Modbus RTU with a meter address of 0001 and a baud rate of 9600 baud. The Modbus Plus address is programmed into the MP1 Modbus Plus adapter directly.

PRINTING OPTION

To print, access Mode 1 and Mode 2 (see Part I: Installation and Operation). Printing serial options should be disabled when using a multimeter communications connection RS485.

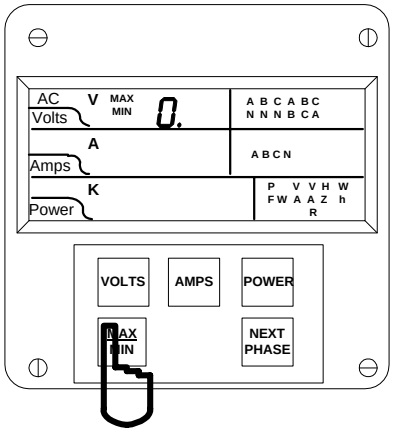
DISABLING PREVENTS:
1. Printing through the keypad.
2. Corrupting data at a computer terminal while multiple meters poll.
3. Corrupting printing commands through communications.

This option connects a serial printer to the RS232 port and prints the data. Disable this feature when the meter is not using an RS232 port (i.e., when RS485 or DC outputs are being used).

9.6: Group 0, Function 3—Programming Procedure

To change the System Configuration Switch Settings:

NOTE: *Press **MAX/MIN**, at any time, to cancel before storing the last digit or switch.*

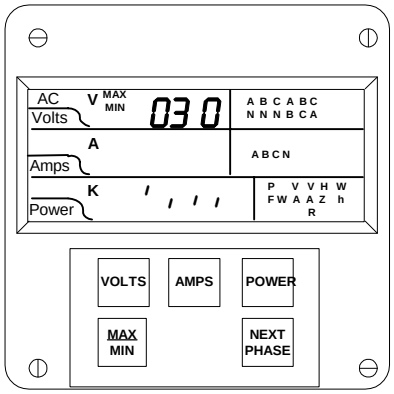


Step 1:

a. Enter Group Level of Programming Mode (see Chp. 8).

b. Press ***MAX/MIN*** until ***0.*** appears in upper display.

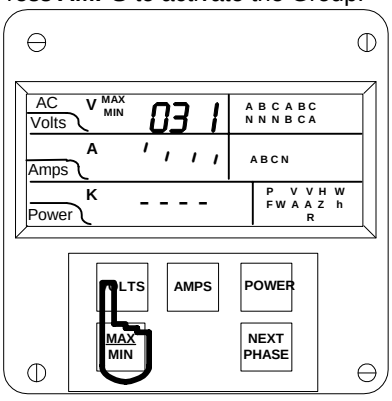
c. Press ***AMPS*** to activate the Group.



Step 2:

a. Press ***MAX/MIN*** until Function ***03.0*** appears in upper display.

⇨ Lower display indicates current PACK 0 Switch Settings.



Step 3:

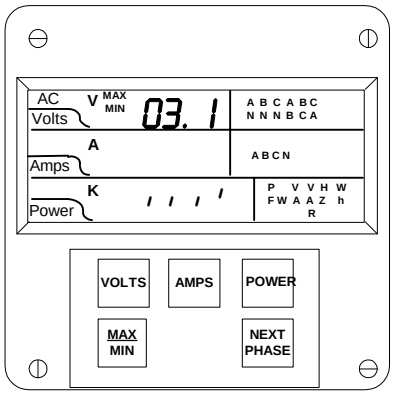
a. Press **VOLTS** until desired PACK appears.

b. Press **AMPS** to begin Data Entry Sequence.

⇨ The previous Switch settings shift to middle display and four dashes appear in lower display. The decimal disappears.

c. Press **VOLTS** to toggle the segments up or down for desired setting.

d. Press **AMPS** to store each setting.



⇨ Repeat procedure until new Switch Setting is entered.

⇨ The middle display blanks and new Switch Settings are indicated on lower display. The decimal reappears.

e. Press **AMPS** to save.

(This example shows enabling of Open Delta Installation switch).

See Chapter 12 to Exit.

9.7: Group 0, Function 6—KYZ Parameter Selection

***NOTE**: FUNCTION 6 applies only if Option -NL or -NL2 was ordered.*

OPTION -NL: This option provides the meter with 2 Relays and one KYZ pulse. The KYZ pulse can be programmed to the features below.

Select a single parameter from **Table 9-5** according to the SBM 300 model being programmed.

OPTION -NL2: This option offers 3 distinct KYZ pulses instead of Relays.
Only three separate parameters may be selected: FUNCTION 6.0 (KYZ Port 0), FUNCTION 6.1 (KYZ Port 1), and FUNCTION 6.2 (KYZ Port 2). The available parameters vary according to the SBM 300 model being programmed. For exact port positions see Installation Sections.

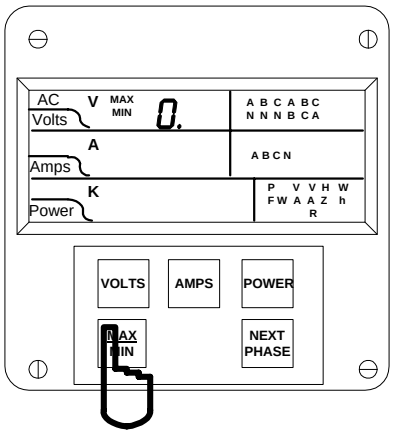
PARAMETER	DESCRIPTION
0	Disable KYZ
1	Positive Watt Hour KYZ
2	VA Hour KYZ
3	Negative Watt Hour KYZ
4	Positive VAR Hour KYZ
5	Negative VAR Hour KYZ

Table 9-5: KYZ Parameters

APPLICABLE SELECTIONS: SBM300 - +WH, -WH, VAH
SBM300 +R* - +WH, -WH, +VARH, -VARH
* (-R option gives the SBM300 VAR/Hour readings instead or VA/Hours).

To perform the KYZ Parameter Selection:

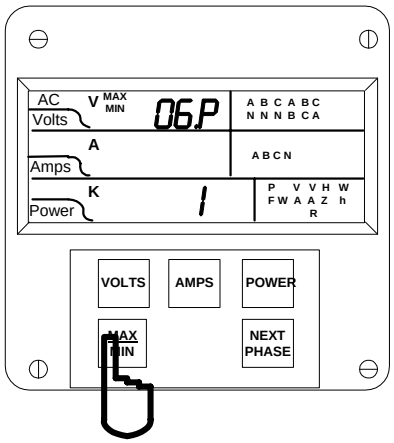
***NOTE**: Press **MAX/MIN** at any time to cancel before storing the last digit or switch.*



Step 1:
a. Enter Group Level of Programming Mode (see Chp. 8).

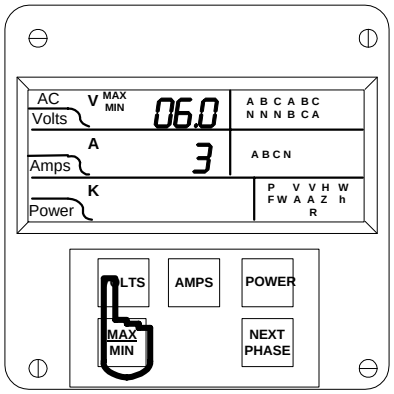
b. Press ***MAX/MIN*** until ***0.*** appears in upper display.

c. Press ***AMPS*** to activate the Group.



Step 2:
a. Press ***MAX/MIN*** until ***06.P*** appears in upper display.

(Standard Selection is 1).

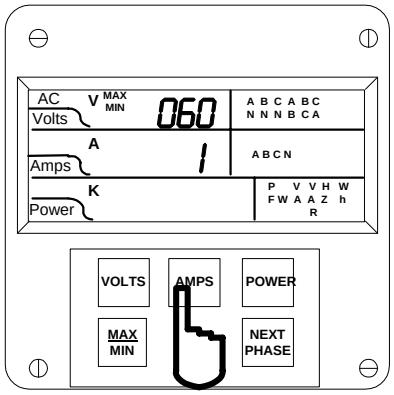


Step 3:

a. Press ***VOLTS*** once and ***06.0*** appears in upper display.

⇨ Middle display indicates preset value.

⇨ Lower display indicates polarity of selected parameter and an annunciator indicates the selected parameter.



Step 4:

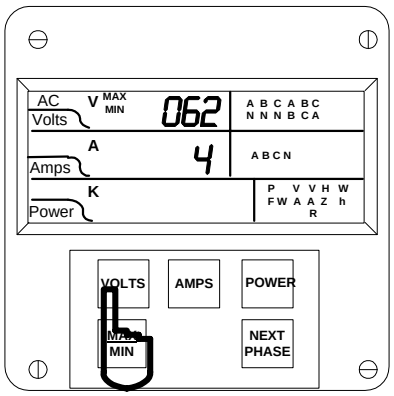
a. Press ***AMPS*** once to select a different parameter.

b. Press ***MAX/MIN*** to increase the parameter number

—or—

c. Press ***VOLTS*** to decrease (until desired parameter appears).

d. Press ***AMPS*** to store. Press ***AMPS*** to save.
⇨ A decimal appears in upper level. (Models with -NL Option, FUNCTION *6* is complete).



APPLIES TO -NL2 OPTION ONLY:
Step 5:

a. Press ***VOLTS*** to proceed to another port (06.1 or 06.2).

⇨ Repeat this procedure to change parameters.

b. Press ***AMPS*** to store each setting.

See Chapter 12 to Exit.

SELECTION IN 06P	KYZ PULSE VALUE PER WATT HOUR FSW=9999.	KYZ PULSE VALUE PER WATT HOUR FSW=999.9	KYZ PULSE VALUE PER WATT HOUR FSW=99.99	KYZ PULSE VALUE PER WATT HOUR FSW=9.999
Multiply by 1	1.0 unit WH	0.1 unit WH	0.01 unit WH	0.001 unit WH
Multiply by 2	0.5 unit WH	0.05 unit WH	0.005 unit WH	0.0005 unit WH
Multiply by 10	0.1 unit WH	0.01 unit WH	0.001 unit WH	0.0001 unit WH
Multiply by 20	0.05 unit WH	0.005 unit WH	0.0005 unit WH	0.00005 unit WH
Divide by 1	1.0 unit WH	0.1 unit WH	0.01 unit WH	0.001 unit WH
Divide by 2	2.0 unit WH	0.2 unit WH	0.02 unit WH	0.002 unit WH
Divide by 10	10.0 unit WH	1.0 unit WH	0.1 unit WH	0.01 unit WH
Divide by 20	20.0 unit WH	2.0 unit WH	0.2 unit WH	0.02 unit WH

Table 9-6: KYZ Pulse Value

NOTE: *The unit WH refers to the counter value on the meter, where the unit equals Kilo or Mega user-defined.*

The FSW number is used only for decimal point placement (see Chapter 10).

HOW TO USE KYZ PULSE VALUE TABLE FOR MULTIPLICATION:

SITUATION 1: FSW=9999.

- Selection is Multiply by 2
- This means that every .5 unit WH =1 pulse.
- Unit=Kilo (see Group 1, Function 2)
- Result: For every 1 KWH increment on the counter, the meter will output 2 pulses.

SITUATION 2: FSW=999.9

- Selection is Multiply by 2
- This means that every .05 unit WH=1 pulse.
- Unit=Kilo (see Group 1, Function 2)
- Result: For every 1 KWH increment on the counter, the meter will output 20 pulses.

SITUATION 3: FSW=99.99

- Selection is Multiply by 20
- This means that every .0005 unit WH=1 pulse.
- Unit=Kilo (see Group 1, Function 2)
- Result: For every 1 KWH increment on the counter, the meter will output 2,000 pulses.

SITUATION 4: FSW=9.999

- Selection is Multiply by 20
- Unit=Kilo (see Group 1, Function 2)
- This means that every .00005 WH=1 pulse.
- Result: For every 1 KWH increment on the counter, the meter will output 20,000 pulses.

HOW TO USE THE KYZ PULSE VALUE TABLE FOR DIVISION:

SITUATION 1: FSW=9999.

- Selection is Divide by 10
- This means that every 10 unit WH=1 pulse.
- Unit=Kilo (see Group 1, Function 2)
- Result: For every 10 KWH increment on the counter, the meter will output 1 pulse.

SITUATION 2: FSW=999.9

- Selection is Divide by 10
- This means that every 1 unit WH=1 pulse.
- Unit=Kilo (see Group 1, Function 2)
- Result: For every 1 KWH increment on the counter, the meter will output 1 pulse.

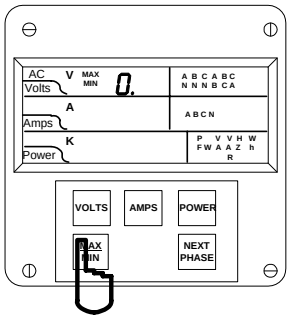
SITUATION 3: FSW=99.99

- Selection is Divide by 20
- This means that every .2 unit WH=1 pulse.
- Unit=Kilo (see Group 1, Function 2)
- Result: For every 1 KWH increment on the counter, the meter will output 5 pulses.

SITUATION 4: FSW=9.999

- Selection is Divide by 20
- Unit=Kilo (see Group 1, Function 2)
- This means that every .02 WH=1 pulse.
- Result: For every 1 KWH increment on the counter, the meter will output 50 pulses.

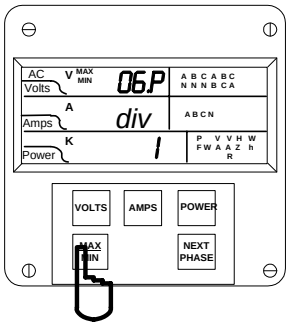
To change the KYZ pulse value:



Step 1:
a. Enter Group Level of Programming Mode, (see Chp. 8).

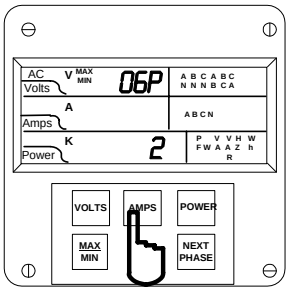
b. Press ***MAX/MIN*** until ***0.*** appears in upper display.

c. Press ***AMPS*** to activate the Group.



Step 2:
a. Press ***MAX/MIN*** until ***06.P*** appears in upper display.

⇨ The lower display indicates multiplication or division factor.
⇨ *Division is indicated by div appearing in the middle display. When middle display is blank, it indicates multiplication.*



Step 3:
a. Press ***AMPS*** to change setting.
⇨ The decimal point disappears.

b. Press ***MAX/MIN*** to advance selections. **-or-**
c. Press ***VOLTS*** to reverse. (Until desired factor appears).

e. Press ***AMPS*** to store.

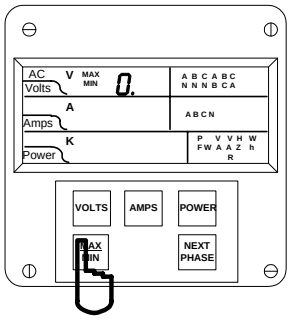
f. Press ***AMPS*** to save.

9.8: Group 0, Function 7—Number of Phases

NOTE: *ENTER **1** FOR SINGLE PHASE/SINGLE WIRE.*
*ENTER **2** FOR SINGLE PHASE/TWO WIRE.*
*ENTER **3** FOR THREE PHASE/THREE OR FOUR-WIRE.*

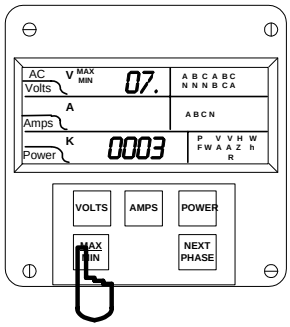
- **STANDARD FACTORY SET-UP IS THREE-PHASE FOUR-WIRE*

***Note**: Press **MAX/MIN** at any time to cancel before storing the last digit or switch.*



Step 1:
a. Enter Group Level of Programming Mode. (Chapter 8)

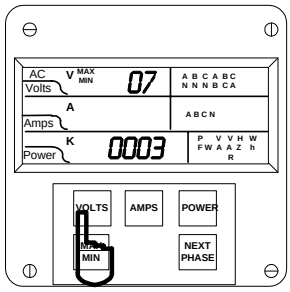
b. Press ***MAX/MIN*** if ***0.*** does not appear.
c. Press ***AMPS*** to activate the Group.



Step 2:
⇨ ***00.*** appears in upper display.

a. Press ***MAX/MIN*** until ***07*** appears in upper display.

b. Press ***AMPS*** to activate the Group.



Step 3:
a. Press ***VOLTS*** to select numbers 1, 2 or 3.

b. Press ***AMPS*** to save.

See Chapter 12 to Exit.

CHAPTER 10
PROGRAMMING GROUP 1 – VOLTAGE, AMP AND WATT SCALE SETTINGS

NOTE: *The SBM 300 full scales will already be programmed, if the order specified current and voltage transformer ratios. The meter label indicates any full-scale setup.*

Programming Group 1 contains voltage, amperage and full-scale power selection, along with scale factor selection and decimal point placement.

The user can re-scale without removing the SBM 300 for calibration. The SBM has been calibrated at standard levels in GROUP 2. Mathematically convert any full-scale ratios to those calibrated levels. If a different current or voltage transformer is used, program the primary value of its ratio. If necessary, convert the ratio to a secondary value of five amps standard current (1 amp is a special order) and 120V or 75V nominal voltage (option L only).

FORMULAS:

$$\frac{\text{Primary}}{\text{Secondary}} \; x \; 120V \qquad \frac{\text{Primary}}{\text{Secondary}} \; \text{x} \; 75\text{V} \qquad \frac{\text{Primary}}{\text{Secondary}} \; \text{x} \; 5\text{A}$$

It may be necessary to convert the full scale to a larger unit. There is a resolution limitation for all full scales of 2000. If a display reading exceeds 2000, it may be unstable and subject to zeroing problems.

Example: The full scale for a CT ratio of 3000/5 should be 03.00 kA.

When changing a PT or CT full scale, calculate the new watts full scale and make any necessary changes. The watts full scale will not auto range.

10.1: Group 1, Function 0—Full Scale Voltage Settings, Scale & Decimal Point Placement

GROUP AND FUNCTION NUMBER	FUNCTION
10.	Full Scale Selection for Volts
11.	Full Scale Selection for Amps
12.	Full Scale Selection for Watts
1E.	Exit Programming GROUP 1

Table 10-1: Group 1 Programming Format

NOTE: Tables 10-2 *and* ***10-3*** *contain Full Scale Settings for typical voltages and currents (PT and CT arrangements).*

SECONDARY PT VALUES	PT RATIO	FULL SCALE
75 V (Suffix 75) L-N MAX	120:1	9.00 KV
120/208 V	1:1 (Direct)	120.0
120/208 V	4:1	0480 V
120/208 V	120:1	014.4 KV
277/480 V (Suffix G)	1:1 (Direct)	0300 V
120/208V	600:1	072.0 KV
120/208	1150:1	138.0 KV

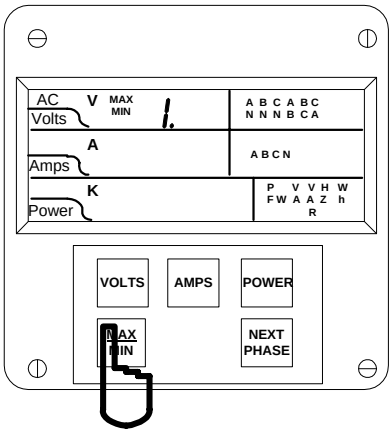
Table 10-2: TYPICAL Full Scale Settings for Volts

If PT is connected line to line, the full scale can be 14.40 KV. Full scale is **300** V L-N, not 277, because the factory calibration is 300 V. Be sure the table is based on a meter regulation of 2000 A/D counts. Thus, for best accuracy, all settings should be placed within that range.

VOLTAGE FULL SCALE:

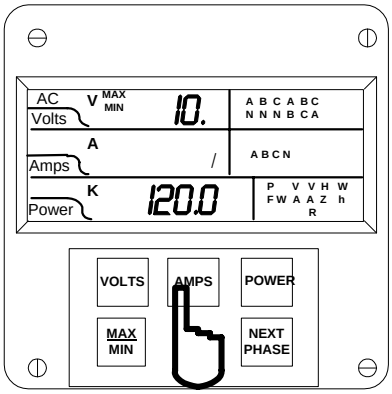
To change the Full Scale Settings:

***NOTE**: Press **MAX/MIN** at any time to cancel before storing the last digit or switch.*



Step 1:
a. Enter Group Level of Programming Mode (see Chp. 8).

b. Press ***MAX/MIN*** until ***1.*** appears in upper display.

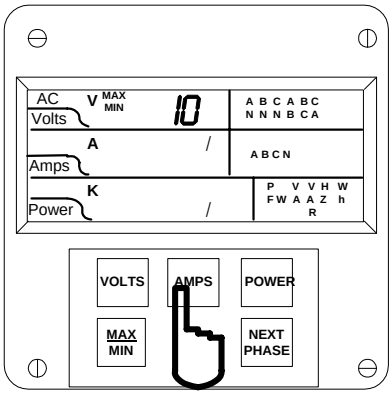


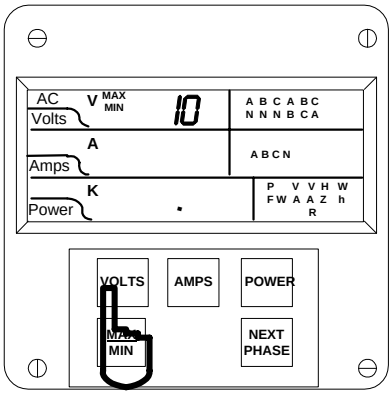
Step 2:
a. Press ***AMPS*** to activate GROUP 1.

⇨ ***10.*** appears in upper display.

⇨ Middle display indicates Scale Factor Setting.

⇨ Lower display indicates Full Scale for voltage.





ENTERING THE SCALE FACTOR:
Step 3:
a. Press ***AMPS*** to begin Data Entry Sequence.
⇨ Lower display is replaced with a single dash.

b. Press ***VOLTS*** and dash changes to a vertical segment that can be moved UP or DOWN to set Scale Factor.
⇨ UP signifies - *Kilovolts*
⇨ DOWN signifies – *Volts*

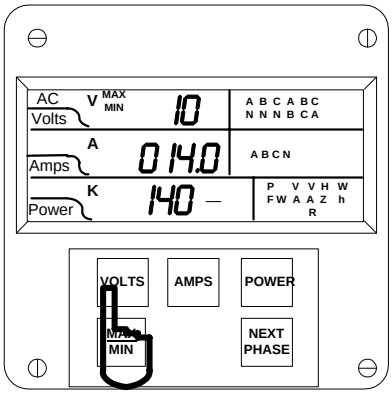
c. Repeat procedure until value is entered.

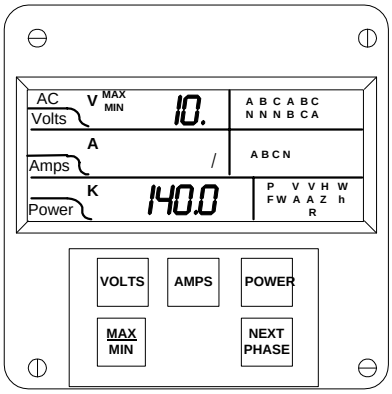
d. Press ***AMPS*** to store.

DECIMAL POINT SELECTION:
Step 4:
a. Press ***VOLTS*** to move decimal point.

b. Press ***AMPS*** to store.

c. Press ***AMPS*** to save.





Step 5:
⇨ Middle display indicates present Full Scale for volts.

⇨ Four dashes appear in lower display.

⇨ Enter the four digit full scale.

a. Press ***VOLTS*** to increase the digit number.

b. Press ***AMPS*** to store each digit.

⇨ Repeat this procedure until desired value is entered.

⇨ Lower display indicates new Full Scale Setting.
⇨ Middle display indicates Scale Factor.

⇨ Group and Function Number (including decimal point) appear in upper display.

d. Press ***AMPS*** to save.

See Chapter 12 to exit.

10.2: Group 1, Function 1—Amperage Full Scale

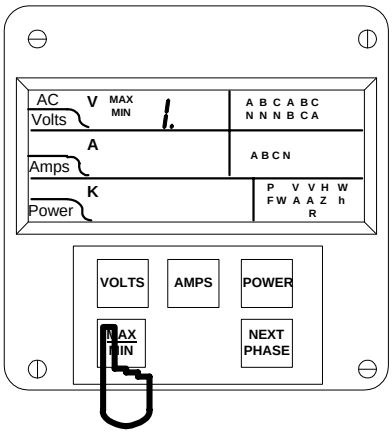
CT TYPE	FULL SCALE
Direct Input	05.00 A
600/5	0600 A
1000/5	1000 A
2000/5	2000 A
3000/5	03.00 KA
5000/5	05.00 KA

Table 10-3: Full Scale Settings for Amps

Also note that the meter reads with digital accuracy to a 2000 count range. Thus all CT and PT full-scale settings in the meter should reflect that limitation. The table above shows the proper settings.

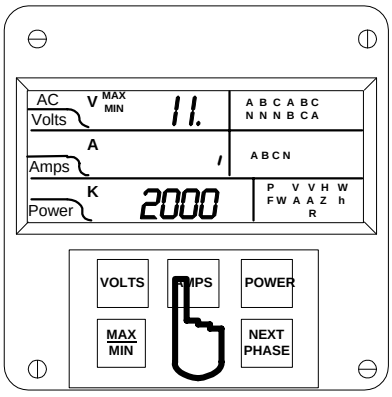
To change the Full Scale Settings:

***NOTE**: Press **MAX/MIN** at any time to cancel before storing the last digit or switch.*



Step 1:
a. Enter Group Level of Programming Mode (see Chp. 8).

b. Press ***MAX/MIN*** until ***1.*** appears in upper display.

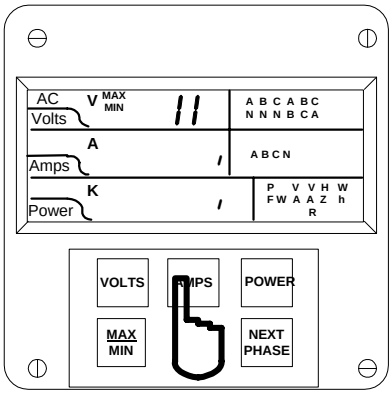


Step 2:
a. Press ***AMPS*** to activate the Group.

b. Press ***MAX/MIN*** until ***11.*** appears in upper display.

⇨ Middle display indicates Scale Factor Setting.

⇨ Lower display indicates Full Scale.

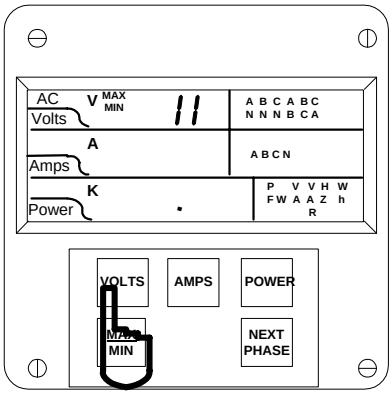


ENTERING THE SCALE FACTOR:
Step 3:
a. Press ***AMPS*** to begin Data Entry Sequence.
⇨ Lower display is replaced with a single dash.

b. Press ***VOLTS*** and dash changes to a vertical segment that can be moved UP or DOWN to set Scale Factor.
⇨ UP signifies - *Kiloamps.*
⇨ DOWN signifies - *Amps.*

c. Repeat procedure until value is entered.

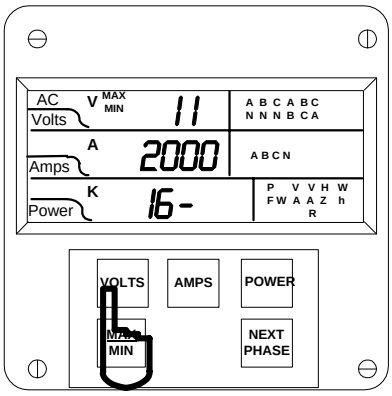
d. Press ***AMPS*** to store.



DECIMAL POINT SELECTION:
Step 4:
a. Press ***VOLTS*** to move decimal point.

b. Press ***AMPS*** to store.

c. Press ***AMPS*** to save.



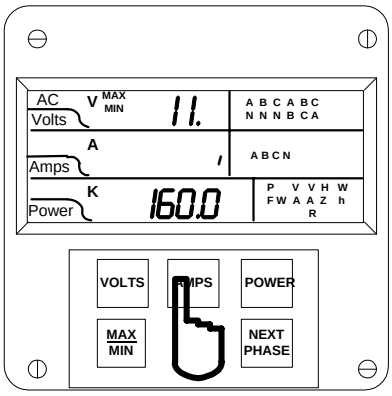
Step 5:
⇨ The Full Scale for current is indicated in the middle display.

⇨ Four dashes appear in lower display.

⇨ Enter the four digit full scale.

a. Press ***VOLTS*** until the number appears.

b. Press ***AMPS*** to store.



⇨ Repeat this procedure until the value is entered.

⇨ Lower display indicates new Full Scale Setting.

⇨ Middle display indicates Scale Factor.
Group and Function Number appear (including a decimal point) in upper display.

c. Press ***AMPS*** to save.

10.3: Group 1, Function 2—Scale Selection and Decimal Placement for Watts

Programming GROUP 1 also provides decimal positioning for maximum resolution. The following examples assist in selecting the best decimal position for FUNCTION *2*.

***NOTE**: Shift the decimal left to increase resolution. Wattage should not exceed a numeral value of 2500. Shift the decimal one position right to decrease resolution.*

Full Scale Wattage (FSW) is the product of FSV and FSA. For FSW for three phases multiply the FSW per phase by 3.

Example 1: Full Scale Voltage (FSV)=120 V
Full Scale Amperage (FSA)=5.00 A

FSW (one phase) =120 Vx5.00 A
FSW (one phase)=600 W
FSW (three phase)=600 Wx3 = 1,800 W

Here the FSW is too small a value for a Megawatt meter. FSW in the Kilowatt meter equals 1.800 KW. In FUNCTION *2,* four 9s appear. Place the decimal point after the first digit. The user cannot change the four digits. The user can only move the decimal point placement.

Example 2: 480/120 PT, 1000/5 CT

FSV=480 V
FSA=1000 A
FSW (one phase)=480 V · 1000 A
FSW (one phase)=480,000 W
FSW (three phase)=480,000 W · 3 = 1,440,000 W

FSW for a Kilowatt meter equals 1440. KW. FSW for a Megawatt meter equals 1.440 MW. In FUNCTION *2,* place the decimal point after the last digit for a Kilowatt meter and after the first digit for a Megawatt meter. It is important to note which type of bezel labeling you have when making this decision.

Example 3: 14.4 KV/120, 1000/5 CT

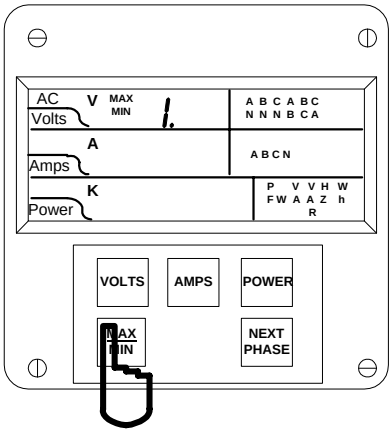
FSV=14.40 KV
FSA=1000 A
FSW (one phase)=14,400 Vx1000 A
FSW (one phase)=14,400,000 W
FSW (three phase)=14,440, 000 Wx3 = 43,200,000 W

FSW for a Kilowatt meter equals 43,200 KW. Here the FSW is too large a value for a Kilowatt meter (the range is 000–2500). FSW for a Megawatt meter equals 043.2 MW. In FUNCTION *2*, place the decimal after the third digit.

***NOTE:** In some applications where the load is normally very low, the watts resolution can be increased by moving the decimal point one position left.*

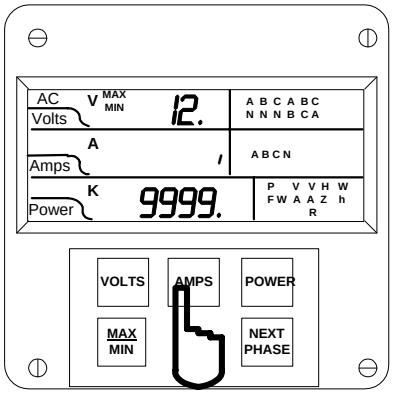
To change the scale factor setting for wattage:

***NOTE**: Press **MAX/MIN** at any time to cancel before storing the last digit or switch.*



Step 1:
a. Enter Group Level of Programming Mode (see Chp. 8).

b. Press ***MAX/MIN*** until ***1.*** appears in upper display.

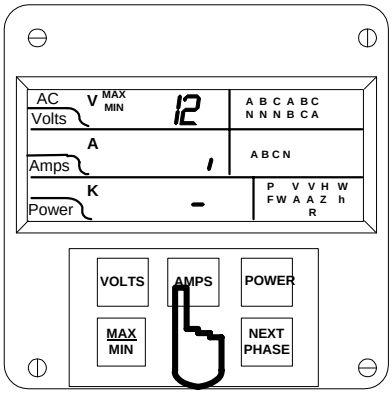


Step 2:
a. Press ***AMPS*** to activate the Group.

b. Press ***MAX/MIN*** until ***12.*** appears in upper display.

⇨ Middle display indicates current Scale Factor Setting.

⇨ Lower display indicates ***9999*** (including current decimal placement).



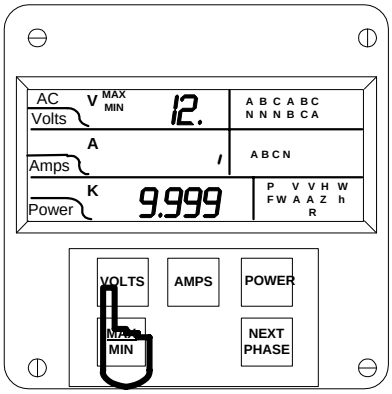
ENTERING THE SCALE FACTOR:
Step 3:
a. Press ***AMPS*** to begin Data Entry Sequence.

⇨ Lower display is replaced with a single dash.

b. Press ***VOLTS*** to move the segment

⇨ UP signifies - *megawatts.*
⇨ DOWN signifies - *kilowatts.*.

c. Press ***AMPS*** to store. Press ***AMPS*** to save.



DECIMAL POINT SELECTION:
Step 4:

⇨ Display blanks and ***9999*** appears in lower display (including current decimal setting).

a. Press ***VOLTS*** to move decimal.

b. Press ***AMPS*** to save.

See Chapter 12 to Exit.

CHAPTER 11

PROGRAMMING GROUP 2—METER CALIBRATION

WARNING—READ THIS SECTION CAREFULLY BEFORE PROCEEDING:

- Any rescaling, such as a change in a transformer ratio, can be accomplished in GROUP 1. Calibration is not necessary.
- Meter calibration cannot be performed if the meter is installed for service. The sensing inputs must be connected to a power supply with variable voltage and separate current outputs.
- The calibration procedure requires highly accurate and stable input signals. Incorrect readings result from improper calibration procedures. If unsure, return unit to the factory for calibration.
- BEFORE calibrating any channel, make a note of its Full Scale Setting (see Chapter 10). Set the Full Scale in accordance with Table 10-2 for calibration. Restore original Full Scale Setting when calibration is completed.

11.1: Calibration Requirements

Calibration on the SBM 300 requires precise inputs of 120 Volts, 5 Amps, and 2.5 Amps. The SBM 300 - G model requires precise inputs of 300 Volts, 5 Amps, and 2.5 Amps. If this equipment is unavailable, contact us for assistance.

GROUP AND FUNCTION NUMBER	FUNCTION
20.	High End Calibration—Volts AN, BN, CN
21.	High End Calibration—Amps A, B, C
22.	Low End Calibration—Amps A, B, C
2E.	Exit Programming Group 2

Table 11-1: Group 2 Programming Format

NOTE: *The voltage and current scales are calibrated with the maximum range value 2000 for current, 14.40 for voltage, 300 for Option G. The calibration value can be identical to the full-scale value in GROUP 1, for better accuracy than the specification. However, if a full scale is ever changed to a higher value than the calibrated value, the value may be less accurate.*

VOLTAGE RANGE	INPUT SOURCE	GROUP 2 VALUE
69.3/120V	75V	1440
120/208V	120V L-N	1440
277/480V	300V	0300
5A CT High End	5A	2000
2.5A Low End	2.5A	1000

Table 11-2: Calibration Source, Full Scale and Value Settings for Calibration

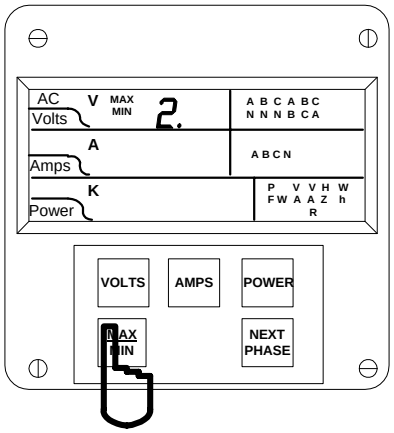
11.2: Group *2*, Functions 0–8—High End Calibration of Voltage Channels, High and Low End Calibration of Amperage Channels

To change the calibration (high end—Functions 0 and 1):

***NOTE**: Press **MAX/MIN** at any time to cancel before storing the last digit or switch.*

NOTE:** Before entering Group 2 to calibrate, Meter Group 1 should have been set for the **HIGHEST VALUE** for **VOLTS** and **AMPS.

***Example:** 1440V, 2000A*
If your Full Scale is 1800V, program Group 1 for 1800V for better accuracy.



Step 1:

a. Enter Group Level of Programming Mode (see Chp. 8).

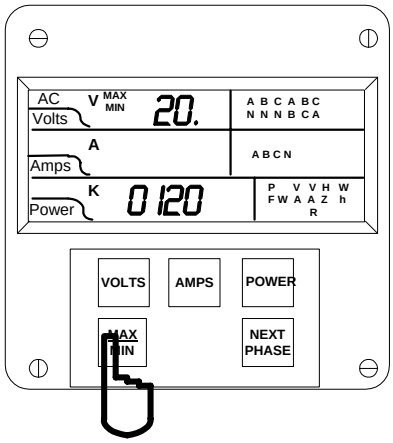
b. Press ***MAX/MIN*** until ***2.*** appears in upper display.

c. Press ***AMPS*** to activate the Group.

⇨A one-digit password is required to continue.

d. Press ***VOLTS*** until ***5*** appears.

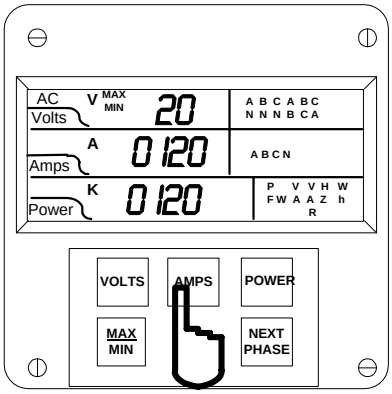
e. Press ***AMPS*** to select.



Step 2:

⇨ Refer to **Table 11-1** for Function Number that corresponds to the area requiring calibration. Calibration for each area begins with A and then moves to B and C.

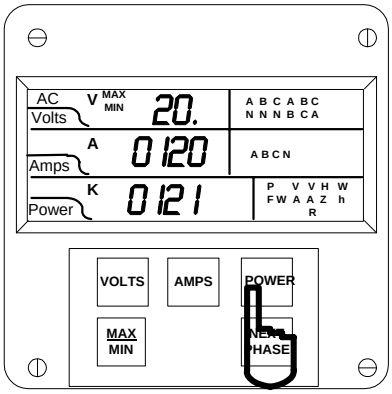
a. Press ***MAX/MIN*** to change Function number.



Step 3:
a. Press ***AMPS*** to activate calibration.

⇨ Digits move to middle display.

⇨ After a moment, digits appear in lower display also.



Step 4:
a. Press ***POWER*** to increase the value and ***NEXT PHASE*** to decrease the value.
⇨ Digits in lower display disappear momentarily, then reappear indicating the new value.

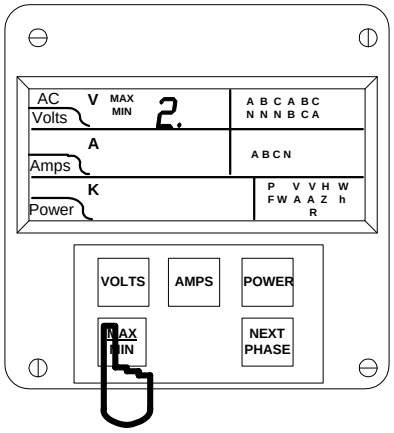
b. Press ***AMPS*** to store and move to the next phase or Amp within the group.

c. Press ***AMPS*** to save.

See Chapter 12 to Exit.

For Amps Low End (Function 2):

***NOTE**: Press **MAX/MIN** at any time to cancel before storing the last digit or switch.*



Step 1:
a. Enter Group Level of Programming Mode (see Chp. 8).

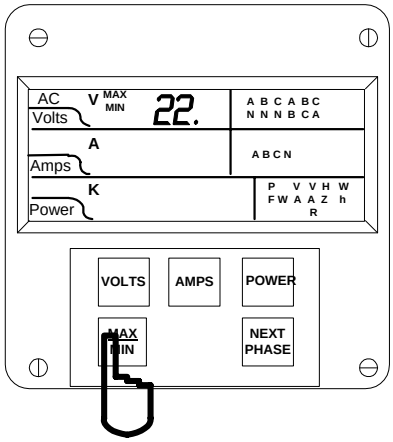
b. Press ***MAX/MIN*** until ***2.*** appears in upper display.

c. Press ***AMPS*** to activate the Group.

⇨ A one digit password is required to continue.

d. Press ***VOLTS*** until ***5*** appears.

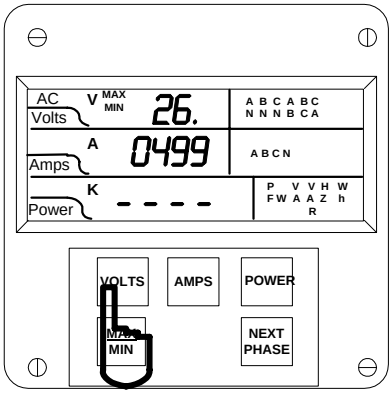
e. Press ***AMPS*** to select.



Step 2:
a. Press ***MAX/MIN*** until ***22.*** appears in upper display.

b. Press ***AMPS*** to activate. (Calibration begins with Amps A, then moves to B and C).

⇨ Middle and lower displays blank.



Step 3:
⇨ New value moves to middle display.

⇨ Lower display indicates the calibrated reading after 10-15 seconds.

⇨ To enter the half scale value in lower display,

a. Press ***VOLTS*** to select digits.

b. Press ***AMPS*** to store and proceed to B or C within the group.

c. Press ***AMPS*** to save.

d. Press ***MAX/MIN*** to end calibration procedure.

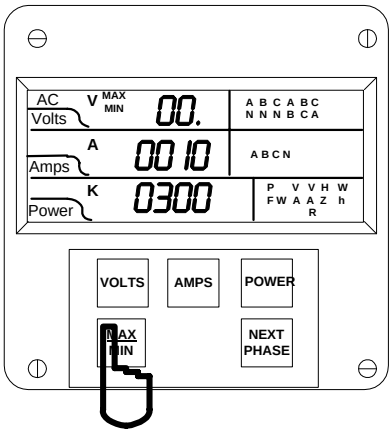
See Chapter 12 to Exit.

CHAPTER 12
EXITING PROGRAMMING MODE

***NOTE**: Steps to exit Programming Mode vary depending on the programming stage.*

Exiting the Programming Mode is **always** necessary to store any new changes and to calculate a new checksum. Failure to exit results in a checksum error: the display blanks and the max LED flashes.

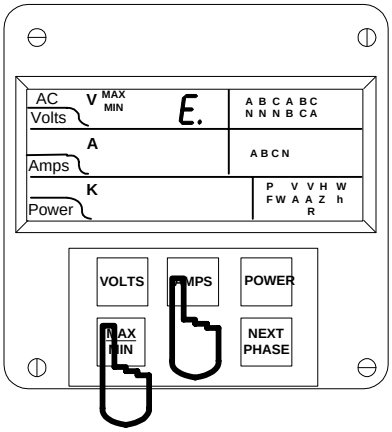
IF YOU ARE LOCATED IN A FUNCTION Level—begin at **Step 1**.
IF YOU ARE LOCATED IN A GROUP Level—begin at **Step 2**.



Step 1:
EXITING FROM FUNCTION LEVEL

a. Press ***MAX/MIN*** until the Group number in upper display is followed by ***E*** (for Exit).

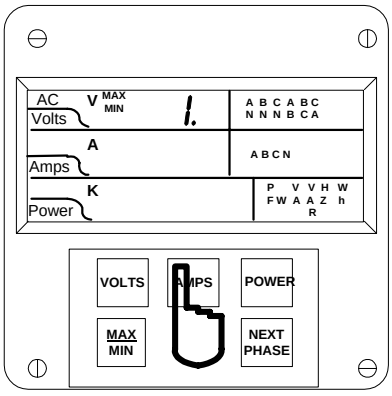
⇨ The meter returns to Function Level.



Step 2:
EXITING FROM GROUP LEVEL

a. Press ***MAX/MIN*** until ***E.*** appears in upper display (for Exit).

b. Press ***AMPS*** to exit entirely from Programming Mode.



Step 1a.:

a. Press ***AMPS*** to exit from Function Level to Group Level.

CHAPTER 13
PROGRAMMING QUICK REFERENCE

13.1: Entering the Programming Mode

1. Hold ***NEXT PHASE*** key and press ***AMPS*** key.
2. Display blanks and shows a '0', '1' or '3'.
3. If '3' is not displayed then press ***AMPS*** key until '3' is displayed.
4. Release ***AMPS*** key and press ***NEXT PHASE*** key, while '3' is still displayed.
5. Display shows '333' momentarily.
6. Upper display starts counting. Press ***NEXT PHASE*** key when '5' is displayed to register the '5'.
7. Repeat step 6 until '555' has been registered.

13.2: Data Entry Sequence

1. At programmable numerical fields or Switch Pack fields, Press ***AMPS*** key to begin Data Entry Sequence.
2. The current setting moves to middle row of display and dashes appear in the bottom row. Press ***VOLTS*** key to toggle between available choices.
3. When a correct choice is selected, press ***AMPS*** key to store.

13.3: Programming Groups

Programming groups	Description
0	Global Meter Setup—Integration Interval, Meter Address, Communication Setting, Relay Settings
1	Full Scale Settings. Voltage Full Scale, Current Full Scale and Power Function Full Scale.
2	Meter Calibration
3	Calibration Ratios
4	Volts and Current Limits
5	Power Function Limits
6	THD Limits
7	Imbalance Reversal Limits
8	DC Output Calibration

13.4: Group 0 - Global Meter Setup

00. Interval.

01. Meter Address for Communication.

02. Baud Rate for Communication.

03. System Configuration Switch Packs.

030. *Reserved Switches.*

031.

A. Blank Non Significant Leading Zeros
B. Reset Protection
C. Phase Reversal Rotation Selection
D. Open Delta Configuration

032.

A. Instantaneous/Average Limit
B. Power Factor Polarity
C. Modbus Options
D. Protocol Selection

033.

A. Computer Control Relay 1
B. Computer Control Relay 2
C. Communication Selection
D. DC-Output/Print Control

04. Relay 1 Programming

04P.

A. Imb/Rev Selection
B. And/or Logic
C & D. Relay Control Selection

040. ON to OFF delay time

041. OFF to ON delay time

05. Relay 2 Programming 05P.

A. Imb/Rev Selection
B. *Reserved*
C. & D. Relay Mode Selection

050. ON to OFF delay time

051. OFF to ON delay time

06. KYZ Programming
    06P. Pulse Factor Programming
    060. KYZ Port 0 Function Mapping
    061. KYZ Port 1 Function Mapping
    062. KYZ Port 2 Function Mapping
07. Number of Phases

13.5: Group 1 - Full Scale Setup

10. Volts Full Scale
11. Currents Full Scale
12. Power Full Scale

13.6: Group 2 - Calibration

20. Volt AN, BN, CN
21. Amp A, B, C (High End)
22. Amp A, B, C (Low End)

13.7: Group 3 - Calibration Ratios

30. Volt AN
31. Volt BN
32. Volt CN
33. Amp A (High-End Ratios)
34. Amp B (High-End Ratios)
35. Amp C (High-End Ratios)
36. Amp A (Low-End Ratios)
37. Amp B (Low-End Ratios)
38. Amp C (Low-End Ratios)

13.8: Group 4 - Volt/Current Limits

40. Volt AN, Volt BN, and Volt CN Limits.
41. Volt AB, Volt BC, and Volt CA Limits.
42. Amp A, Amp B, and Amp C Limits.
43. Amp N Limits.