JEMSTAR

Digital Multifunction Electricity Meter

User Manual

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Important Safety Notice

Installation, operation, and maintenance of this product can present potentially hazardous conditions if safety procedures are not followed. To ensure that this product is used safely, it is important that you:

- Review, understand, and observe all safety notices and recommendations within this manual.
- Review your company safety procedures for meter installation and service.

DANGER!

Hazardous voltages are present during normal servicing of this device that can cause severe injury or death. These voltages are present throughout the utility's potential transformer (PT) and current transformer (CT) circuits, and the meter's connection terminals. Only qualified, properly trained personnel should perform installation and servicing on this equipment.

Table of Contents

GENERAL INFORMATION

JEMSTAR METER OVERVIEW

The *JEMStar* Digital Power Meter is a multifunction electricity meter for use in revenue, survey, and control metering applications. *JEMStar* is available in a variety of installation styles including Socket-base (S-base), A-base using an adapter, and Switchboard case.

JEMStar uses DSP (Digital Signal Processing) techniques to provide advanced metering capabilities and is intended for use in Transmission and Distribution (T&D, Tieline or Substation) and Generation metering applications. It is also intended to serve the Commercial and Industrial (C&I) revenue metering market.

JEMStar incorporates features common to modern electronic polyphase meters including:

- Real and reactive power and energy measurement
- Industry standard packaging
- Display of consumption, demand, and "instantaneous" registers
- Load Profile data collection and storage
- Serial data communications options for remote retrieval of registers and Load Profile data, as well as programming
- Time of Use metering
- Pulse outputs

In addition, *JEMStar* offers additional features and options not found in many existing meter products:

- Apparent power and energy
- Q measurements
- Per-phase voltage, current, and phase measurements
- Summation of energy measured by external devices (Totalization)
- Loss Compensation (Transformer and Line)
- Voltage and Current Transformer Gain Correction
- Field Diagnostics
- Power Quality monitoring
- Distortion measurement
- Thermal demand emulation
- Demand prediction
- Analog outputs
- Alarm outputs
- Wide Voltage range (55 – 530V)
- 14400 Baud Modem
- Call home on power outage or alarm conditions
- Contact Inputs
- 36 sets of Self-Read registers
- Easy field-upgradeable meter firmware

Note: Certain features may require the installation of an optional module, firmware upgrade, or software package.

Supporting Software

The following packages are available for use with *JEMStar*:

- ***JEMWare*** Configuration Program for setting up the meter's operation. Also contained within JEMWare is a *Site Diagnostic Tool* which will:
  Display the Site Diagnostic registers
  Plot real time readings on a polar graph

- ***JEMRead*** Data Retrieval Program to perform the following functions:
  Read and download data registers
  Read and download Load Profile data
  Read and download system Health and Status information
  Read Self-Read Registers
  Read Event Logs
  Set Time of Day and Date
  Perform Billing Period Reset

- ***UTS MV-90™[1] Translation Interface Module (TIM)*** software that can be added to an existing MV-90 system. This package will perform the data retrieval functions that are normally assigned by JEMRead. For further information, contact AMETEK, or go to the web at www.itron.com.

[1] MV-90 is a trademark of Itron Energy Information Systems, Inc.

TECHNICAL DESCRIPTION

JEMStar offers a large variety of meter register data that can be viewed from the meter's display or retrieved using serial communications. Some of the register types include consumption (summation), peak demand, time and date of peak demand, coincident demand, average power factor, coincident power factor, cumulative, continuous cumulative registers, and various status registers including date, time, health status, and firmware version. *JEMStar* also has time-of-use capabilities, and most registers can be associated with a particular time-of-use rate.

The meter has an internal pulse recorder for storing load-profile data. The standard meter provides enough memory to store four channels of recorded data in 15-minute intervals for 64 days. Utilizing fewer channels will extend the length of time data may be recorded (for example, reducing the number of channels by ½ doubles the length of recording time). Special events such as power failures, time sets, and demand resets are also stored in the load-profile data. This data can be retrieved through serial communications using JEMRead™ software. Optionally, a custom Translation Interface Module (TIM) is available for the popular MV-90™ software supplied by Itron, Inc. The *JEMStar* meter can also provide analog and contact outputs for external monitoring devices.

Serial communications are performed through an optical port on the front of the meter and a communication option board (RS-232, RS-485, Ethernet, or the internal modem). The meter has four levels of password protection with assignable privileges to accommodate read-only applications. A hardware "key" is also provided in the meter, which if removed prevents any configuration or calibration changes.

JEMStar is software configurable using JEMWare™. This software allows the meter to be scaled for direct primary readings, demand information, register information, load-profile configuration, and time-of-use rates. Refer to the JEMWare instruction manual 1083-602 for details on all the different parameters that can be programmed into the *JEMStar*.

Event Recording

JEMStar maintains records of certain events independent of the Load Profile features. JEMRead is able to retrieve some of this information independently. However, if you need access to the data for troubleshooting or historical purposes, it is available in the meter. Contact AMETEK for information about using the Protocol Command Set Manual 1083-603.

All recorded events include the following information:

- A description of the type of event
- The date and time at which the event occurred
- If applicable, the time after the event

The following events are recorded:

- Power Outage: any recognizable failure of the auxiliary power is recorded with the time when power went down, the time at which it was restored, and an indication of which voltage inputs were live (as displayed on the potential indicators) when power went down. The five most recent power outages are saved in memory.
- Time Set and Daylight Saving Time Change: these are recorded in the same list. They include the time before the change, the time after the change, and an indication of whether it was a manual (front panel or serial data) or automatic (Daylight Saving Time) change. The five most recent time changes are recorded.
- Register Freeze: Each Freeze includes the time the Freeze was performed, as well as an indication of whether the Freeze was manual (serial command) or automatic. The five most recent Freezes are recorded.
- Register Preset: The most recent Register Preset is recorded with the time at which the Preset occurred.
- Test Mode: The most recent Test Mode session is recorded with the time at which the Test Mode session was entered and left.
- Calibration: The most recent Calibration session is recorded with the time at which the Calibration occurred.
- Site Monitoring: The 20 most recent Site Monitoring events are recorded. Each one includes the time at which the condition was detected as well as an indication of the detected condition.
- Billing Period Reset: The five most recent Billing Period Reset events are recorded. Each one includes the time at which the reset was performed and an indication of whether the reset was automatic, a serial command, or a front-panel reset.
- Configuration: The 3 most recent Configuration events are recorded. Each one includes the time at which the configuration occurred as well as an indication of whether it was a front-panel or remote (serial) configuration.
- Voltage Sag / Swell: The 100 most recent voltage sags or swells detected by the meter are logged. Each event records the minimum, maximum, and average voltage and current and the average power factor for the duration of the event.

*Note that *some* events (such a power outages and freezes) are reported in the JEMRead Load Profile download.

MODEL NUMBER DESCRIPTION

This user manual is applicable to a broad range of *JEMStar* meter options. To determine the options on your meter, read the model number located in the center front of the meter faceplate and compare it to the following guide.

JEMStar Model Number -

Meter Form	Enclosure	Frequency	Display	Current	- Communication Options	I/O Options
05=Form 5 06=Form 6 08=Form 8 09=Form 9	A= A Base R= Switchboard S= Socket J2= JEM2 Retrofit Q= Quantum® Retrofit	5 = 50 Hz 6 = 60 Hz	0 = Std. LCD 1 = Backlit LCD Option	02 = Class 2 10 = Class 10 20 = Class 20	0 = None 1 = RS-232 2 = RS-485 3 = Modem 4 = Modem/RS-232 5 = Modem/RS-485 6 = Modem/ RS-485CR 7 = Modem/PHPF 8 = Modem/PHPF/RS-232 9 = Modem/PHPF/RS-485 A = Modem/PHPF/RS-485CR B = RS-232/485 Dual Comm. C = Ethernet/RS-232/485	0 = None 1 = DI/DO 2 = 0-1 mA 3 = 0-1 mA/DI/DO 4 = 4-20 mA 5 = 4-20 mA/DI/DO 6 = 5-KYZ

Acronym Key

DI = Digital Contact Inputs
DO = Digital Contact Outputs
CR = Communications Repeater
PHPF = Phone Home on Power Failure
KYZ = Form-C contact output

Typical Example

JS - 05R6020 – 93 - DNP

JS = *JEMStar*-Series meter
05 = Form 5
R = Small Switchboard (Relay) case
6 = 60 Hz operating frequency
0 = Standard LCD Display
20 = Class 20
-9 = Internal Modem with Phone Home on Power Failure, and RS-485 serial comm
3 = 0 – 1 mA Analog Output, Digital Contact Inputs, Digital Contact Outputs
-DNP = Distributed Network Protocol v3.0 option

Additional Firmware Options

- Demand Prediction
- 12 Channels Load Profile (4 are standard)
- DNP 3.0 protocol
- Modbus protocol
- Voltage Sag / Swell Detection and Logging
- External Energy Totalization

JEMSTAR SPECIFICATIONS

Product specifications are subject to change. Please consult the factory for updates, improvements, and new features.

Meter Forms

Form Number	Type
Form 5	3 wire wye & delta, network
Form 6	2-1/2 element wye
Form 8	4 wire delta
Form 9	4 wire wye

Current Classes

2 Amp (.0008 – 2A)
10 Amp (.004 – 10A)
20 Amp (.004 – 20A)

Measured Quantities

Integrated quantities

Integrated quantities are power measurement quantities that are integrated over time, and which may be accumulated. Integrated quantities are used for developing Consumption, Fixed or Sliding Window Demand (Peak or Coincident), Load Profile, or Pulse Contact outputs.

JEMStar measures the following integrated quantities:

- Watthours delivered/received, per-phase, polyphase total
- VARhours delivered/received, per-phase, polyphase total
- VAhours delivered/received, per-phase, polyphase total
- Amphours, per-phase (up to 3 phases), polyphase total
- Qhours delivered/received, per-phase, polyphase total
- V^2hours, A^2hours per-phase, polyphase total

Instantaneous quantities

Instantaneous quantities are short-term average or RMS measurements of electrical characteristics in a circuit. Instantaneous quantities are suitable for Instantaneous Registers, Thermal Demands, or analog outputs.

JEMStar measures the following instantaneous quantities:

- Watts and VARs delivered, received, or bidirectional per-phase, polyphase
- VA delivered, received, or bidirectional per-phase, polyphase
- Q delivered, received, or bidirectional per-phase, polyphase
- Volts and $Volts^2$ per-phase (up to 3 phases)
- System Volts (average of 2 or 3 phases depending on meter form)
- Amps per-phase, polyphase plus Neutral Current
- $Amps^2$ per-phase, polyphase
- PF per-phase, polyphase
- Frequency
- Volts THD per-phase
- Amps THD per-phase

Uncompensated Quantities
JEMStar is able to simultaneously provide both uncompensated and transformer- or line-loss compensated measurements for Watt / Watthour, VAR / VARhour, VA / VAhour, Q / Qhour, and Power Factor quantities in Display Registers, Load Profile, and KYZ pulse outputs. Analog outputs are always loss compensated if compensation is enabled in the meter.

Optional Features

JEMStar can be equipped with the following optional features.

- Additional 8 channels of Load Profile (4 channels included as standard)
- Demand Prediction
- External Energy Totalization
- Voltage Sag / Swell detection and logging
- Modbus and DNP communications protocols

Input Range Limits and Burdens

Current Inputs

Current Input Class	Operation Range	Overload Imax	Burden at T_A S-, A-Base	Burden at T_A Switchboard
Class 2	.0008–2 A	3.0 A	0.5 VA	0.5 VA
Class 10	.004–10 A	15 A	0.5 VA	1.25 VA
Class 20	.004–20 A	30 A	0.5 VA	2.5 VA

Voltage Inputs

Vnominal	69, 120, 240, 277, 380, 480
Vrange	55-530
Burden*	0.5 VA @ 530V

*Does not include auxiliary power requirements.

Current Overload
1.5x rated class current continuous 20x rated class current for 1 second

Auxiliary Power

Vnominal	69, 120, 240, 277, 380, 480
Vrange	55-530

Auxiliary Power Burden
15 VA maximum, 10 VA typical (normally derived from A-phase voltage input on S-base and A-base meters)

Accuracy

The nominal conditions referenced in the specifications are defined as follows:

V_{INPUT} = Nominal Input Voltage
T_A = Test Amperes = ½ Class Amps
I_{CLASS} = Meter Class Current
Full Scale = I_{CLASS} x V_{INPUT}

Class 10 and 20:				
Watthours (per phase, polyphase total):	**Class 10 Input Current**	**Class 20 Input Current**	**Accuracy (PF=1)**	**Accuracy (PF=0.5 lag)**
	0.5 to 10 A	0.5 to 20 A	0.07 % RD (0.03% RD typical)	0.1 % RD
	0.3 to 0.5 A	0.3 to 0.5 A	0.1 % RD	0.2 % RD
	0.1 to 0.3 A	0.1 to 0.3 A	0.2 % RD	0.25 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.25 % RD	
VARhours (per phase, polyphase total):	**Class 10 Input Current**	**Class 20 Input Current**	**Accuracy (PF=0)**	**Accuracy (PF=0.5 lag)**
	0.5 to 10 A	0.5 to 20 A	0.2 % RD	0.2 % RD
	0.3 to 0.5 A	0.3 to 0.5 A	0.2 % RD	0.3 % RD
	0.1 to 0.3 A	0.1 to 0.3 A	0.3 % RD	0.35 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.35 % RD	
VAhours, Qhours (per phase, polyphase total):	**Class 10 Input Current**	**Class 20 Input Current**	**Accuracy (PF=1)**	**Accuracy (PF=0.5 lag)**
	0.5 to 10 A	0.5 to 20 A	0.2 % RD	0.2 % RD
	0.3 to 0.5 A	0.3 to 0.5 A	0.2 % RD	0.3 % RD
	0.1 to 0.3 A	0.1 to 0.3 A	0.3 % RD	0.35 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.35 % RD	
Instantaneous Watts (per phase, polyphase total):	**Class 10 Input Current**	**Class 20 Input Current**	**Accuracy (PF=1)**	**Accuracy (PF=0.5 lag)**
	0.5 to 10 A	0.5 to 20 A	0.15 % RD	0.15 % RD
	0.3 to 0.5 A	0.3 to 0.5 A	0.15 % RD	0.25 % RD
	0.1 to 0.3 A	0.1 to 0.3 A	0.25 % RD	0.3 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.3 % RD	
Instantaneous Vars (per phase, polyphase total):	**Class 10 Input Current**	**Class 20 Input Current**	**Accuracy (PF=0)**	**Accuracy (PF=0.5 lag)**
	0.5 to 10 A	0.5 to 20 A	0.25 % RD	0.25 % RD
	0.3 to 0.5 A	0.3 to 0.5 A	0.25 % RD	0.35 % RD
	0.1 to 0.3 A	0.1 to 0.3 A	0.35 % RD	0.4 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.4 % RD	
Instantaneous VA, Q (per phase, polyphase total):	**Class 10 Input Current**	**Class 20 Input Current**	**Accuracy (PF=1)**	**Accuracy (PF=0.5 lag)**
	0.5 to 10 A	0.5 to 20 A	0.25 % RD	0.25 % RD
	0.3 to 0.5 A	0.3 to 0.5 A	0.25 % RD	0.35 % RD
	0.1 to 0.3 A	0.1 to 0.3 A	0.35 % RD	0.4 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.4 % RD	

Class 2:

	Class 2 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
Watthours (per phase, polyphase total):	0.1 to 2 A	0.1 % RD	0.1 % RD
	0.05 to 0.1 A	0.1 % RD	0.2 % RD
	0.025 to 0.05 A	0.2 % RD	0.4 % RD
	0.01 to 0.025 A	0.3 % RD	0.5 % RD

	Class 2 Input Current	Accuracy (PF=0)	Accuracy (PF=0.5 lag)
Varhours (per phase, polyphase total):	0.1 to 2 A	0.2 % RD	0.2 % RD
	0.05 to 0.1 A	0.2 % RD	0.3 % RD
	0.025 to 0.05 A	0.3 % RD	0.5 % RD
	0.01 to 0.025 A	0.4 % RD	0.6 % RD

	Class 2 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
VAhours, Qhours (per phase, polyphase total):	0.1 to 2 A	0.2 % RD	0.2 % RD
	0.05 to 0.1 A	0.2 % RD	0.3 % RD
	0.025 to 0.05 A	0.3 % RD	0.5 % RD
	0.01 to 0.025 A	0.4 % RD	0.6 % RD

	Class 2 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
Instantaneous Watts (per phase, polyphase total):	0.1 to 2 A	0.15 % RD	0.15 % RD
	0.05 to 0.1 A	0.15 % RD	0.25 % RD
	0.025 to 0.05 A	0.25 % RD	0.45 % RD
	0.01 to 0.025 A	0.35 % RD	0.55 % RD

	Class 2 Input Current	Accuracy (PF=0)	Accuracy (PF=0.5 lag)
Instantaneous Vars (per phase, polyphase total):	0.1 to 2 A	0.25 % RD	0.25 % RD
	0.05 to 0.1 A	0.25 % RD	0.35 % RD
	0.025 to 0.05 A	0.35 % RD	0.55 % RD
	0.01 to 0.025 A	0.45 % RD	0.65% RD

	Class 2 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
Instantaneous VA, Q (per phase, polyphase total):	0.1 to 2 A	0.25 % RD	0.25 % RD
	0.05 to 0.1 A	0.25 % RD	0.35 % RD
	0.025 to 0.05 A	0.35 % RD	0.55 % RD
	0.01 to 0.025 A	0.45 % RD	0.65% RD

Class 2, 10, 20

Instantaneous Volts (per phase, polyphase total):	**Class 2**	**Class 10**	**Class 20**
	0.15 % RD	0.15 % RD	0.15 % RD

Instantaneous Amps (per phase, polyphase total):	**Class 2**	**Class 10**	**Class 20**
	0.05 % RD + 0.025 % Iclass	0.05 % RD + 0.05 % Iclass	0.05 % RD + 0.025 % Iclass
	0.4 % RD 0.25A → 2.0A	0.4 % RD 0.25A → 10A	0.4 % RD 0.25A → 20A

Instantaneous Volts^2 (per phase):	**Class 2**	**Class 10**	**Class 20**
	0.2 % RD	0.2 % RD	0.2 % RD

Instantaneous Amps^2 (per phase, polyphase total):	**Class 2**	**Class 10**	**Class 20**
	0.2 % RD + 0.005 % Iclass^2	0.2 % RD + 0.005 % Iclass^2	0.2 % RD + 0.005 % Iclass^2

Volts^2 Hours (per phase):	**Class 2**	**Class 10**	**Class 20**
	0.2 % RD	0.2 % RD	0.2 % RD

Amphours (per phase, polyphase total):	**Class 2 Input Current**	**Class 10 Input Current**	**Class 20 Input Current**	**Accuracy**
	0.1 A to 2 A	1 A to 10 A	1 A to 20 A	0.3 % RD
	0.05 A to 0.1 A	0.5 A to 1 A	0.5 A to 1 A	0.6 % RD

Amp^{2}Hours (per phase, polyphase total):	**Class 2 Input Current**	**Class 10 Input Current**	**Class 20 Input Current**	**Accuracy**
		2 A to 10 A	2 A to 20 A	0.3 % RD
		1 A to 2 A	1 A to 2 A	1.0 % RD
		0.5 A to 1 A	0.5 A to 1 A	3.0 % RD

Measured Quantity (All):

Instantaneous Power Factor (per phase):	0.004 * FS / VAphase

Instantaneous Power Factor (system): **Form 5** **Form 6, 8/9**	 0.004 * 2FS / VAsystem 0.004 * 3FS / VAsystem

Volts THD:	1.0 % absolute		

Amps THD:	1.0 % absolute		

Loss Compensation

Type:	Transformer Loss Compensation (TLC) Line Loss Compensation (LLC)
Features:	Separate coefficients for delivered and received power User-configurable
Compensation Characteristics:	Line Watt loss Transformer copper Watt loss Transformer copper VAR loss Transformer iron Watt loss Transformer iron VAR loss
Loss Compensation On Registers:	Watts, Watthours, VARs, VARhours, VA, VAhours, Q, Qhours, PF

NOTE: Registers, Load Profile channels, or KYZ Pulse outputs that are individually selected to be "uncompensated" in JEMWare have the following accuracy modifications:

Class 10, 20 current range	**Class 2 current range**	**accuracy modifier (add to accuracy listed above)**
0.3A to Class Amps	**0.03A to Class Amps**	**add 0.05% of reading**
up to 0.3A	**up to 0.03A**	**add 0.10% of reading**

For example, an uncompensated Watthour register will have an accuracy of 0.12% at 10 A and 1.0 PF. If the same register is compensated (even though no compensation is enabled in the meter overall), that register will have an accuracy of 0.07%. See the JEMWare User Manual (document 1083-602) for details on how to select a register as "uncompensated."

Auxiliary Power

Requirements:	55 – 530 Volts AC 90 – 250 Volts DC (switchboard models only)
Source:	S-base and A-base: derived from A-phase voltage input Switchboard: separate terminals, AC or DC
Auxiliary Power Burden:	15 VA maximum; 10 VA typical
Power Factor Influence:	Maximum additional error due to power factor influence is ±0.002%/P.F. for P.F. less than 0.5.

Temperature Operating Ranges

External Environment	- 30° C to +85° C (- 30° C to +65° C with backlit display option)
Storage Temperature	- 40° C to +85° C
Max. average temperature coefficient for Watthour, Qhour, and VARhour:	±75 ppm of reading / °C, from -30°C to +85°C

Frequency Range

50 Hz	45 to 55 Hz
60 Hz	55 to 65 Hz

Clock Accuracy

External tracking (line frequency):	Accuracy of the clock is directly determined by the power system frequency, except during loss of auxiliary power to the meter. The internal reference accuracy is applicable for that time period.
Internal tracking:	3 minutes per month maximum error (crystal referenced)

Meter Creep

The meter does not creep	No pulses or registration will occur on any function that depends on current with the current circuit open.

Analog Outputs (Option)

Quantity	Three independent outputs
Type	Factory set for either 0 – 1 mA or 4 – 20 mA
0 – 1 mA Range	Source and sink up to 2.4 mA; Compliance ±10V max.
4 – 20 mA Range	External 24V loop supply required
Accuracy	
0 – 1 mA Range	0.1% of full scale output, derated by an additional 75 ppm of Rated Output per degree C difference from nominal temperature of 23°C.
4 – 20 mA Range	0.1% of full scale output, derated by an additional 50 ppm of span per degree C difference from nominal temperature of 23°C.
Usage	User-configurable for any instantaneous quantity

Pulse/Contact Alarm Outputs (Option)

Pulse Outputs based on:	Watthours, VARhours, VAhours, Qhours, Amphours, V^2hours, A^2hours
Analog & Alarm Outputs based on:	Watts, VARs, VA, Q, Amps, $Amps^2$, Volts, $Volts^2$, PF, THD, and Frequency
Quantity	Four outputs using DI/DO board Five outputs using 5-KYZ board
Type	**DI/DO:** Two-wire, dry Form-A solid-state switching FET, requires external wetting voltage; configurable for N.O. or N.C. operation via JEMWare software. **5-KYZ:** Three-wire, dry Form-C, solid-state switching FET, requires external wetting voltage; configurable via JEMWare software.
Max. open-circuit voltage	200V DC or peak AC
Max. closed-circuit Saturation voltage drop	2.5 V at 30 mA max
Max. rated switching current	50 mA
TTL-compatible output	External 4.7 kΩ pull-up to +5Vdc
Usage	User-configurable to monitor: - Any consumption quantity

	- Energy pulse constant (KYZ mimic) - Site Monitor alarm - Threshold alarm - Demand Sync - Voltage Sag / Swell alarm - System Error alarm
Max. Rate of Operation	20 transitions per second (e.g.: 10 full close/open pulse cycles per second)

Test Outputs

Type	IR LEDs test outputs are provided through the optical port transmitter, which becomes a test output when the meter is in the test mode.

Contact Inputs (Option)

Quantity	Two independent inputs
Type	Two-wire, Form-A contact inputs (require an external dc current to activate a photo transistor)
Minimum ON Voltage	l0 Vdc
Maximum ON Voltage	40 Vdc
Maximum Input Current	50 mA
Maximum Pulse Rate	10 transitions per second
Usage	User-configurable for: - Pulse counter - Interval Synchronization Pulse - TOU Rate Override - Status Input - Totalization input

Registers

Instantaneous Registers

Characteristics	- Updated every 1.5 seconds - Average of 1.5 seconds
Displayed Quantities:	
Per Phase and Polyphase	W Del, W Rec,, W Bidirectional, VAR Del, VAR Rec, VAR Q1, VAR Q2, VAR Q3, VAR Q4, VAR Bidirectional, VA Del, VA Rec, VA Bidirectional, Volts, Amps, Q Del, Q Rec, Q Bidirectional, PF Del, PF Rec, PF Bidirectional, V^2, A^2
Per Phase	Volts THD, Amps THD
Phase A only	Frequency

Consumption Registers

Characteristics	- Updated no less than every 2 seconds - Configurable to be associated with any Time of Use (TOU) Rate. If associated with any rate other than Total, the Consumption Register shall accumulate only energy measured while that rate is active
Displayed Quantities:	
Per Phase and Polyphase	Wh Del, Wh Rec, VARh Del, VARh Rec, VAh Del, VAh Rec, VARh per quadrant, Ah, Qh Del, Qh Rec, V^2h, A^2h
Display scaling	In secondary (at meter terminals) or primary (at PT / CT input) units
Preset	Any desired value that may be displayed
Register Retrieval	By serial communications

Totalization Registers (optional)

Characteristics	- Special-purpose Consumption registers - Displayed quantities, scaling, preset, and register retrieval are identical to Consumption registers. - May be configured to add additional accumulation in response to energy pulses received on the *JEMStar*'s Contact Input channels. See the JEMWare User Manual (document 1083-602) for details on setting up Totalization registers.

Average Power Factor Registers

Characteristics	Configurable to be associated with any Time of Use (TOU) Rate. If associated with any rate other than Total, the Average PF Register is based only on energy accumulated while that rate is active. Average Power Factor is available only as a register.
Display	Average Power Factor (PF) for the Billing Period.
Calculation	The PF is calculated continuously from Watts and VAs accumulated since the last Billing Period Reset. The accumulators are cleared on a Billing Period Reset.

Demand (Fixed or Sliding Window) Registers

Displayed Quantities:	
Per Phase and Polyphase	W Del, W Rec, VAR Del, VAR Rec, VA Del, VA Rec, VAR per quadrant, A, Q Del, Q Rec
Display scaling	In secondary (at meter terminals) or primary (at PT / CT input) units.
Demand Interval Length	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, or 60 minutes Configurable for one or more subintervals per interval, as long as the total interval length (number of subintervals per interval times subinterval length) equals one of the periods listed above. No more than 12 subintervals per interval.
Preset	Any desired value that can be displayed
Register Retrieval	By serial communications

Peak Demand

Displayed Quantities	Normal peak, Cumulative Demand, or Continuous Cumulative Demand
Characteristics	Configurable to be associated with any Time of Use (TOU) Rate. If associated with any rate other than Total, the Peak Demand Register is calculated only on energy measured while that rate is active.

Time of Peak Demand

Displayed Quantities	Time or Date at which the corresponding Peak Demand occurred

Coincident Demand

Displayed Quantities:	
Per Phase and Polyphase	W Del, W Rec, VAR Del, VAR Rec, VA Del, VA Rec, VAR per quadrant, A, Q Del, Q Rec
Display scaling	In secondary (at meter terminals) or primary (at PT / CT input) units.
Demand Interval Length	Matches the corresponding Peak Demand length
Preset	Any desired value that may be displayed
Register Retrieval	By serial communications

Coincident Power Factor

Displayed Quantities	Average PF over the Demand Interval in which a Peak Demand was established

Thermal Demand Registers

Types	Thermal Demand Peak Thermal Demand Time of Peak Thermal Demand
Displayed Quantities:	
Per Phase and Polyphase	W Del, W Rec, VAR Del, VAR Rec, VA Del, VA Rec, VAR per quadrant, Volts, A, Q Del, Q Rec, PF
Per Phase	Volts THD, Amps THD
Phase A only	Frequency

Demand Prediction Registers (optional)

Displayed Quantities:	
Per Phase and Polyphase	W Del, W Rec, VAR Del, VAR Rec, VA Del, VA Rec, VAR per quadrant, Amp, Q Del, Q Rec

Periodic Self-Read

Records Displayed	Date and time of the Self Read Health Status summary Up to 4 Registering quantities
Storage	Up to the 36 most recent Self Read records
Configurable for:	- Every Demand (Sub)Interval Closure - Every Hour - Every Day - Every Month - Every Billing Period Reset

Status Registers

Storage	Time, date, firmware version, comm setting, and health status

Time of Use Registers

Description	- Four season schedules - Nine day types including each day of the week and two holiday types - Twenty-year calendar with up to 200 holidays specified - Each measurement register can be associated with one of nine time-of-use rates (A – H, and Total) - Up to eight rate changes can be specified for each day type

Load Profile

Displayed Quantities:	
Per Phase and Polyphase	Wh Del, Wh Rec, VARh Del, VARh Rec, VAh Del, VAh Rec, VARh per quadrant, Ah, Qh Del, Qh Rec, Avg. W Del, Avg. W Rec, Avg. VAR Del, Avg. VAR Rec, Avg. VAR per quadrant, VA,Volts, Amps, Power Factor, Hertz, Volts-THD, Amps-THD, Pulses, Status, A^2, V^2, A^2h, V^2h, Q, Qhr, Totalization channels 1 - 12
Description	- Up to 12 channels of storage (four standard) - Programmable interval length (1, 2, 3, 4, 5, 6, 10, 12, 15, 30, and 60 minutes); independent of Demand Interval - May record optional Totalization channels as well. See Totalization registers above.

Communication Ports

Optical Port

Description	- Type 2, Front panel mounted - Mating Sensor can be attached with the meter cover installed (magnetic type), or cover removed (hanging type) - Complies with ANSI C12.13-1991, Section 3.6 - Uses JEM Binary Protocol - User configurable for 300 to 19200 baud

RS-232

Description	- Supports Tx, Rx, Gnd, and RTS signals - Half duplex operation - Configurable for 300 to 38400 baud - Mutually exclusive with RS-485 option - Configurable for all JEMStar protocols

RS-485

Description	- Supports Tx, Rx, Gnd signals - Configurable for 300 to 38400 baud - Mutually exclusive with RS-232 option - Configurable for all JEMStar protocols - Network up to 32 meters with CommRepeater option - Recommended max. cable length: 4000 feet; actual length is dependent upon environment

Dual Communication Option

Description	- 2 independent serial ports - User-configurable for RS-232 or RS-485 - Modem is NOT available with this option

Internal Modem Option

Description	- Configurable for 300 to 14400 baud - Configurable answer schedule - Configurable for JEM Binary protocol
Compliance	- CCITT: V.34 bis, V.34, V.32 bis, V.32, V.22 bis,V.22, and V.21 - Bell®: 212A and 103
Speeds	- 14400, 9600, 2400, 1200, and 300 bps - Industry Standard ‘AT’ command set - V.42/MNP® protocols (Error correction: V.42, MNP® 2-4, and MNP 10)
Data Compression	V.42 bis and MNP 5

Call-Home on Power Outage Modem Option

Description	- Internal modem that calls up to 4 telephone numbers and transmits a message during power failure - User configurable phone numbers and messages

Communication Repeater

Description	- Permits up to 32 meters to be grouped using a single internal modem - Requires the RS-485 option installed in each meter of a group

Ethernet Option

Features include:	- 10 Base-T physical layer; RJ45 connector - Up to four simultaneous connections - Supports all available serial protocols: - Modbus RTU, ASCII slave mode - DNP 3.0 - ANSI Tables - JEM Binary

Environmental

Specification:

Operable in weather, rain, and salt-spray environments as specified in ANSI Standard C12.16: Sections 7.2 and 7.4.

Operating Temperature Range

-30º to +85 ºC continuous with no coincident solar influence.
Basic meter accuracy is derated by 75 ppm of Reading per degree C variance from nominal 23ºC.

Display Operating Range

Readable: -20 to +85 ºC with no coincident solar influence

Storage Range

Unpowered: - 40 to +85 ºC

Humidity

5 to 95% relative humidity, non-condensing

External Magnetic Fields

Compliance with ANSI Standard C12.16-1991: American National Standard for Solid-State Electricity Meters, Section 10.2.4

RF Interference (RFI)

Compliance with ANSI Standard C12.16-1991: American National Standard for Solid-State Electricity Meters, Section 10.2.10

Electrostatic Discharge (ESD)

Compliance with ANSI Standard C12.16-1991: American National Standard for Solid-State Electricity Meters, Section 10.2.11

Insulation

Voltage / Current Inputs	In accordance with ANSI Standard C12.16-1991: American National Standard for Solid-State Electricity Meters, Section 10.2.1
Auxiliary Power Input: (Switchboard only)	1500 Vrms, 60Hz for 1 minute between Aux. Power and voltage input. 2500 Vrms, 60Hz for 1 minute between Aux. Power and all other inputs, outputs and case.
Contact Inputs	500V RMS, 60Hz for 1 minute between each contact input circuit and any other contact input circuit 1 kV RMS, 60Hz for 1 minute between each contact input circuit and all other circuits, terminals, and case

Contact Outputs	500V RMS, 60Hz for 1 minute between each contact output circuit and any other contact output circuit 1 kV RMS, 60Hz for 1 minute between each contact output circuit and all other circuits, terminals, and case
Communication Ports	
RS-232/RS-485 Ethernet:	1 kV RMS, 60Hz for 1 minute between the RS-232/485 and Ethernet circuits and all other circuits, terminals, and case
Modem	1 kV RMS, 60Hz for 1 minute between the modem telephone line circuit and all other circuits, terminals, and case

Surge Withstand (SWC)

In compliance with ANSI Standard C37.90.1-1989: IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems: Section 2.2 (Oscillatory SWC) and related sections

Fast Transient

In compliance with IEC Standard 687 Section 5.5.4: Fast Transient Burst Test

Agency Standards and Certification

ANSI	Tested and certified to comply with ANSI Standard C12.16-1991.
IEC	Tested and certified to comply with IEC Standard 60687:1992
FCC	The internal modem complies with FCC Part 68

METER INSTALLATION

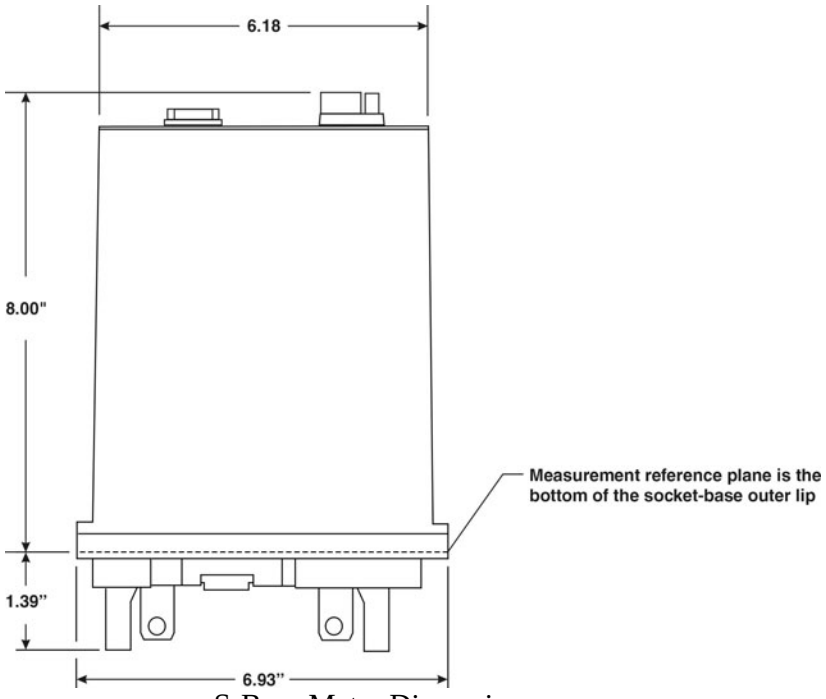
CASE STYLES

JEMStar is available in the following case styles:

- Socket connected (S base), conforming to ANSI standard C12.10-1987, Section 5
- Small Switchboard case
- Adapter to convert S-base meter to bottom-connected (A-base) style

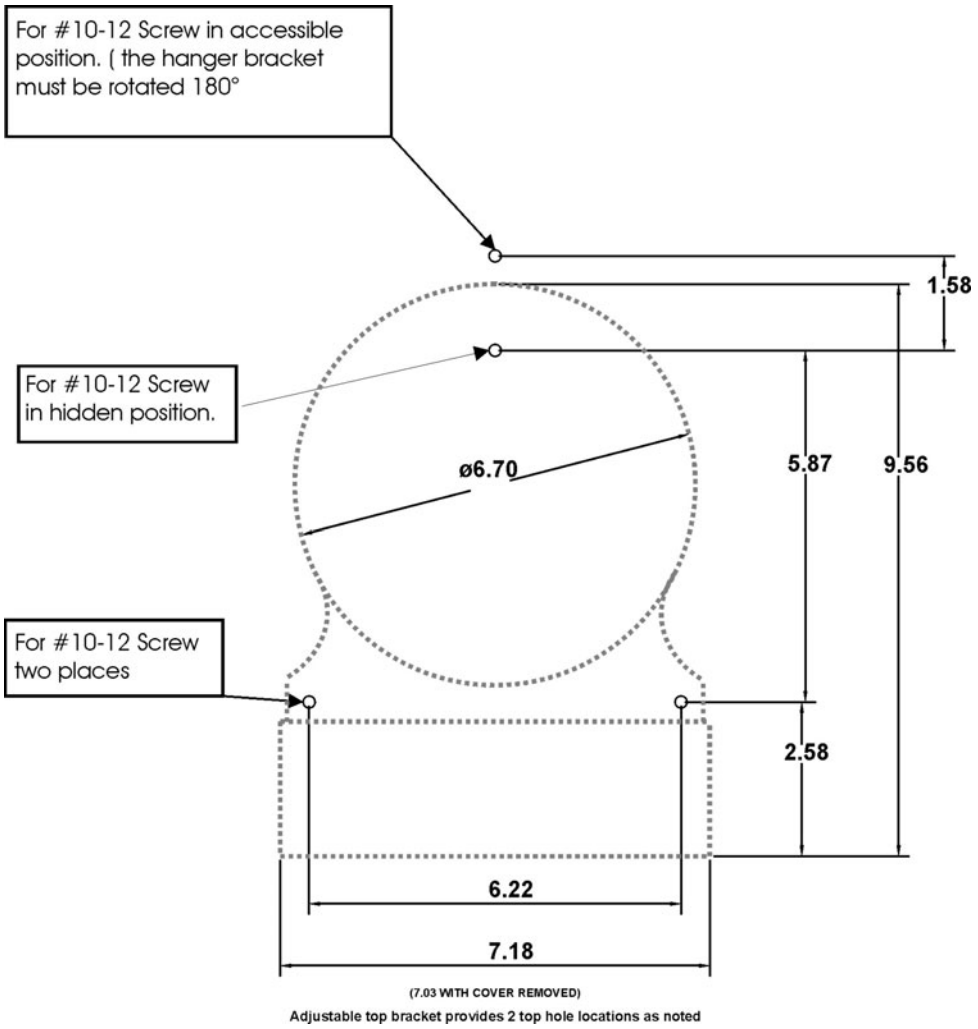
Size and Weight

- S base: 5.5 pounds
- Meter with A-base adapter: 7.5 pounds
- Small switchboard case: 11.5 pounds



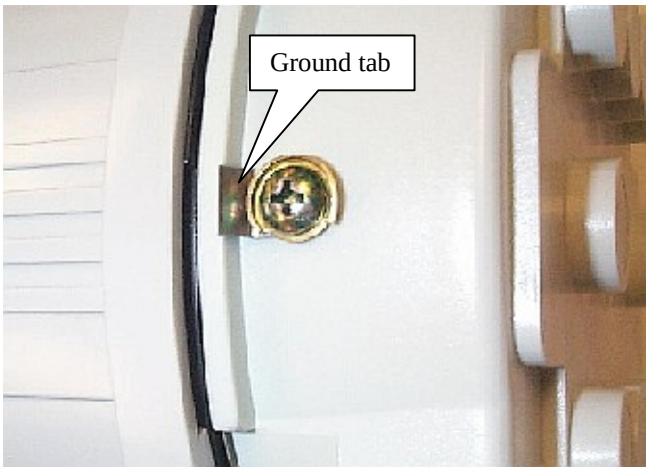
S-Base Meter Dimensions

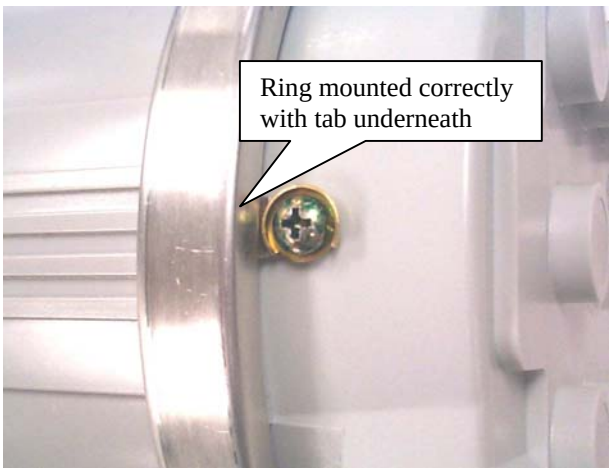
A-Base Mounting



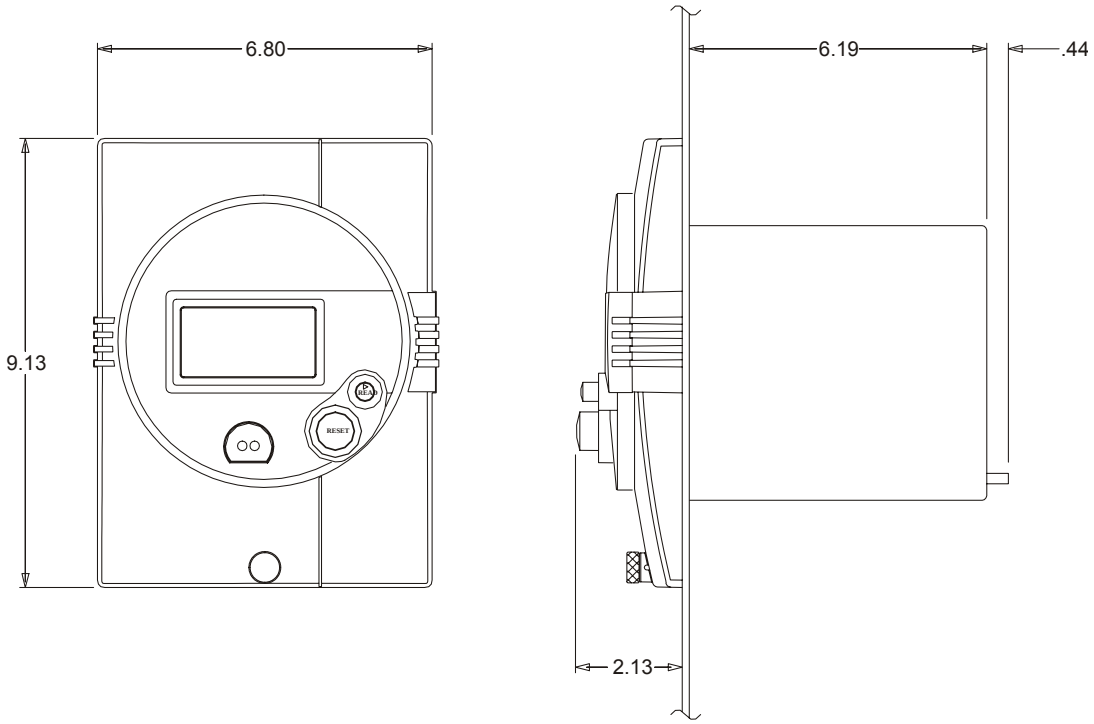
A-Base Adapter Mounting Dimensions
(With S-base meter installed, total depth in front of mounting panel is 10.25")

IMPORTANT: When installing the meter locking ring on the A-base adapter, be sure that the ground tab on the right side of the adapter is securely fitted *under* the ring.



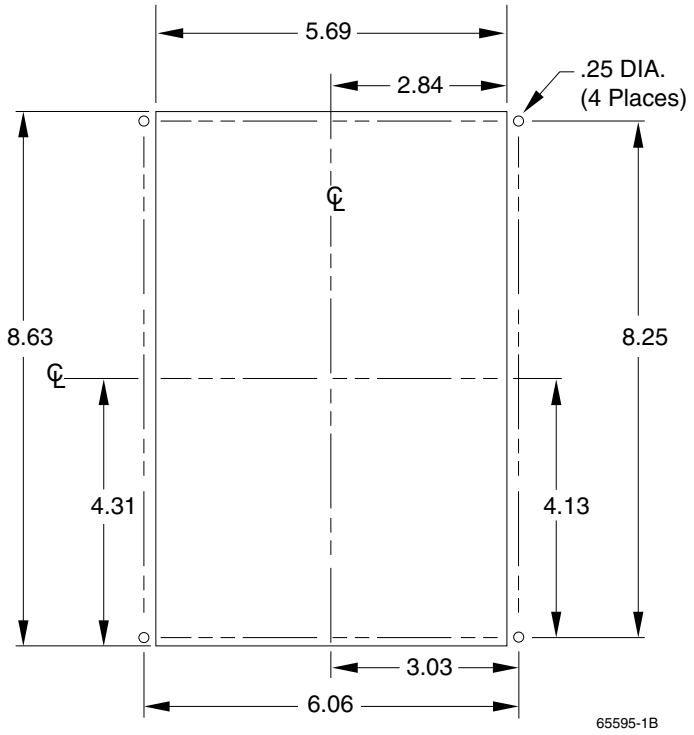


Switchboard Case Mounting



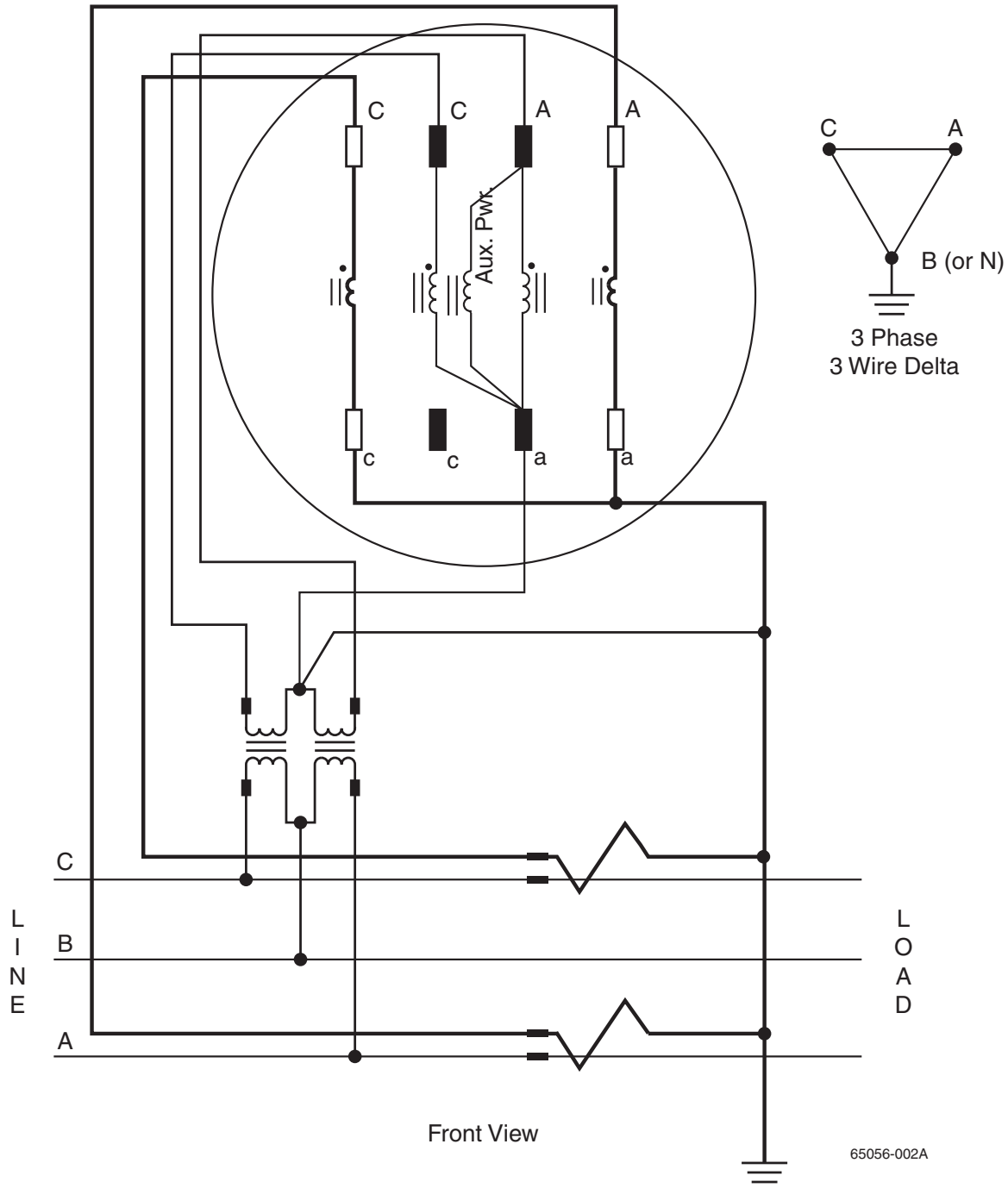
Switchboard Case Meter Dimensions

Panel Cutout Dimensions

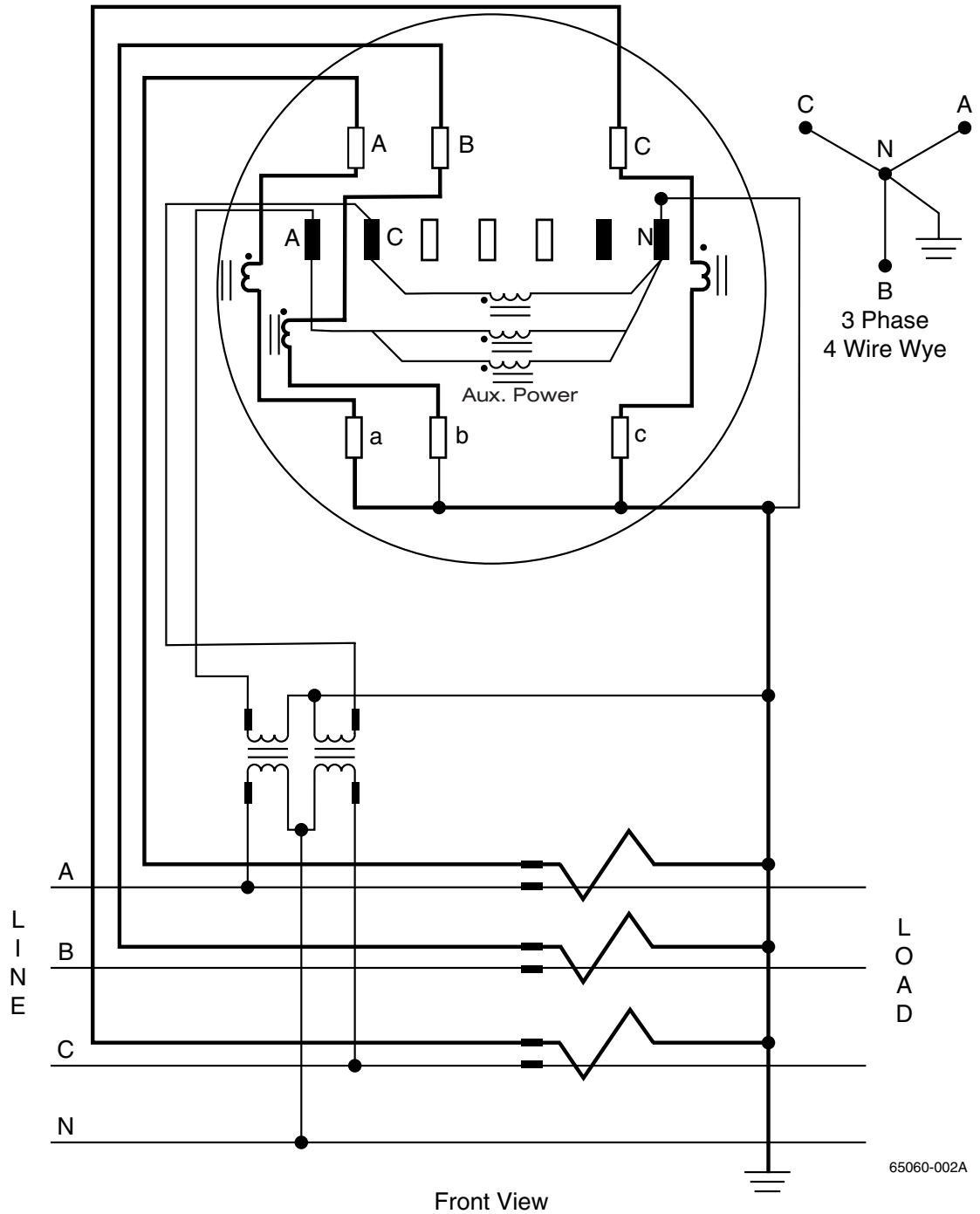


WIRING DIAGRAMS

Form 5S 2 Element 3 Wire Delta

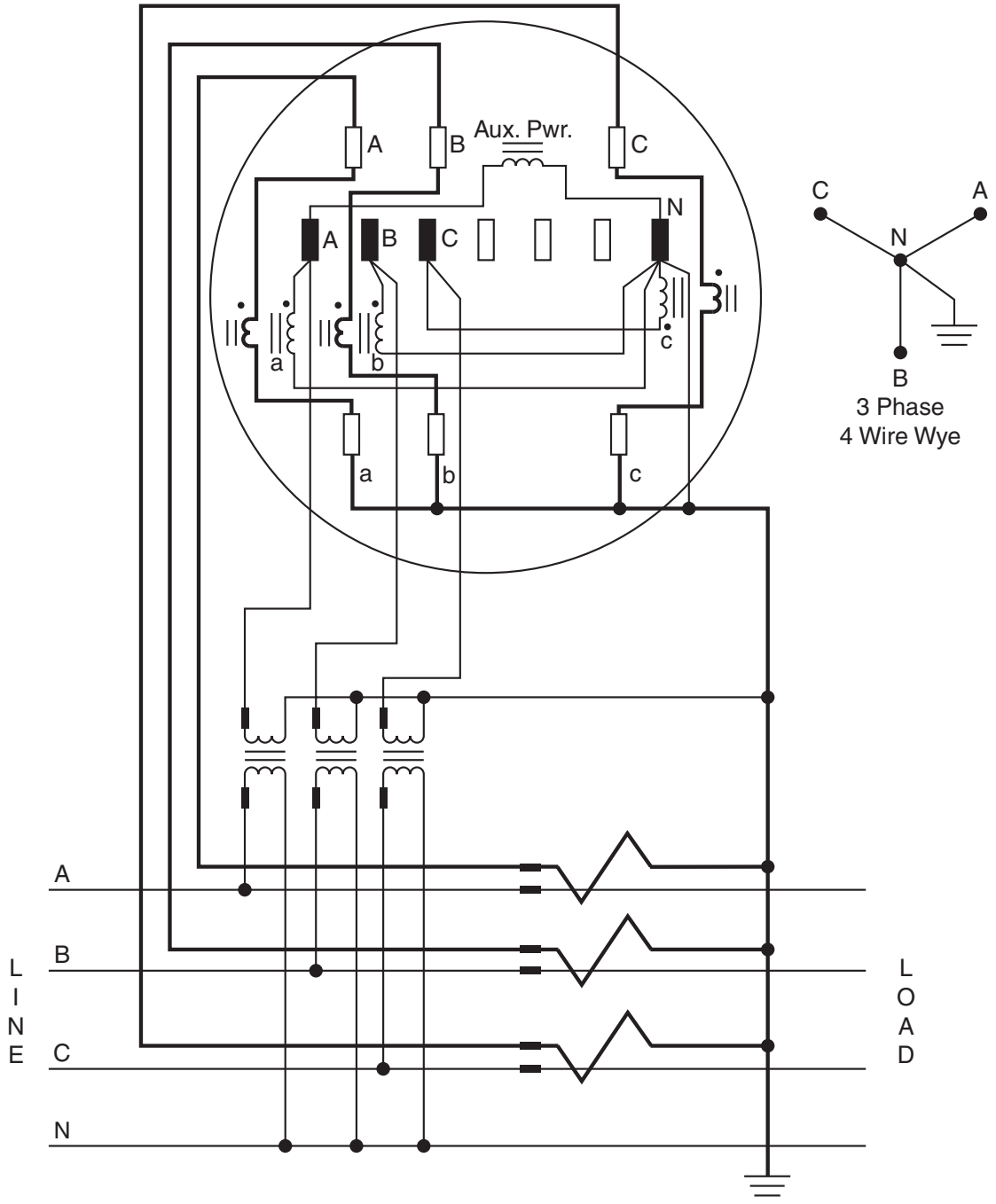


Form 6S 2½ Element 4 Wire Wye

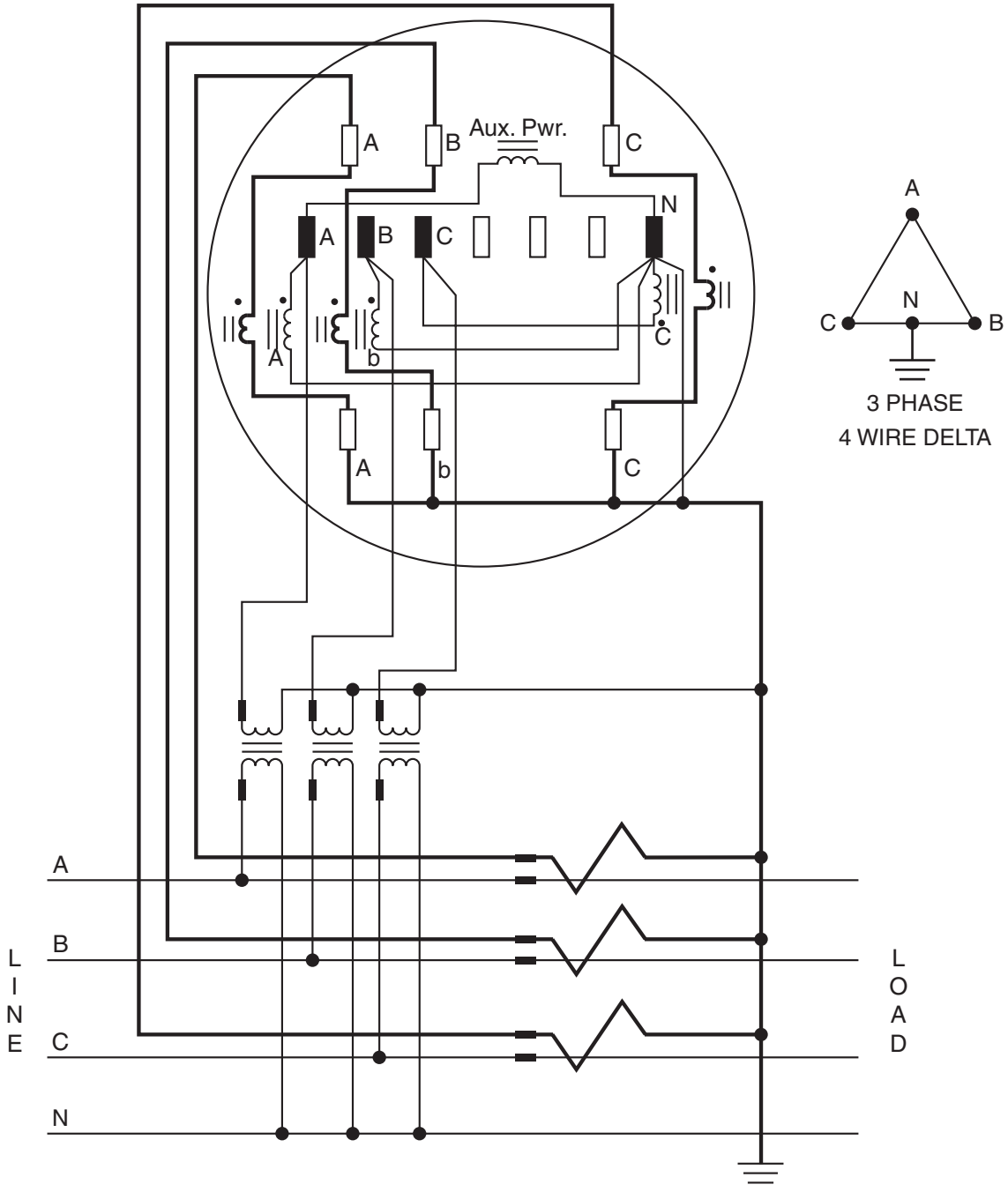


Front View

Form 9S 3 Element 4 Wire Wye

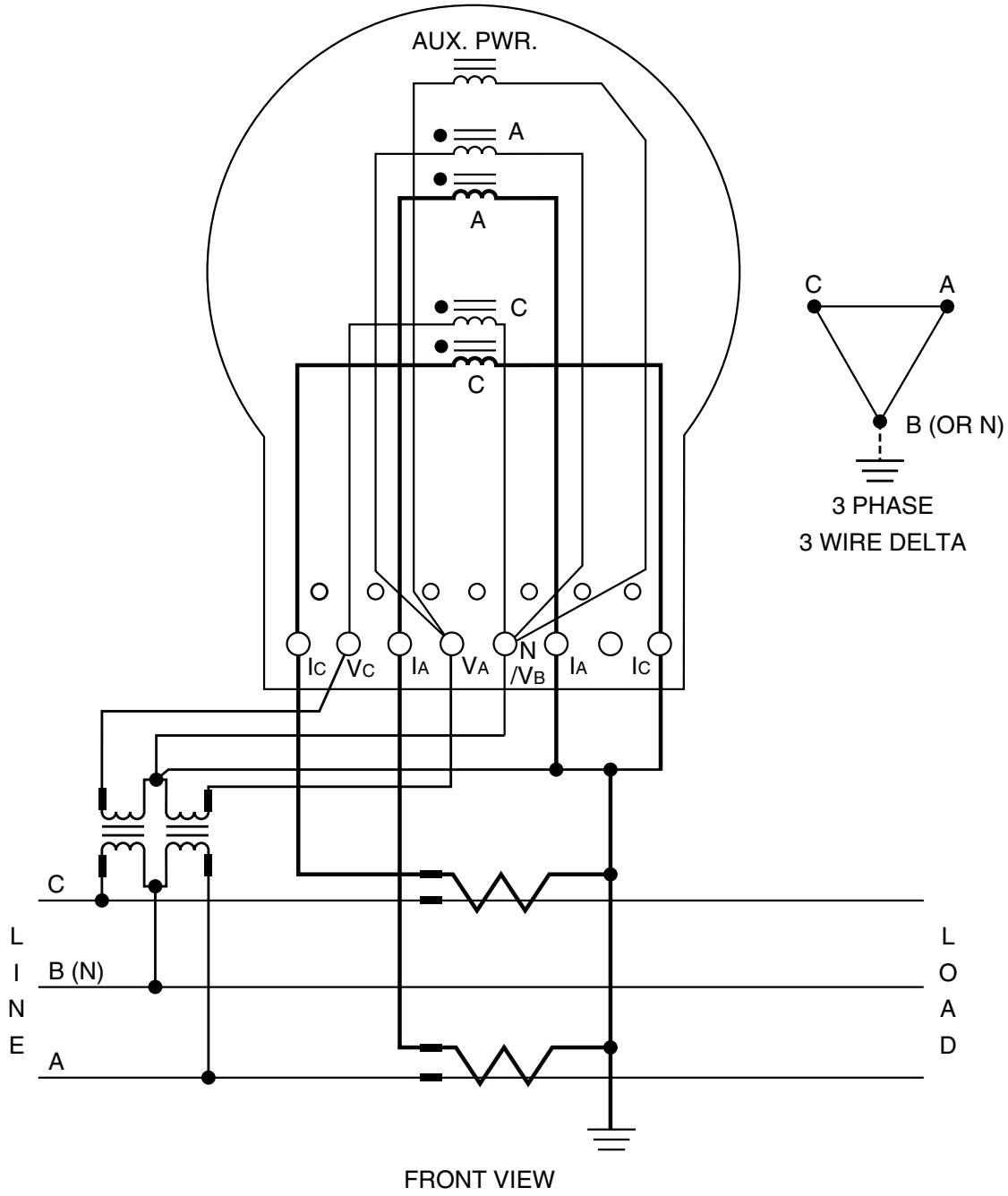


Form 8S 3 Element 4 Wire Delta

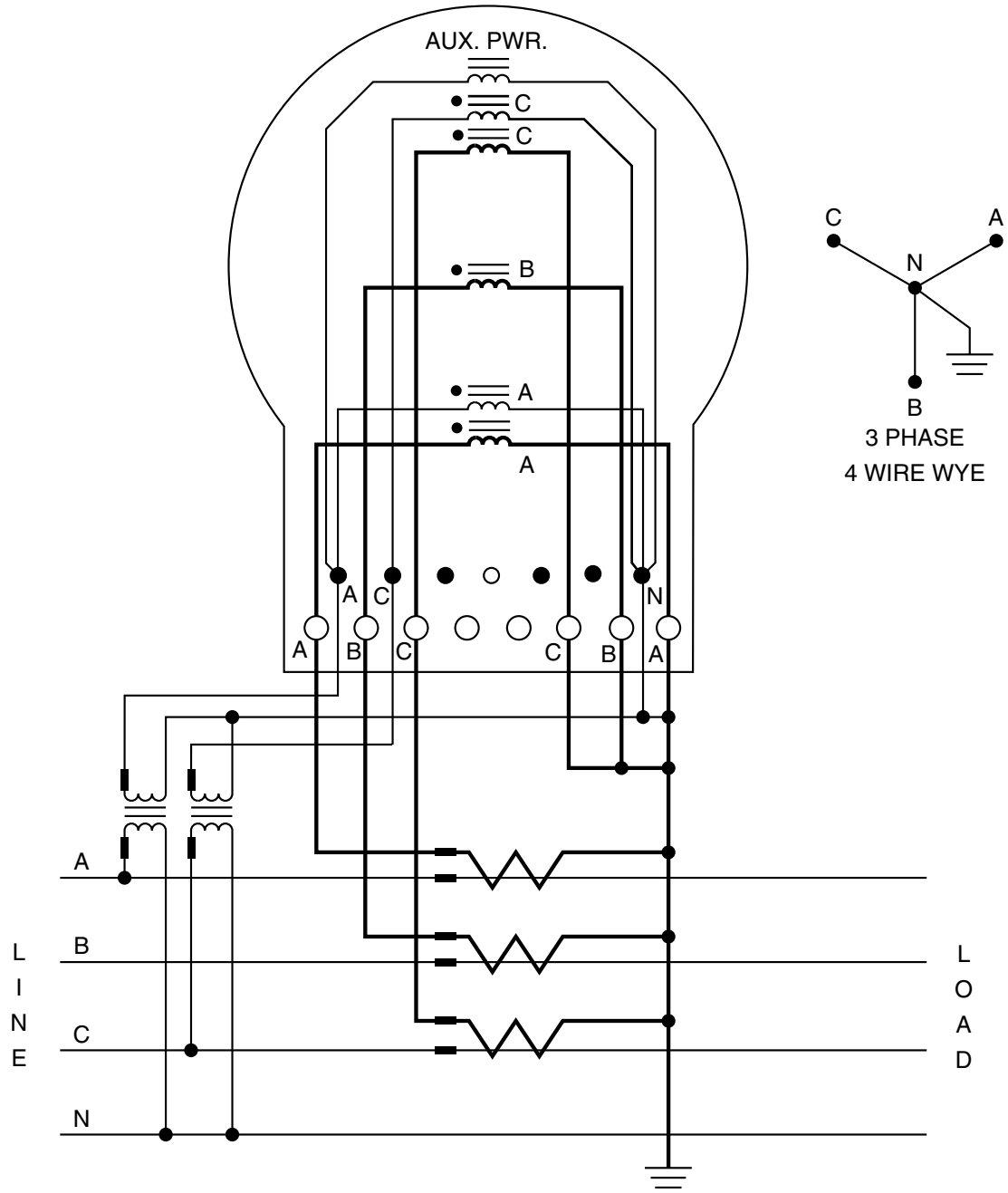


Front View

FORM 5A 2 ELEMENT 3 WIRE DELTA

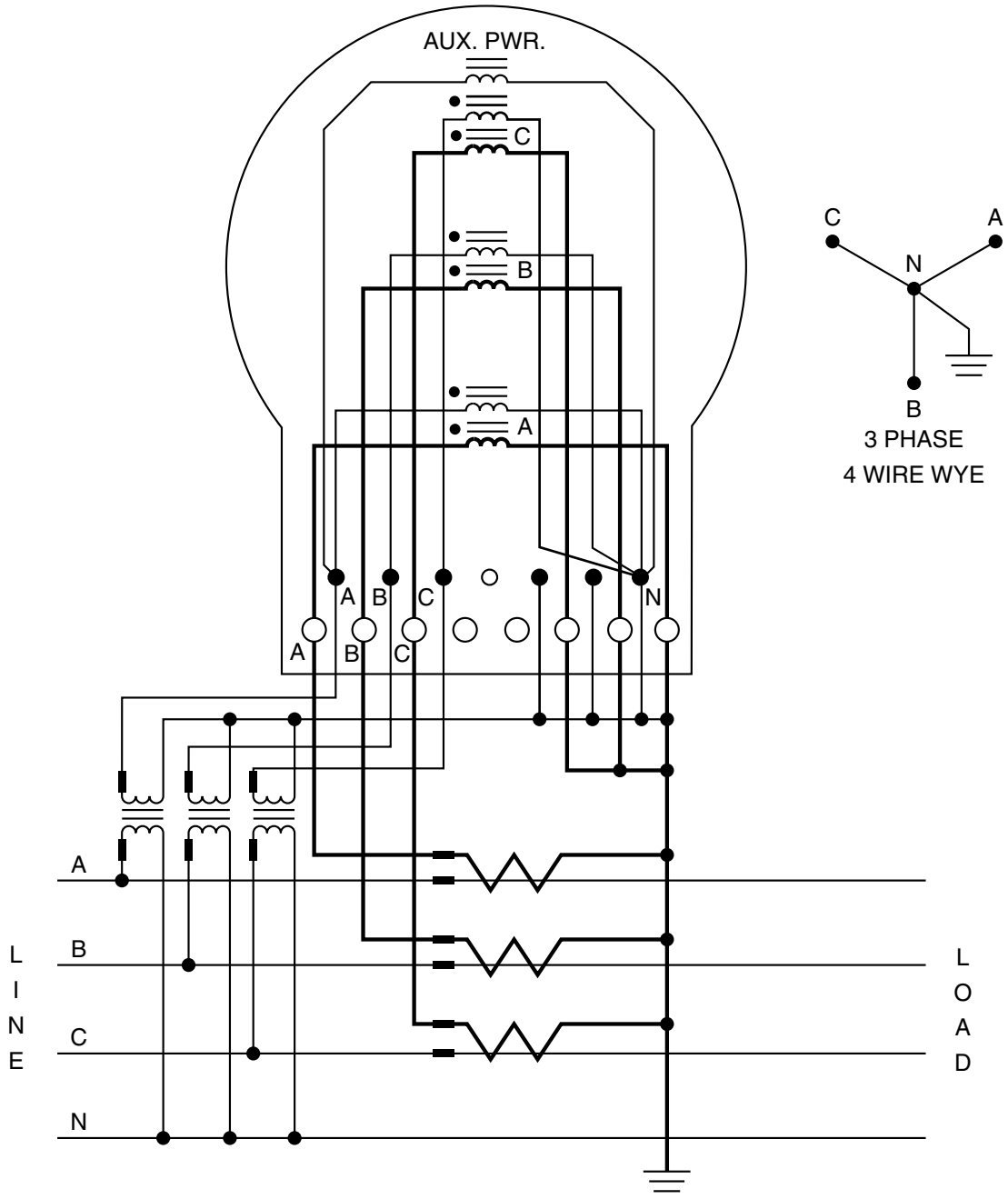


FORM 6A 2 1/2 ELEMENT 4 WIRE WYE



FRONT VIEW

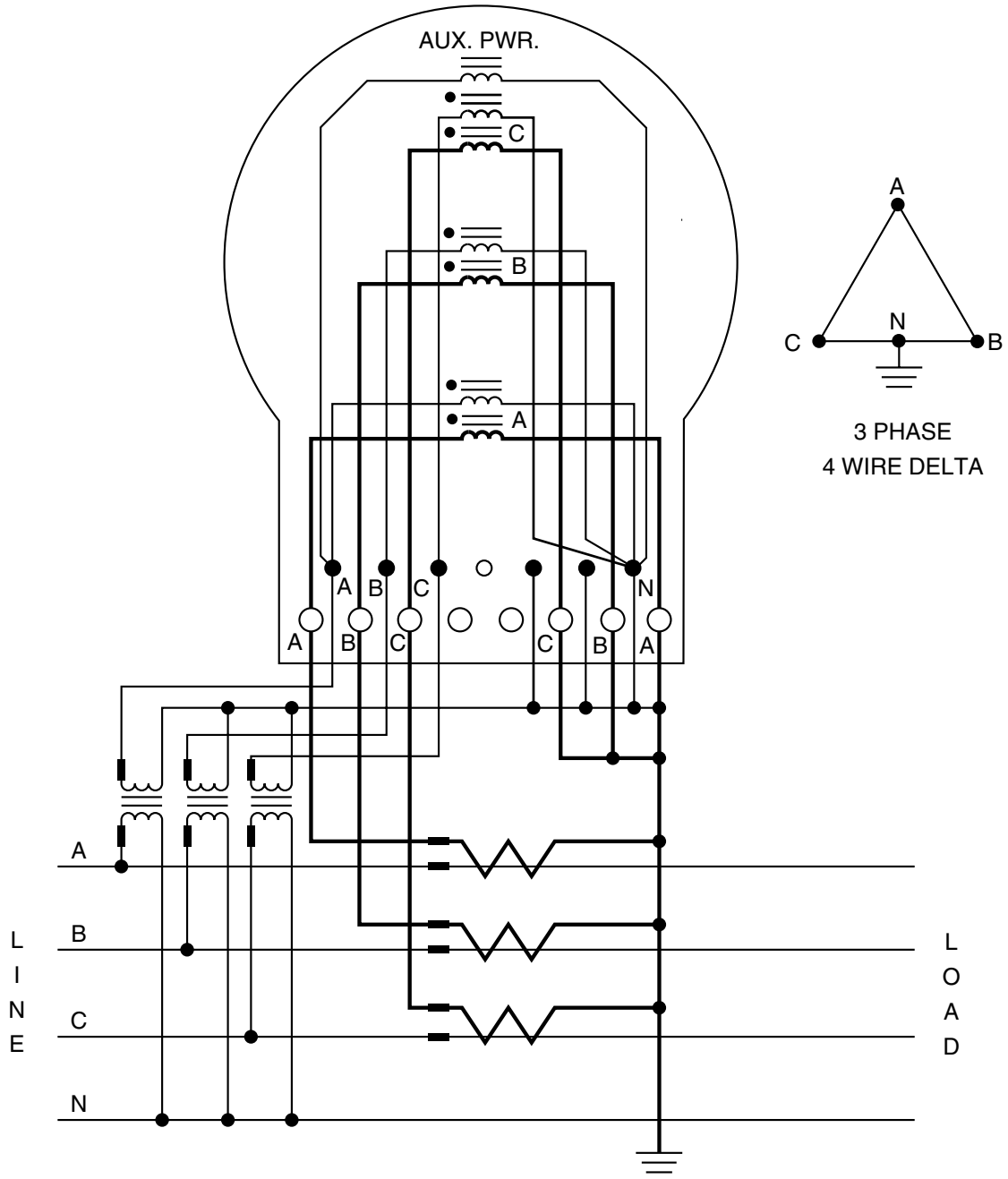
FORM 8A/9A 3 ELEMENT 4 WIRE WYE



3 PHASE
4 WIRE WYE

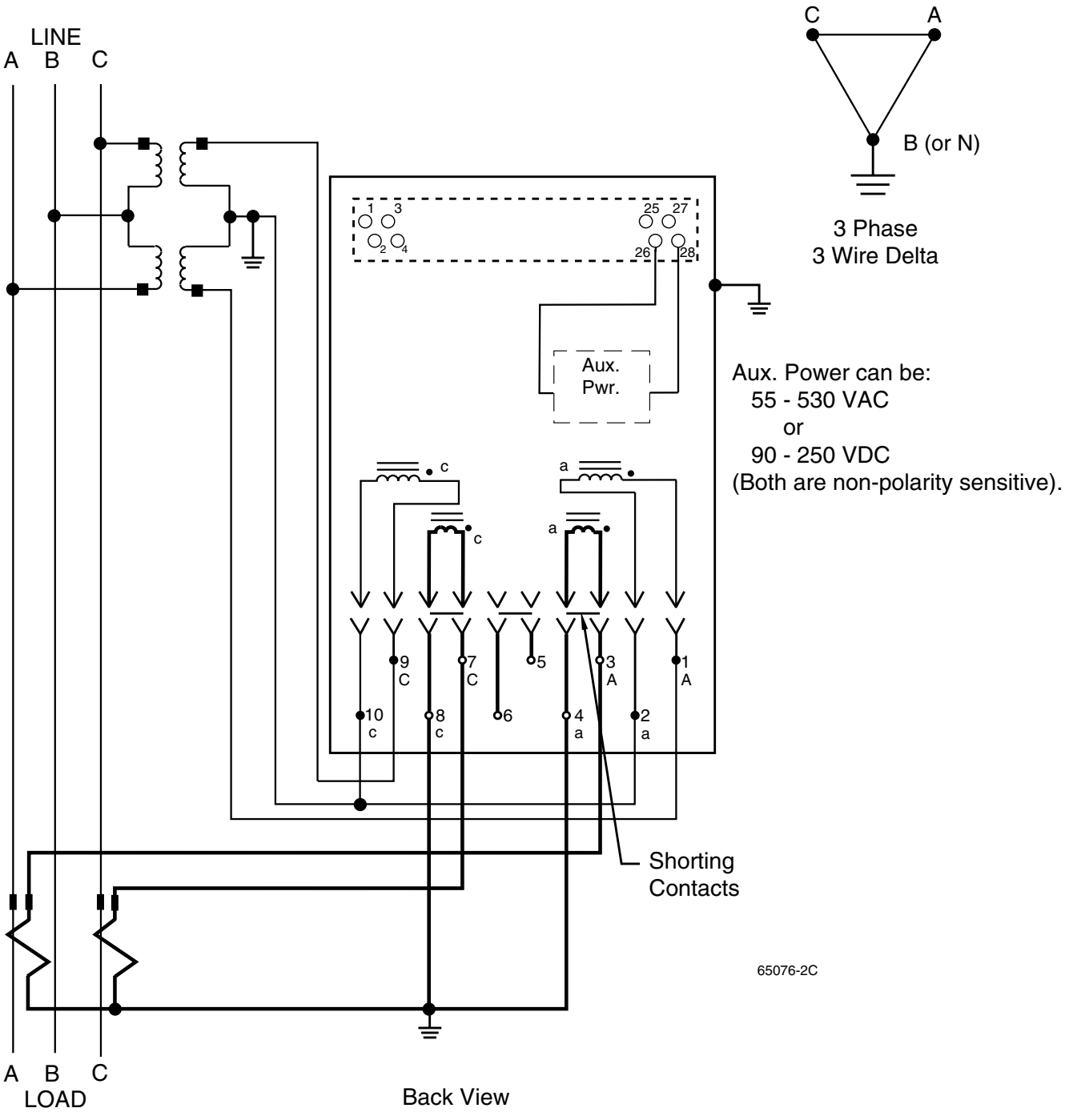
FRONT VIEW

FORM 8A/9A 3 ELEMENT 4 WIRE DELTA

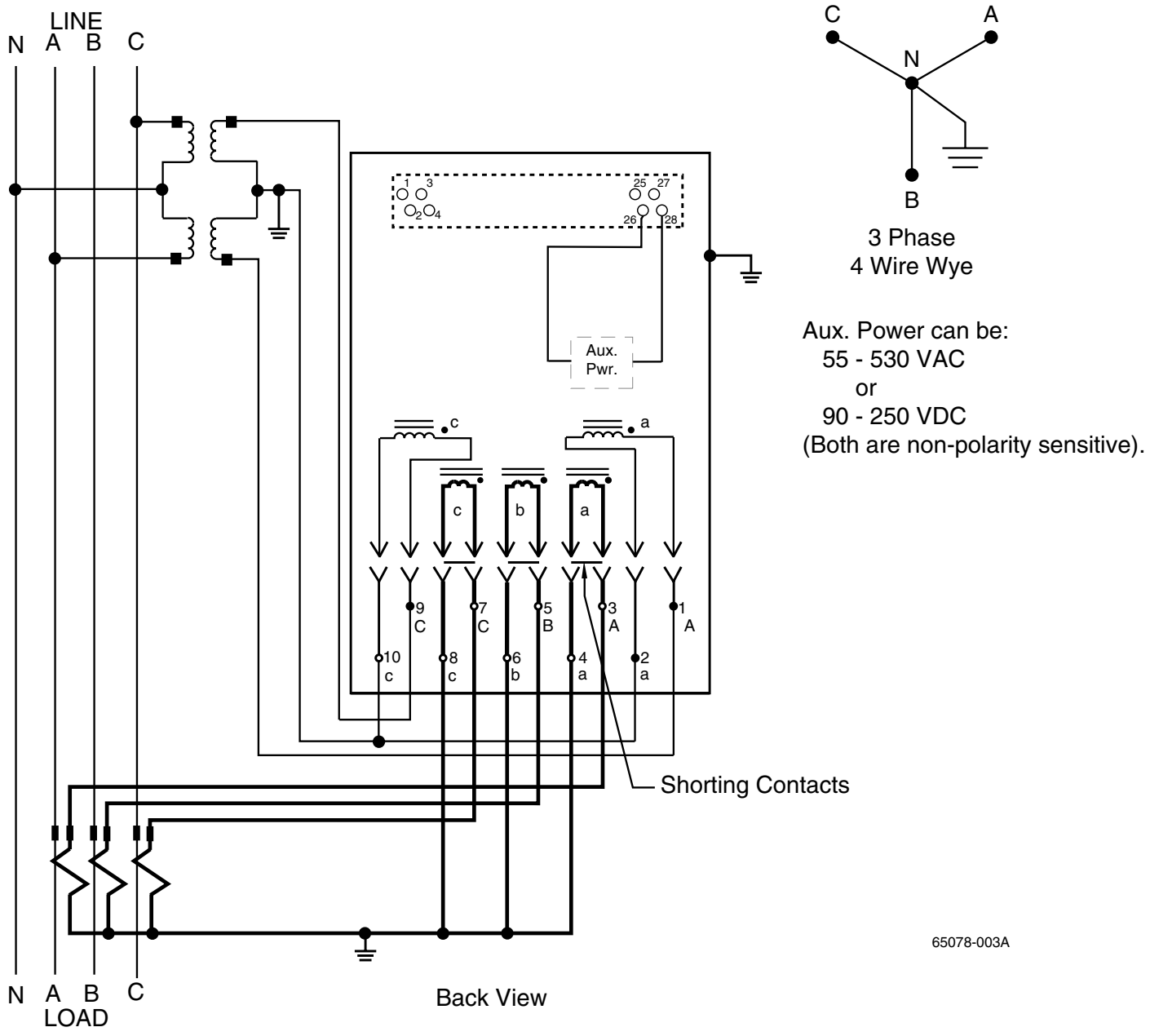


FRONT VIEW

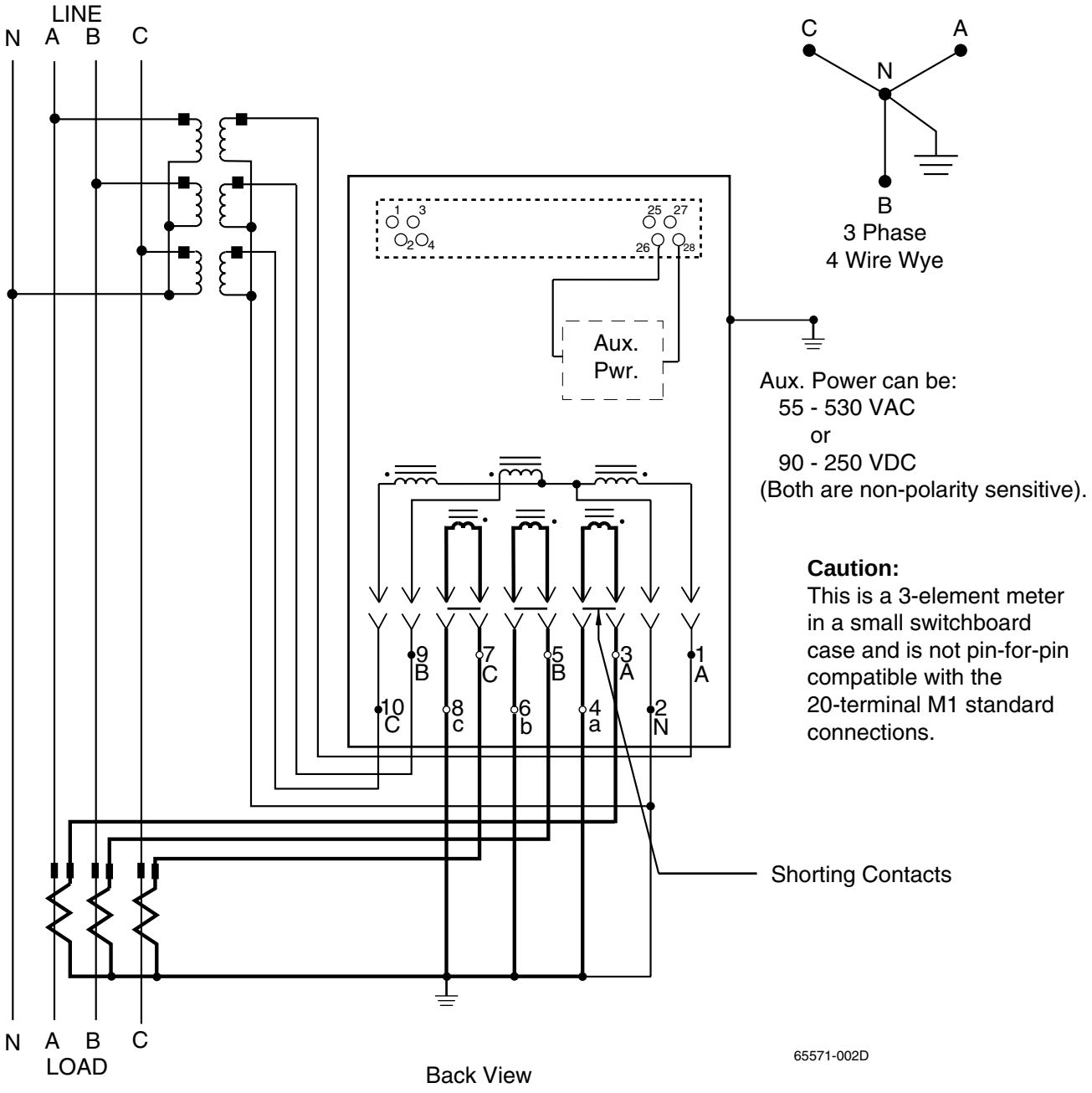
5R Switchboard 2 Element 3 Wire Delta



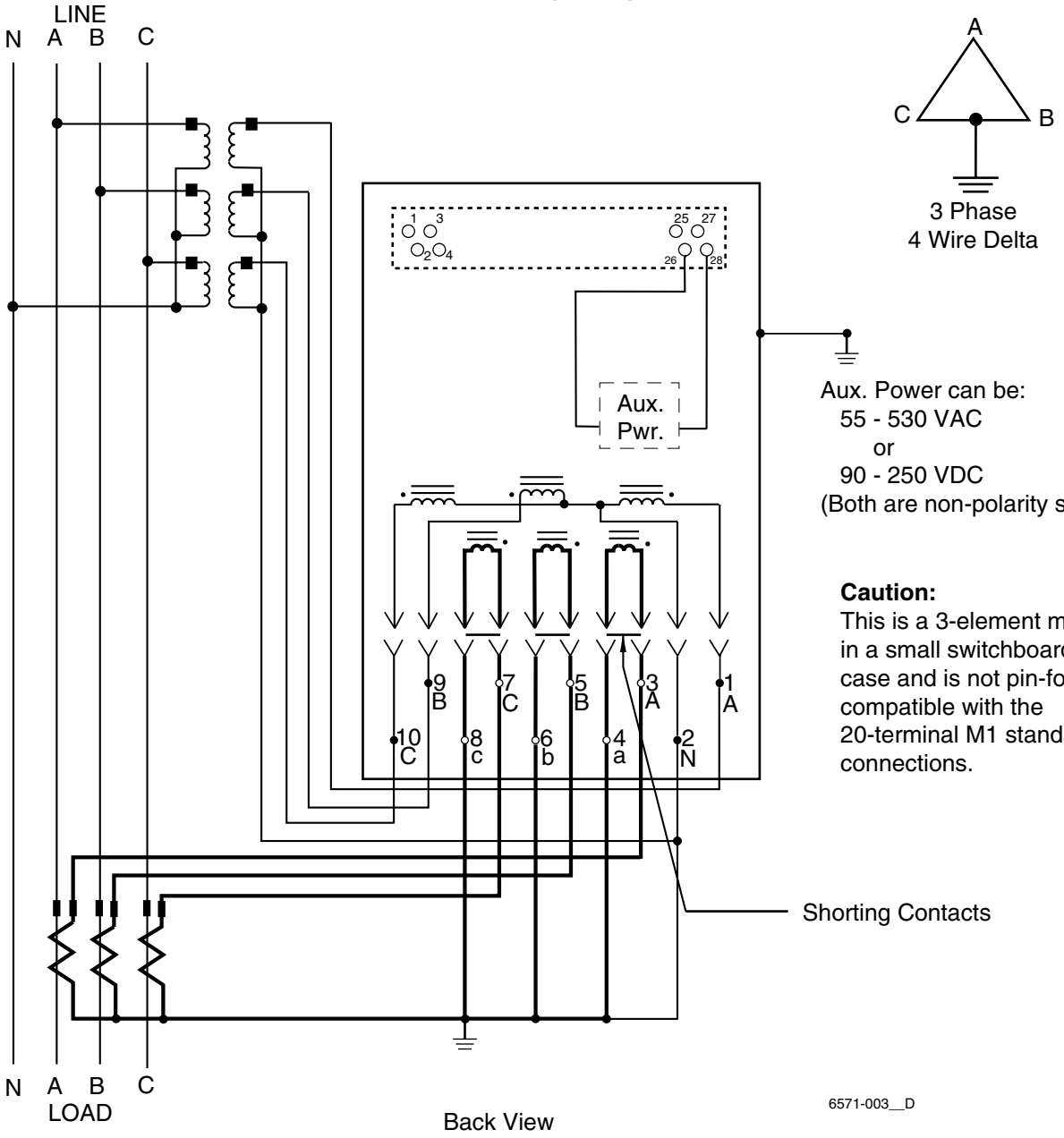
6R Switchboard 2½ Element 4 Wire Wye



9R Switchboard 3 Element 4 Wire Wye



Form 8R Wiring Diagram *4-wire Delta*



EXTERNAL CONNECTIONS

JEMStar uses industry-standard power connector configurations consistent with the standards listed in the Specifications section. *JEMStar* Switchboard Case power connectors will accept 12 gauge solid wire or a ring or spade lug.

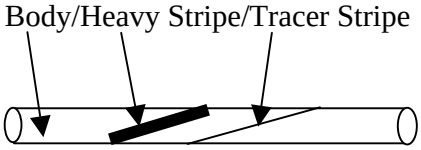
Connections that are intended to be made and broken during normal meter operation (e.g. temporary data connections, Test Pulse pickup, etc.) are accessible without exposing the operator to live power terminals or conductors.

Other *JEMStar* electrical connections (e.g. Contact Outputs, Contact Inputs, Modem) are brought outside the meter as pigtail leads (S-base, A-base) of an appropriate wire gauge and insulation to maintain the electrical requirements of ANSI standards. The Switchboard model provides user connections on rear-mounted terminal blocks.

Reading the Wire Colors

All output wires are individually color coded to simplify identification of each signal. Each wire can have one, two, or three colors. The sequence of colors is read as follows:

- Body insulation is the first color
- Heavy stripe is the second color
- Thin tracer stripe is the third color



Grounding Recommendations

It is important to ensure that all conductive outer surfaces of the *JEMStar* meter are properly grounded. The S-base and A-base models are constructed with plastic housings, so this is not a concern, however the Switchboard case is steel and must have a good protective ground. Supply an adequate, low-impedance ground to the *JEMStar* case and verify with an ohmmeter. Be sure not to make grounding connections on painted surfaces. All signal inputs and outputs that will be wired for extended distances from the *JEMStar* should be shielded cables, with the shield grounded at one end. The instrument PT and CT commons should be grounded consistent with your company's wiring procedures.

Signal Inputs

Voltage Inputs

The meter will operate continuously at any voltage within the nominal range of 55 – 530 volts while still meeting all operational specifications.

The *JEMStar* voltage inputs have a burden of less than 0.5 VA each. This does not include the Auxiliary Power input, which requires less than 15 VA.

Current inputs

The *JEMStar* is configured at manufacture for one of the standard current Class ranges listed in the Specifications section. Each *JEMStar* current input can withstand a continuous overload of 1.5 times the Class current, or 20 times the Class current for 0.5 second without damage or permanent change in registration. The *JEMStar* current inputs have a burden of less than 0.5 VA each.

Auxiliary Power

For S-Base and A-base models, Auxiliary Power is connected internally to the Phase A voltage input. No separate connection is required.

The Switchboard models are designed to obtain Auxiliary Power from a separate connection. This can be either AC or DC voltage.

- **Separate AC Auxiliary Power**
  AC Auxiliary Power connections are connected to screw terminals on the rear of the case. Refer to the Switchboard wiring diagrams shown just prior to this section. In this method, the Aux. Power input will operate from 55 to 530 VAC, and is non-polarity sensitive.

- **Separate DC Auxiliary Power**
  DC Auxiliary Power connections use the same terminals as the AC Aux. Power. In this method, the Aux. Power input will operate from 90 to 250 VDC, and is non-polarity sensitive.

Contact Inputs

JEMStar can include an optional feature that consists of two Form A (N.O.) contact inputs. Each input can be configured to perform any one of the following functions:

- Input to a pulse counter that is recorded as a channel in Load Profile. Each transition (make *or* break) is counted as a pulse.
- Interval synchronization pulse. Each "make" causes the Demand Interval and / or Load Profile (if so configured) to be re-synchronized.
- TOU Rate Override: Each "make" will cause the present Time of Use rate to change to a user-configured “override” billing rate.
- Status Input: Each "make/break" of an external contact can be monitored by the meter and will be logged in the Load Profile data report.
- Totalization input: Each "make" will be cause a configurable amount of energy to be added to a Totalization register's accumulated total.

NOTE: You may encounter excessive serial communication errors if the JEMStar meter is configured to use Totalization inputs AND the meter is receiving pulses at a high rate. While the JEMStar communication protocol uses error checking to prevent data corruption, communication times may be extended. To temporarily stop the interference, disconnect the contact inputs until communication is complete.

JEMStar does not provide a wetting voltage for the contact inputs; the user must provide an external wetting source. The external source must have the following characteristics:

- Minimum ON voltage 10VDC
- Maximum ON voltage 40VDC

- Current limited to 50 mA

JEMStar will de-bounce both "make" and "break" transitions on each contact input for at least 20 milliseconds. The maximum detectable pulse rate is 10 *transitions* per second.

For the S-Base and A-Base meter styles, *JEMStar* contact input connections are provided via a multi-conductor cable. The wire colors are as follows.

Contact Input Connections

Color	Signal
Wht/Brn/Blk	Din 1 -
Wht/Brn	Din 1 +
Wht/Blu	Din 2 -
Wht/Blu/Blk	Din 2 +

For Switchboard style meters, the connections are provided on rear-mounted terminal blocks.

Switchboard Contact Input Connections

Terminal	Signal
20	Din 1 -
19	Din 1 +
18	***** Din 2 - / Rx -
17	***** Din 2 + / Rx +

**NOTE: If the Ethernet option is installed terminals 17 and 18 can be configured for either Din2 or Ethernet RX. Refer to the Ethernet Switchboard Interface Board section on page 60 for jumper settings.*

SIGNAL OUTPUT OPTIONS

Contact Outputs

JEMStar can be equipped with either of two optional contact I/O boards: the **DI/DO** board that consists of four Form A (N.O.) contact outputs; or the **5-KYZ** board that consists of five Form C (N.O. / N.C.) contact outputs. Note: Only one type of contact output board can be installed in a JEMStar.

DI/DO Board

Each **DI/DO** output can be configured to perform any one of the following functions:

- Energy pulse output: configurable for any consumption quantity or energy constant
- End of Demand Interval Output: the output will close for one second when a demand (sub) interval closes.
- Site Monitoring Alarm output: the output will close when a Site Monitoring alarm condition is detected.
- Threshold Alarm output: the output will close when the selected Register exceeds a user-configured upper setpoint. The output will re-open when the Register falls below a user-configured lower setpoint.
- Sag / Swell Alarm output: the output will close if the optional Sag / Swell Detection system determines that a voltage sag or swell event is in progress.
- System Error Alarm output: the output will close if a meter System Error condition is present.

JEMStar does not provide a wetting voltage for the contact outputs; external wetting must be applied. The *JEMStar* contact closure outputs meet the following specifications:

- Maximum open-circuit voltage is 200 volts, DC or peak AC.
- Maximum closed-circuit voltage drop is 2.5 volts at 30 mA.
- In the closed state, the contact will conduct in either direction.
- The maximum current rating for a closed contact is 50 mA.
- The contact outputs are TTL-compatible when used with an external 4700-ohm pull-up resistor to an external +5VDC source.
- Maximum output rate is 20 transitions per second. A transition is defined as a single change of state, either open-to-close or close-to-open. This equates to 10 complete pulse cycles per second.

For the S-Base and A-Base meter styles, *JEMStar* contact output connections are provided via a multi-conductor cable. The wire colors are as follows.

Contact Output Connections

Color	Signal
Wht/Yel/Blk	Dout 1 -
Wht/Yel	Dout 1 +
Wht/Org/Blk	Dout 2 -
Wht/Org	Dout 2 +
Wht/Grn	Dout 3 -
Wht/Grn/Blk	Dout 3 +
Wht/Red	Dout 4 -
Wht/Red/Blk	Dout 4 +

For Switchboard style meters, the connections are provided on terminal blocks.

Switchboard Contact Output Connections

Terminal	Signal
16	***** Dout 1 - / Rx -
15	* Dout 1 + / Rx +
14	Dout 2 -
13	Dout 2 +
12	Dout 3 -
11	Dout 3 +
10	***** Dout 4 - / Rx -
9	***** Dout 4 + / Rx +

**NOTE: If the Ethernet option is installed terminals 15 and 16 can be configured for either Dout1 or Ethernet RX, or terminals 9 and 10 can be configured for either Dout4 or Ethernet RX. Refer to the Ethernet Switchboard Interface Board section on page 60 for jumper settings.*

5-KYZ Option Board

The **5-KYZ** board provides five Form-C (KYZ) contact outputs for connection to external devices. The first four outputs operate with all the same functions as the DI/DO contact outputs, and have all the same features and specifications (refer to the preceding section for information about output usage). The fifth contact output can be use for any function except Threshold Alarms. The differences between the two option boards are described below.

Feature	**DI/DO Board**	**5-KYZ Board**
Number of Contact Outputs	4	5
Type of Contact Outputs	Form A (N.O.) (1)	Form C (N.O./N.C.)
Analog Outputs Available	Yes	No (2)

(1) The Form A contacts on the DI/DO Board can also be programmed for Normally Closed operation using JEMWare software.
(2) Because all the output wires/terminals are used by contact outputs, the analog output option is not available in conjunction with the 5-KYZ board.

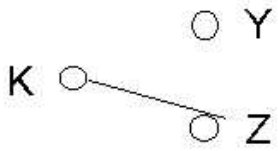
Refer to JEMWare instruction manual 1083-602 for information about assigning the operating functions of the contacts.
The following table defines the Input/Output connections for the 5-KYZ board.

Function	**S-BASE / A-BASE Wire Color**	**R-BASE Terminal Block**
Din1 +	WHT/BRN	19
Din1 -	WHT/BRN/BLK	20
***** Din2 + / Rx +	WHT/BLU/BLK	17
***** Din2 - / Rx -	WHT/BLU	18
K1	WHT/RED/BRN	8
Y1	WHT/BLK	4
Z1	WHT/ORG/GRN	5
K2	WHT/GRY	3
Y2	WHT/ORG/BRN	6
Z2	WHT/RED/GRN	7
K3	WHT/RED	10
Y3	WHT/ORG	13
Z3	WHT/ORG/BLK	14
K4	WHT/GRN	12
Y4	WHT/GRN/BLK	11
Z4	WHT/RED/BLK	9
***** K5 / Rx -	WHT/YEL/BLK	16
* Y5 / Rx +	WHT/YEL	15
Z5	WHT/GRN/BRN	n/c **

**NOTE: If the Ethernet option is installed terminals 17 and 18 can be configured for either Din2 or Ethernet RX, or terminals 15 and 16 can be configured for either K5/Y5 or Ethernet RX. Refer to the Ethernet Switchboard Interface Board section on page 60 for jumper settings.*
*** Relay #5 provides a single Form A (N.O.) contact in the Switchboard style (R-Base) enclosure.*

Configuring Contact Outputs on a 5-KYZ board

The configuration of the 5-KYZ Board is the same as setting up a DI/DO Board. However, when you set up a contact output (in JEMWare) for Normally Open, you are setting the "K-Y" section of the output for NO, and the "K-Z" section for NC. You may also set the output for reverse operation. That is, if you configure JEMWare for Normally Closed, you are setting the "K-Y" section for NC, and the "K-Z" section for NO.



Contact state shown with JEMWare configured for Normally Open.

Analog Outputs

JEMStar can include an optional feature that consists of three analog output channels. All three channels are configured at the factory for either 0-1 mA or 4-20 mA output. Each of these channels may be configured for any instantaneous quantity. Loss Compensation can be utilized with any Analog Output that is based on Watts, VARs, VA, PF, or Q.

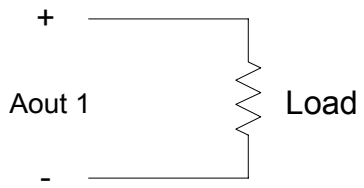
0-1 mA Outputs

A *JEMStar* meter equipped with 0-1 mA analog outputs has the following characteristics:

- Each output channel will source and sink up to 2.4 mA.
- Each output channel will have a compliance voltage of at least ∀10 volts.
- Analog output accuracy is 0.1% of its full scale output, and is de-rated by an additional 75 ppm of Rated Output per degree C difference from nominal.
- The output can be configured to indicate bi-directional input quantities.

Example:

Input Range	Analog Output
- 1000 watts	-1 mA
0 watts	0 mA
+ 1000 watts	+1 mA



0 - 1 mA Output Connection

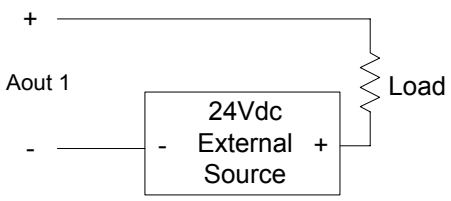
4-20 mA Outputs

A *JEMStar* meter equipped with 4-20 mA analog outputs has the following characteristics:

- Each output channel requires a separate, external loop supply of up to 24 volts.
- Analog output accuracy is 0.1% of its full scale output, and is de-rated by an additional 50 ppm of span per degree C difference from nominal.
- The outputs can also be configured to indicate bi-directional input quantities.

Example of bi-directional input range:

Input Range	Analog Output
- 1000 watts	4 mA
0 watts	12 mA
+ 1000 watts	20 mA



4 - 20 mA Output Connection

Analog Output Connections

For the S-Base and A-Base meter styles, *JEMStar* analog output connections are provided via a 3-foot multi-conductor cable. The wire colors are as follows.

S- & A-Base Analog Output Connections

Color	Signal
Wht/Red/Brn	Aout 1 -
Wht/Red/Grn	Aout 1 +
Wht/Org/Brn	Aout 2 -
Wht/Org/Grn	Aout 2 +
Wht/Blk	Aout 3 -
Wht/Gry	Aout 3 +

For Switchboard style meters, the connections are provided on terminal blocks.

Switchboard Analog Output Connections

Terminal	Signal
8	Aout 1 -
7	Aout 1 +
6	Aout 2 -
5	Aout 2 +
4	Aout 3 -
3	Aout 3 +

COMMUNICATION PORTS

Serial Communications

JEMStar uses JEM® Binary Protocol on all communication ports. The command set allows for the following functions:

- Configure the meter
- Read registers
- Read Load Profile
- Check health and status
- Set the time
- Preset registers
- Perform Billing Period Reset
- Read recorded events
- Read Site Diagnostic Data
- Reload the meter register's operating firmware (remote firmware upgrade)
- Validate the user's authorization to perform certain functions. (Password protection)

Configuration commands are structured such that any one command may be used to change a configurable item without causing the meter to stop running due to a mismatch in the total configuration. For example, reconfiguring the TOU schedule for all Rate 1 periods without a Rate 1 register does not cause the meter to stop functioning.

The *JEMStar* supports up to four passwords, three with definable privileges. The first "master" password always has total access to meter functions. Privileges for each of the other passwords are configurable for any or all of these categories:

- Read Normal register list
- Read Alternate register list
- Read any displayable quantity
- Set Time
- Perform Billing Reset
- Enter Test, Site Diagnostic, or Calibrate Mode
- Preset Registers
- Configure meter identity (ID strings, CT / PT ratios, etc.) and Comm parameters
- Configure TOU schedule
- Configure everything else not itemized
- Read any configuration item

Optical Port

JEMStar uses a front panel mounted Type 2 Optical Port. The physical configuration of the port is such that a magnetic mating probe may be attached with the cover on the meter. With the cover removed, a wire retaining clip is required. The *JEMStar* Optical Port incorporates JEM Binary Protocol, and may be configured for 300, 1200, 2400, 9600 or 19200 baud communications.

RS-232

The *JEMStar* can be optionally equipped with an RS-232 serial port. It is configurable for any valid communication address supported by the meter, and can be configured for 300, 1200, 2400, 9600, 19.2K, or 38.4K bps communications. The port is operated in half-duplex mode using four signal wires: Common, Transmit Data, Receive Data, and Request To Send. The RS-232 option is mutually exclusive with the RS-485 option; that is, only one *or* the other can be installed (unless the Dual Comm feature is installed).

For the S-Base and A-Base meter styles, *JEMStar* serial output connections are provided via the multi-conductor cable. The wire colors are as follows.

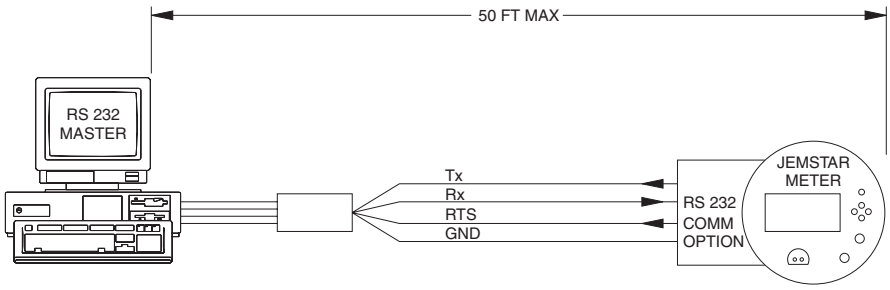
RS-232 Output Connections

Color	Signal
Wht/Grn/Blu	Tx
Wht/Red/Blu	Rx
Wht/Pur	Gnd
Wht/Red/Org	RTS

For Switchboard style meters, the connections are provided on rear terminal blocks.

Switchboard RS-232 Connections

Terminal	Signal
21	Tx
22	Rx
23	Comm Gnd
24	RTS



RS 232 CONNECTION DIAGRAM

RS-485

The *JEMStar* can be optionally equipped with RS-485 serial communications. The RS-485 port operates in half-duplex mode (e.g.: the Transmit and Receive signals share the same wire). It is configurable for any valid communication address supported by the meter, and can be configured for 300, 1200, 2400, 9600, 19.2K, or 38.4K bps communications. The maximum reliable distance for RS-485 communications is approximately 4000 feet, however this length can vary depending on the type of cable used, external electrical interference, etc. The RS-485 option is mutually exclusive with the RS-232 option; that is, only one *or* the other can be installed (unless the Dual Comm feature is installed).

For the S-Base and A-Base meter styles, *JEMStar* serial output connections are provided via the multi-conductor cable. The wire colors are as follows.

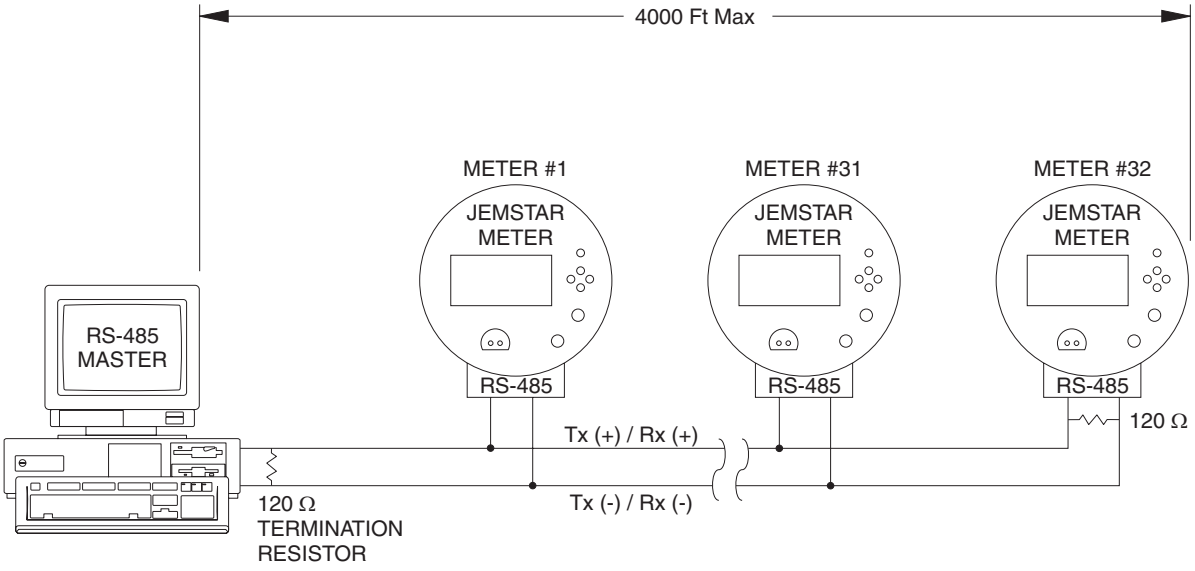
RS-485 Output Connections

Color	Signal
Wht/Grn/Blu	XMT/RCV +
Wht/Red/Blu	XMT/RCV -

For Switchboard style meters, the connections are provided on terminal blocks.

Switchboard RS-485 Output Connections

Terminal	Signal
21	XMT/RCV +
22	XMT/RCV -



RS-485 CONNECTION DIAGRAM

Modem

JEMStar can be optionally equipped with an internal modem. The port is configurable via JEMWare for any communication address supported by the meter, and can be set for 300 to 14400 bits per second. A custom initialization string can also be configured to adapt the modem to specific conditions (see Appendix A for AT command codes).

Modem tip and ring connections for the S-base and A-base models are made using a standard four-wire RJ-11 phone jack. For Switchboard style meters, the connections are provided on rear-mounted terminal blocks.

Switchboard Modem Connections

Terminal	Modem Connection
2	Tip
1	Ring

Answer Modem

The *JEMStar* internal modem can be programmed to determine the number of rings required before answering. An answer window, which restricts the modem to answering only during certain times of the day, is also programmable. The modem will connect at any baud rate up to 14400 bps.

The modem can be configured for two different answering periods (number of rings) per day. When selected, it will answer after a selected number of rings for a defined period each day, and after some other number of rings for the rest of the day.

The modem can also detect another telephone device sharing the line going off-hook, and surrender the line immediately, as long as the shared device is downstream of the modem.

Phone-Home Modem

The *JEMStar* internal modem has the capability of performing call-originate ("phone-home") calls. The meter can be programmed to call-originate as a result of certain events including:

- Demand Threshold
- Site Alarm
- Threshold Alarm
- Data retrieval, and on a scheduled call-in for data retrieval (as supported by MV-90)
- Power Fail (optional)

Each event can be set to call up to four different phone numbers. The modem can be configured to transmit an ASCII text message, or a series of DTMF tones. The modem can be set up to drop into slave mode, where it waits to be interrogated using whatever protocol the modem is configured to use.

Phone home operation calls the phone number and reports the information as a text message, without requiring any special processing software. Once the meter establishes communications, it sends a user-specified ASCII or DTMF response indicating the meter name and location, the time of call, and which events occurred. This can be logged either by a computer running terminal-emulation software, or by a serial printer connected to the modem.

FCC Compliance of the Internal Modem

This equipment complies with Part 68 of the FCC rules governing communications devices. On the meter face is a label that contains the FCC registration number and Ringer Equivalence Number (REN) for this equipment. This information must be provided to the telephone company, if requested.

This equipment should be connected to a standard RJ11 Telco jack. The REN is used to determine the quantity of devices that may be connected to a telephone line. Excessive REN's on the telephone line may result in the devices not ringing in response to an incoming call. In most cases, the sum of the REN's should not exceed five. To be certain of the number of devices that may be connected to your specific line (as determined by the number of REN's), contact your local telephone company.

If the modem causes harm to the telephone network, the telephone company will notify you as soon as possible. In addition, you will be advised of your right to file a complaint with the FCC, should this be necessary.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice for you to make the necessary modifications so that your service is not interrupted.

If trouble is experienced with this modem, please contact Ametek Power Instruments for repair and warranty information. If the trouble is affecting the telephone network, the telephone company may request that you remove the equipment from the network until the problem is resolved. The customer should not attempt to repair this equipment. The modem cannot be used on public coin service provided by the telephone company. Connection to Party Line Service is subject to tariffs. Contact your state public utility commission, public service commission, or corporation commission for information.

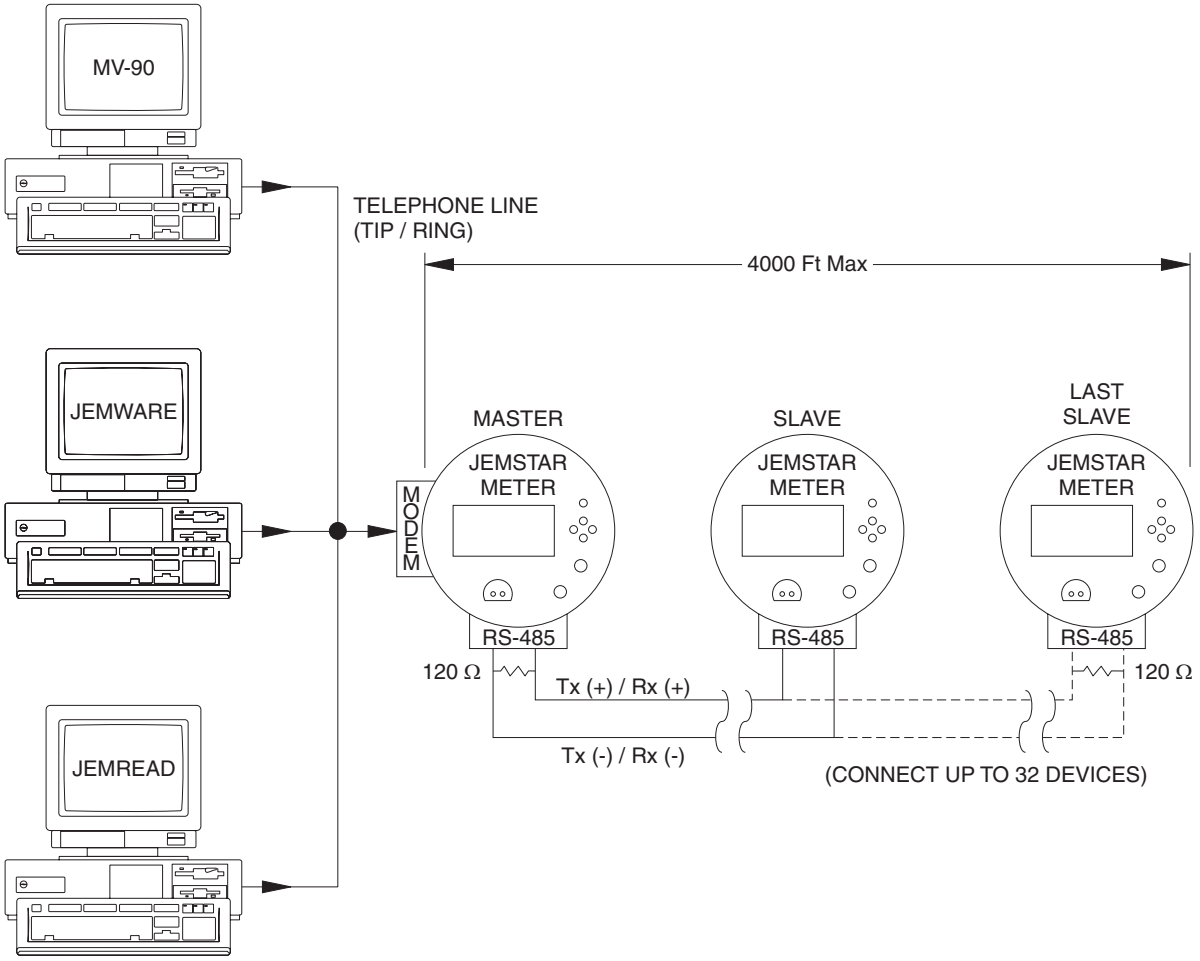
Call-Home on Power Outage

JEMStar can be optionally equipped with an internal modem capable of initiating telephone calls for up to four separate telephone numbers and transmitting a message in the event of a loss of power at the meter. The telephone numbers and message are software configurable using *JEMWare*. The internal battery pack that supports this option uses long life lithium cells, however if the need arises, the batteries can be easily replaced by removing the meter top cover (see the Maintenance section).

Communication Repeater

JEMStar can be optionally equipped with a Communication Repeater option that allows a network of meters to share a single internal modem. This feature requires the RS-485 option to be installed on all meters connected in the network. The *JEMStar* CommRepeater operates as a master to slave configuration.

Each meter in the network must be assigned a unique communication address via JEMWare configuration software. Multiple meter connectivity is obtained through one CommRepeater master meter and subsequent slave meters as shown in the diagram below.

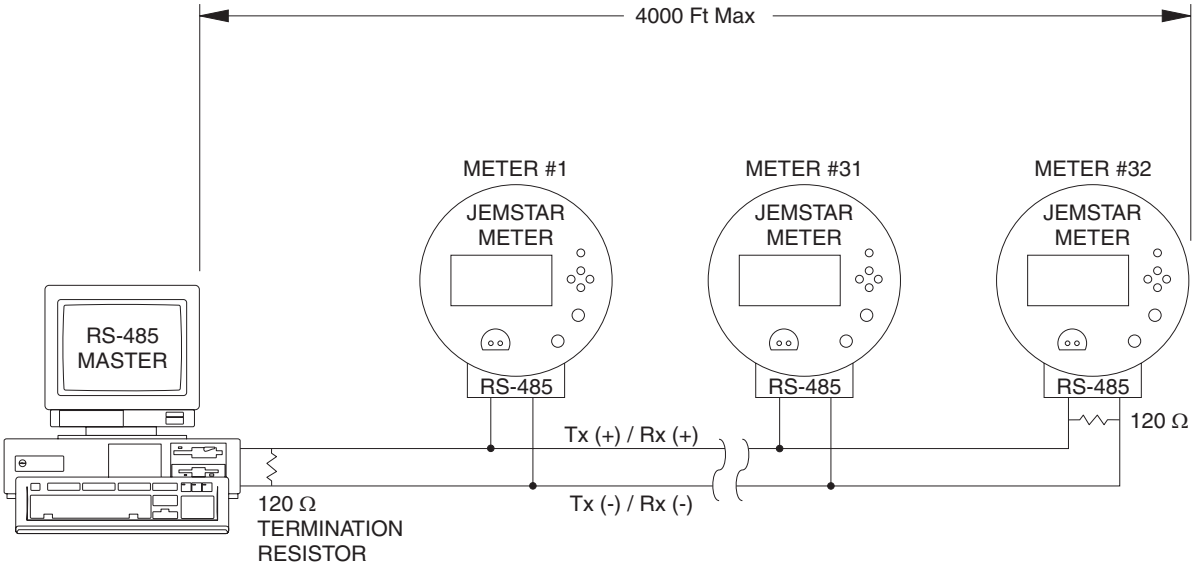


TYPICAL COMMREPEATER DIAGRAM

The interface to the master meter must be through a phone line that is connected to the internal *JEMStar* modem. Note that the slave meters (those without an internal modem) in the network cannot cause the modem to originate a call. The daisy-chained slaves are connected in a standard RS485 configuration. These signals are connected via the I/O cable (S and A-base), or rear-mounted terminal blocks (switchboard case). See the previous section titled “RS-485 Connections” for wiring details. The *JEMStar* CommRepeater utilizes a half-duplex communications link.

RS485 Operating Mode

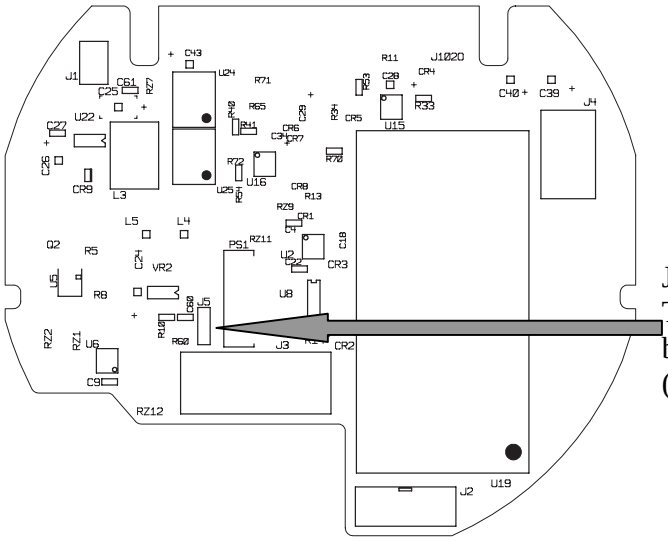
The RS485 protocol permits up to 32 transceiver pairs to share a party line. Because RS485 communications are differential, much longer cable lengths are possible than RS-232C. The total length of the network wiring must not exceed 4000 feet. A single twisted-pair of wires can connect up to 32 drivers and receivers for half-duplex communications.



RS-485 CONNECTION DIAGRAM

The signals labeled "TX(+)/RX(+)" and "TX(-)/RX(-)" are a half-duplex pair that carry Received Data to the meter and Transmitted Data to the master.

There are no restrictions on where the meters are connected to the wires, and it is not necessary to have the meters connected at the ends (you may have other devices connected in the same string). However, *the wire pair must be terminated at each end with a 120-ohm resistor*. If the *JEMStar* meters are the end devices, this is accomplished simply by installing a jumper on the meter's Communication board. If you have another type of device located at the end, refer to the instruction manual for that device; you may need to install the resistor externally.



JEMSTAR CommRepeater Termination Jumper J5 on Comm board, shown in “terminated” position (upper two pins shorted)

The jumper is a standard 0.1” center, two-pin, female, shorting connector commonly used on most PC motherboards. Contact Ametek Power Instruments and specify part number 4195-263, or ask your local computer shop for replacements.

For meters that are not at the ends of the RS-485 network, place the jumper in the “unterminated” position by plugging it onto the bottom two contacts.

Dual Communications Option

Certain JEMSTAR applications require a SCADA type system and a retrieval system to exist simultaneously, which require two serial communications channels. The standard JEMSTAR offers one channel of configurable RS232/485. The Dual Communications board is an optional feature of the JEMSTAR meter, which will allow two channels of RS232/485, each channel being user-selectable via hardware jumpers on the circuit board. Note that the modem option is not available when using the Dual Comm board.

The dual communications option requires the user to designate parameters for both channels as listed below. The channels can be set up using either the meter's front panel keypad or via JEMWare software.

Network Address
Each port may be configurable for any valid communication address as supported by the particular protocol. An RS485 link may have no more than a maximum of 32 meters daisy-chained. See the previous CommRepeater section of this manual for further information.

Baud Rate
Each serial port may be configured for 300, 1200, 2400, 9600, 19200, or 38400 bps communications.

Both channels are able to run the following protocols simultaneously:

- ❑ JEM10 Binary
- ❑ Modbus
- ❑ ANSI tables

Note: DNP can only be run on one of the two channels at a time.

Jumper Settings for Dual Comm Board

The Dual Communications board is different from the standard serial/modem communications board. Use the following information when setting up the two ports.

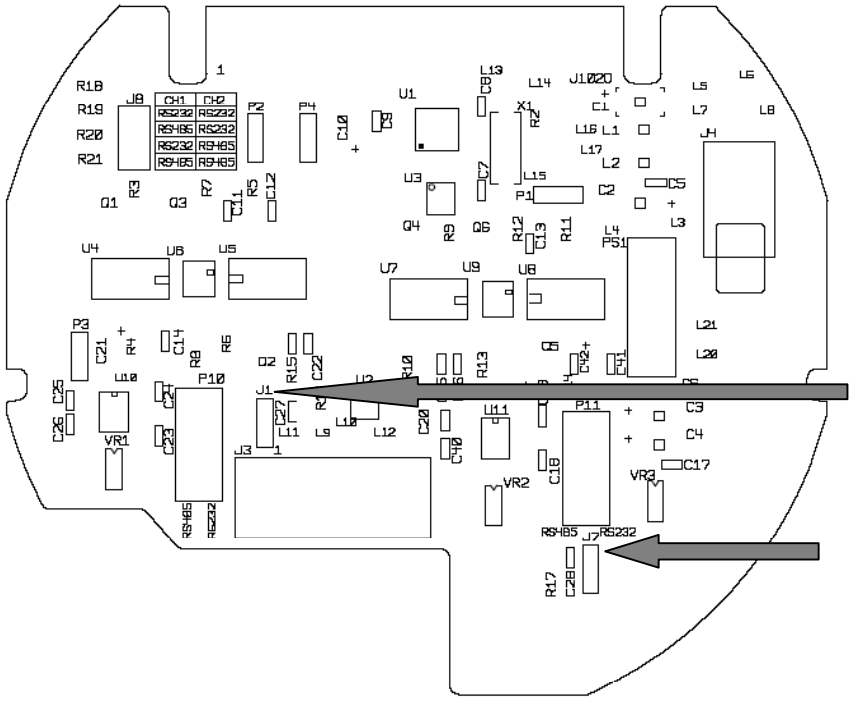
J8: Install only one jumper in one of the four locations. This is used to define the port assignments as RS232 or RS485. For example, the top jumper position defines both ports as RS232. Use jumper part number 4195-263*.

P2, P3, P4: Not used, these are for factory test purposes.

P10, P11: These are 2x7 jumper packages, part number 4195-643. Install jumper on the left two columns of pins for RS485 communications, install on the right two columns for RS232. P10 is used for channel 1; P11 is used for channel 2.

J1, J7: Use these jumpers (4195-263*) to add the RS485 termination resistors to the circuit only when required. Refer to the CommRepeater section for more information about when termination resistors are required. Connecting the upper two pins will insert the termination resistor in the circuit; the lower two pins will take it out. J1 is for channel 1; J7 is for channel 2.

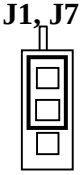
Note: For RS-232 operation the termination jumper(s) (J1/J7) must be in the unterminated state



RS485 Termination Jumper J1 on the Dual Comm board,

RS485 Termination Jumper J7 on the Dual Comm board. Shown in "terminated" position (upper two pins shorted)

J1, J7



* The 4195-263 jumpers are standard 0.1" center, two-pin female shorting connectors commonly used on most PC motherboards. Contact Ametek Power Instruments or ask your local computer shop for replacements.

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Dual Comm Serial Data Output Connections

The serial data (RS232 or RS485) is wired out using J3 for channel 1, and J4 used for channel 2. For the S-Base and A-Base meter styles, Dual Comm channel 1 serial output connections are provided via the multi-conductor cable. The wire colors are as follows.

Channel 1 S-Base, A-base Connections

Wire Color	RS485 Signal	RS232 Signal
Wht/Grn/Blu	Xmt/Rcv +	Tx
Wht/Red/Blu	Xmt/Rcv -	Rx
Wht/Pur		Comm Gnd
Wht/Red/Org		RTS

For Switchboard style meters, channel 1 connections are provided on rear terminal blocks.

Channel 1 Switchboard Connections

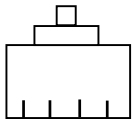
Rear Terminals	RS485 Signal	RS232 Signal
21	Xmt/Rcv +	Tx
22	Xmt/Rcv -	Rx
23		Comm Gnd
24		RTS

For the S-base and A-base meter styles, Dual Comm channel 2 serial output connections are brought out on J4. A standard four-wire telephone cable is provided with an RJ-11 jack.

Channel 2 S-base, A-base Connections

J4 Pin Number	RS485 Signal	RS232 Signal
1		RTS
2	Xmt/Rcv +	Tx
3	Xmt/Rcv -	Rx
4		Comm Gnd

J4 Front View



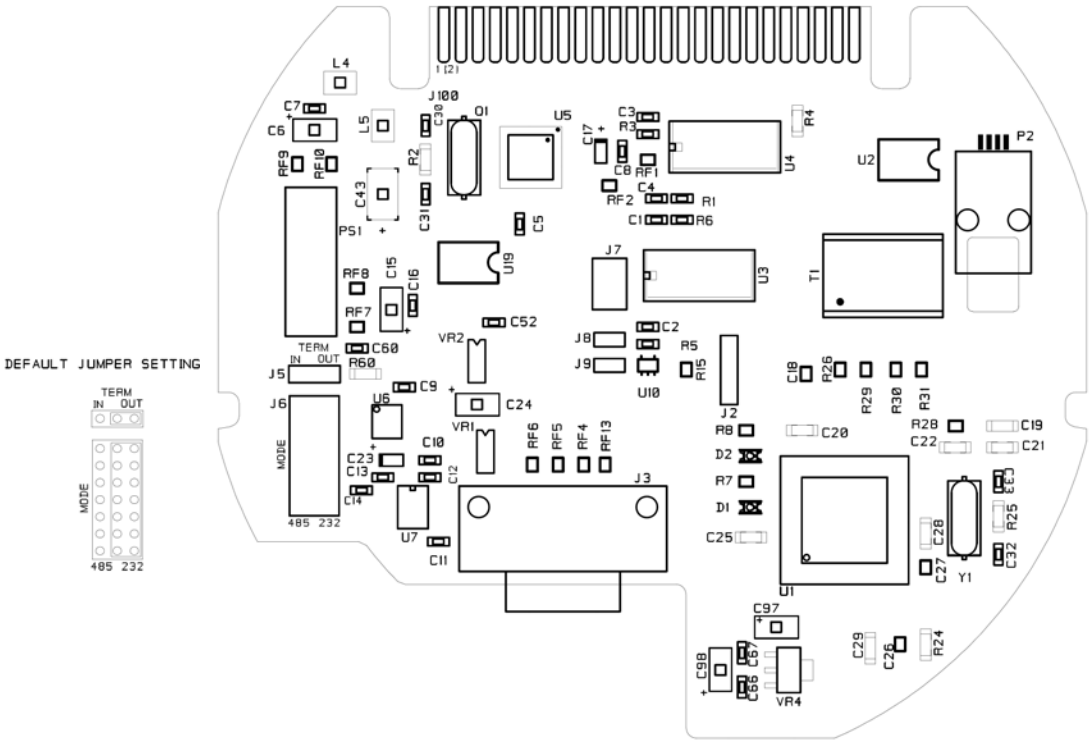
For Switchboard style meters, channel 2 connections are provided on rear terminal blocks. Note: RTS is not available on channel 2 of the Switchboard model.

Channel 2 Switchboard Connections

Rear Terminals	RS485 Signal	RS232 Signal
1	Xmt/Rcv +	Tx
2	Xmt/Rcv -	Rx
23		Comm Gnd

Ethernet/Serial Port

JEMStar can be optionally equipped with an ethernet port and a single serial port configurable for RS-232 or RS-485 communications. The serial port can be configured for 300, 1200, 2400, 9600, 19.2K, or 38.4K bps communications. Refer to above for additional details on the single serial port and RS-232/485 capabilities. The ethernet port works independently of the serial port so it can be used at any time. The ethernet port is configurable via *JEMWARE* for any IP address or it can obtain an IP address automatically using DHCP. The Ethernet port supports all *JEMStar* protocols. (Modbus, DNP, ANSI Tables, Binary) Up to four simultaneous connections are possible, permitting each user to access whatever metering information is necessary. Up to four passwords can be configured in the meter to restrict or allow certain functions per user. For example, one user can be granted access to display registers while a second user has access to load profile data and a third simultaneous user has access to all data and configuration settings.
The *JEMWARE* configuration software can connect to the meter via ethernet, serial or optical port. Ethernet connections are provided through a standard RJ45 jack.



JEMStar Ethernet/Serial Communication Board

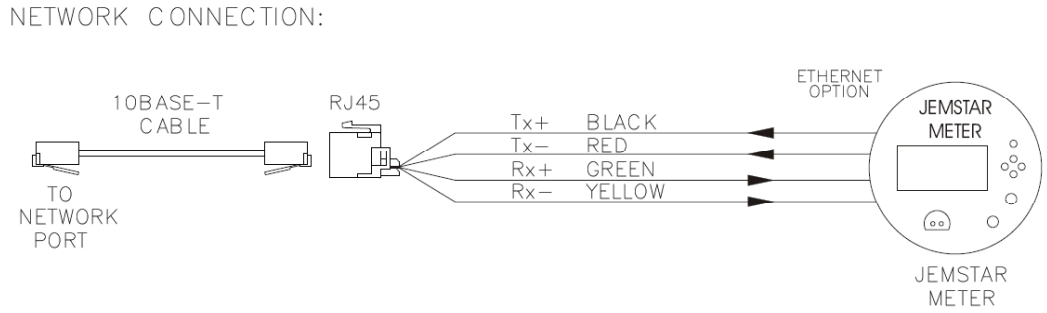
RS-485 Terminators:
Set the terminator J5 to IN for the last channel in an RS-485 chain.
Set the terminator to OUT for all RS-232 applications.

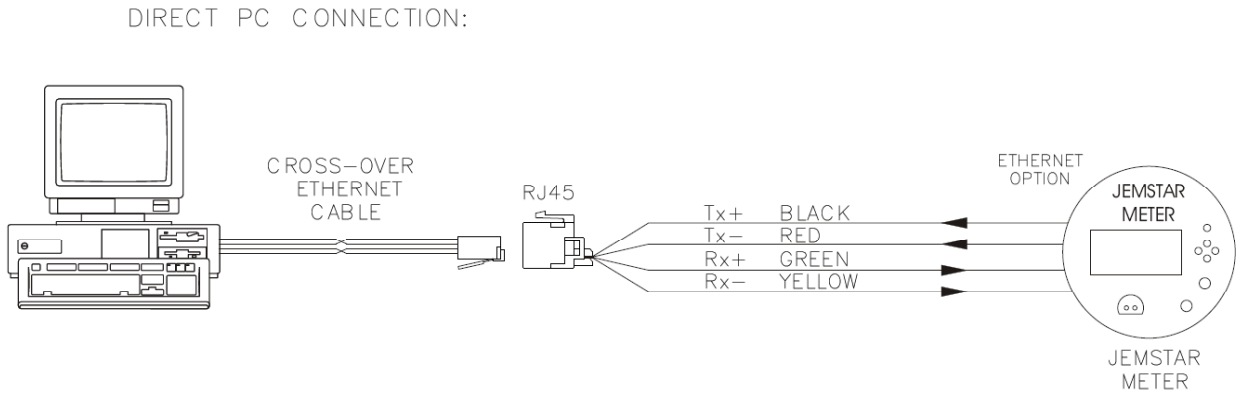
External Ethernet Connections

Socket and A-Base housing:

The connections are brought out on a standard 8-pin RJ-45 jack.

Pin Number	Ethernet Signal
1	Tx +
2	Tx -
3	Rx +
6	Rx -



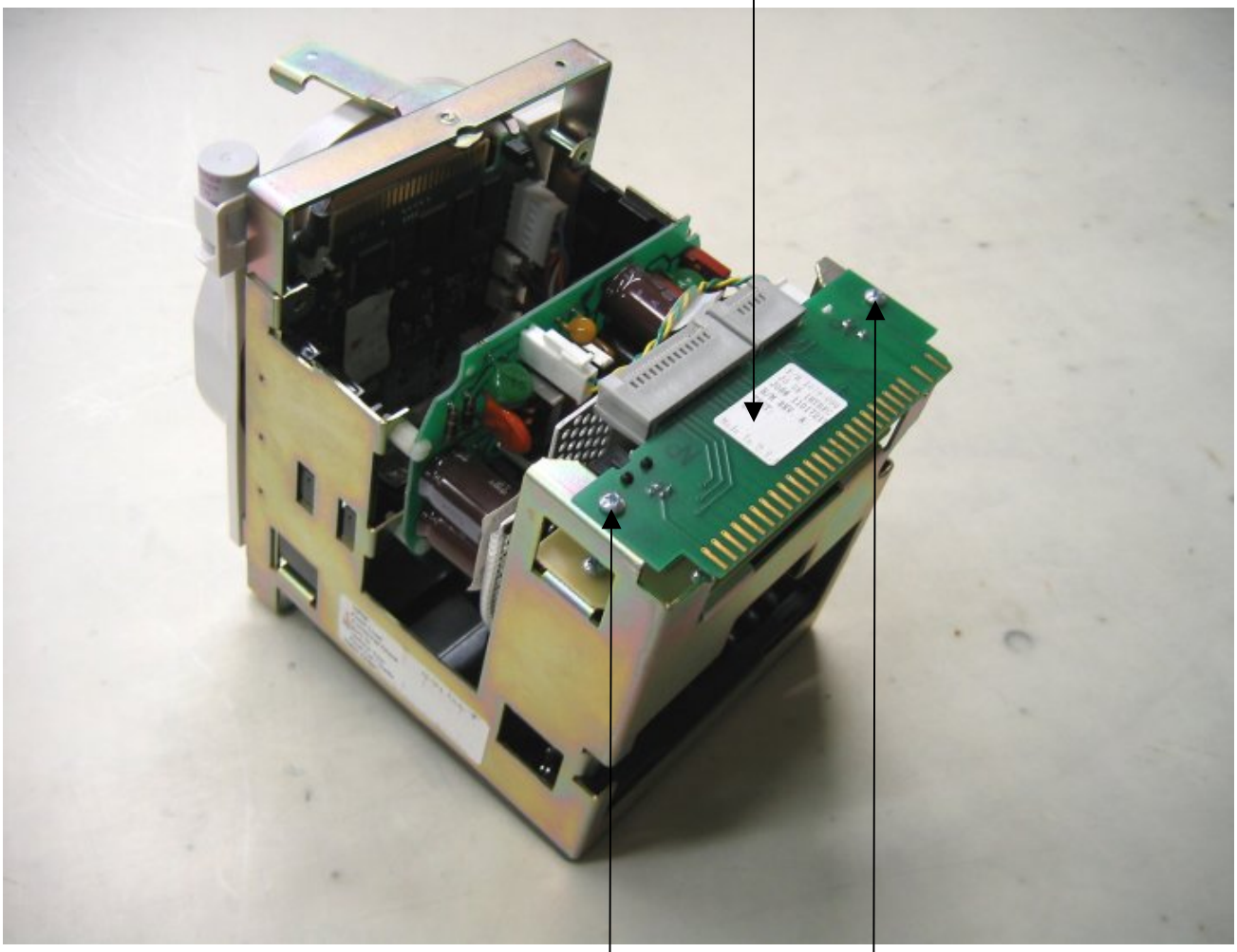


Switchboard housing:

Ethernet Switchboard Interface Board

The Switchboard Interface Board provides Input, Output, Power, and Communications connections to the terminal block on the switchboard version of the meter.

Interface Board location



For field upgrades:

1. Remove the two #6 screws
2. Remove the connectors; 10 position ribbon, 26 position ribbon, 2 position power, and RJ-11 (for modem, RS232, orEthernet), from the interface board
3. Plug the connectors into the new interface board
4. Install #6 screws

For all switchboard meters, except those with Ethernet Communications option, there are no user settings on this board. If the Ethernet option is installed the user must select the terminals to be used for the Ethernet receive signals. The selection is made by changing jumpers J10 through J15 on the Ethernet Interface Board. The Ethernet receive (Rx + and -) terminals depend on the type of input/output board intalled.

Ethernet Connections for standard DI/DO board

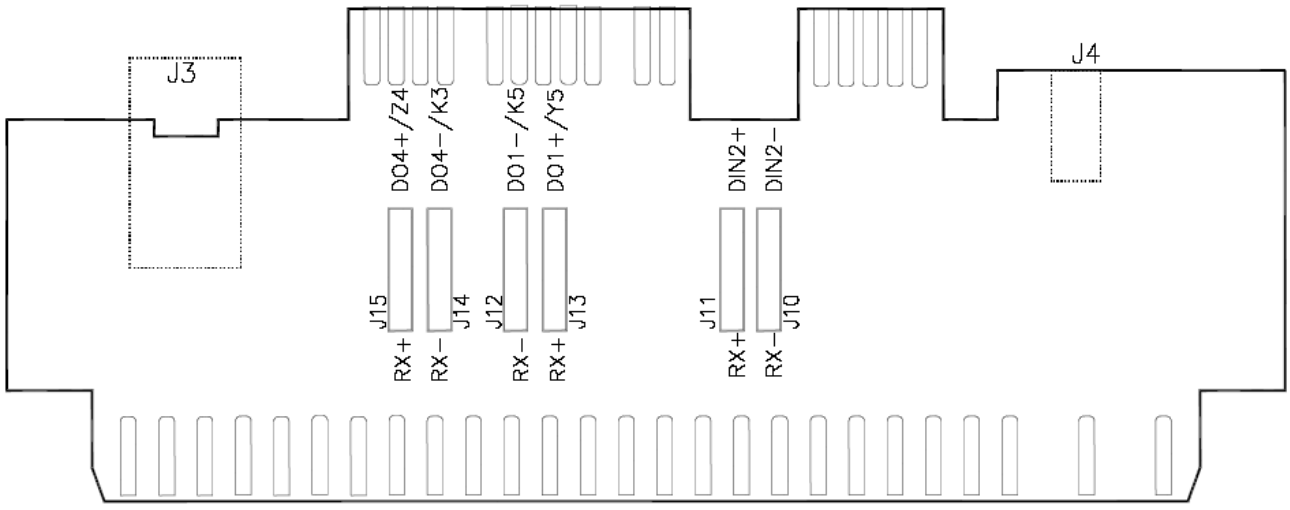
Rear Terminals	Signal	Interface Jumper
1	Tx +	-
2	Tx -	-
9	Dout4 + / Rx +	J15
10	Dout4 - / Rx -	J14
15	Dout1 + / Rx +	J13
16	Dout1 - / Rx -	J12
17	Din2 + / Rx +	J11
18	Din2 - / Rx -	J10

Ethernet Connections for 5 KYZ board

Rear Terminals	Signal	Interface Jumper
1	Tx +	-
2	Tx -	-
15	Y5 / Rx +	J13
16	K5 / Rx -	J12
17	Din2 + / Rx +	J11
18	Din2 - / Rx -	J10

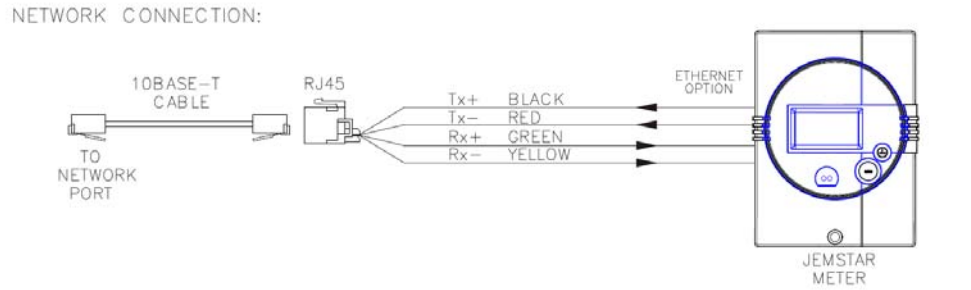
Ethernet Interface Board layout:

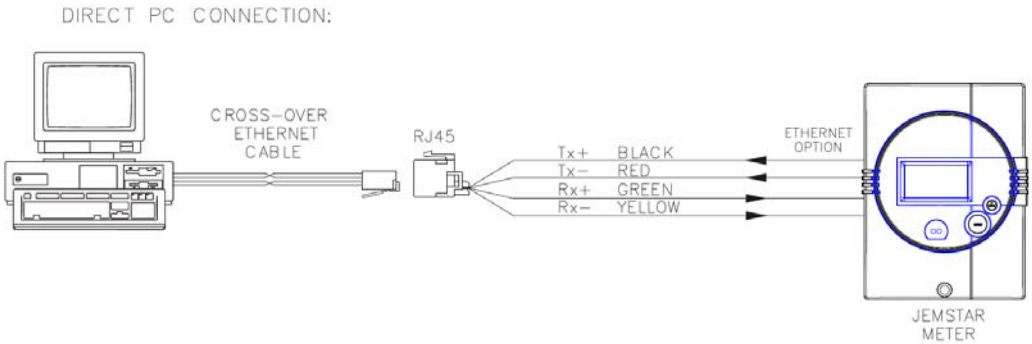
Set jumpers J10 through J15. Select only one pair of connections for Rx + and Rx -:

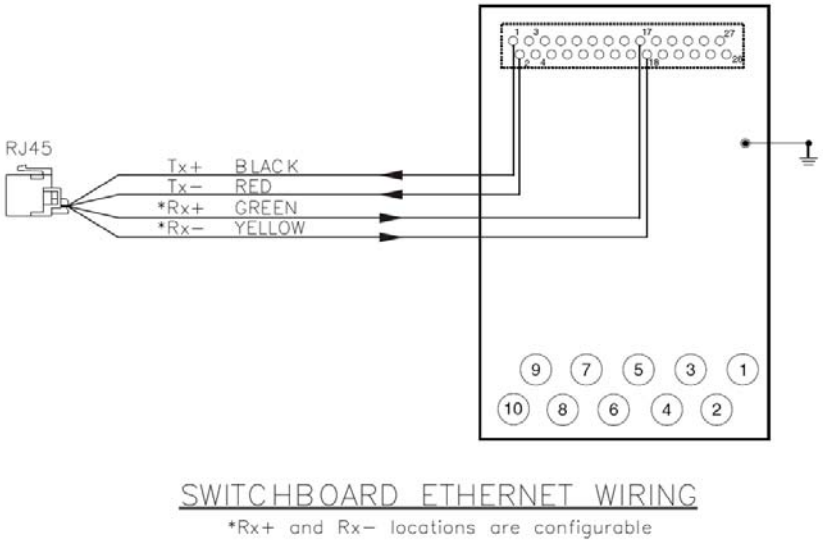


A cable is provided for connecting the rear terminal block to an Ethernet connection. The cable colors are as follows:

Wire Connections		
Signal	**Color**	**Pin Number**
Tx +	Black	1
Tx -	Red	2
Rx +	Green	3
Rx -	Yellow	6







SWITCHBOARD ETHERNET WIRING

*Rx+ and Rx− locations are configurable

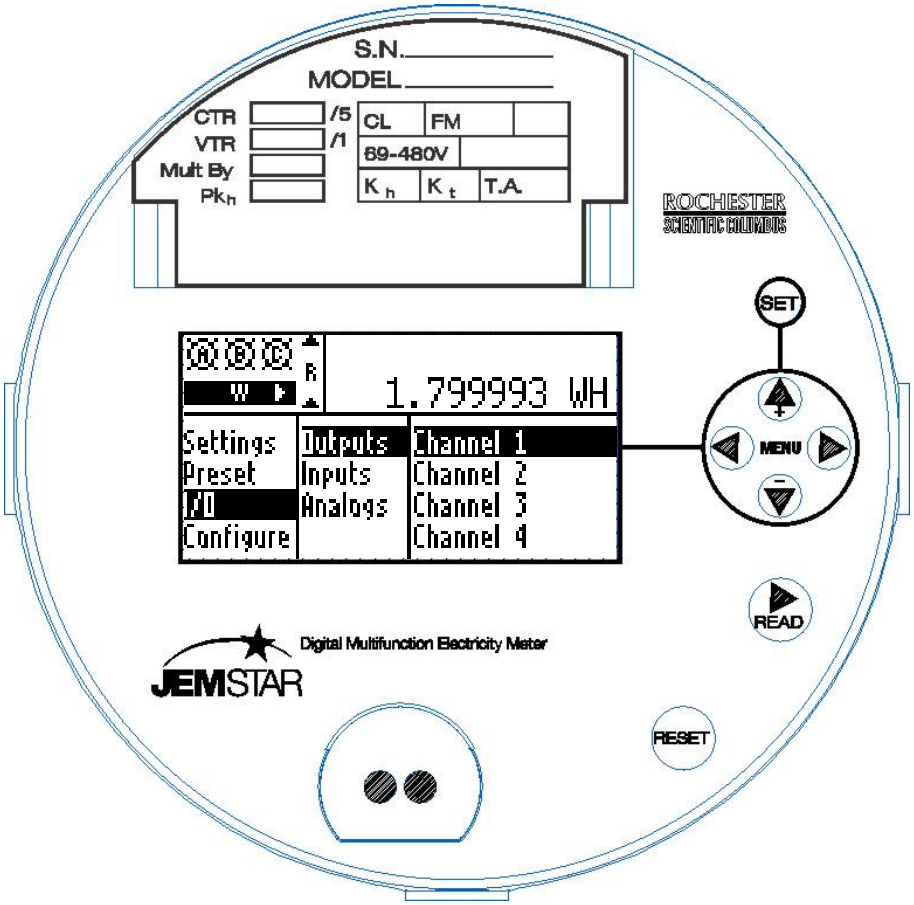
Rear View:

METER OPERATION

METER NAMEPLATE AND USER INTERFACE

Meter Nameplate

The meter's nameplate provides general information about the meter including model number, form, class, voltage, frequency, wiring configuration (3-Wire or 4-Wire), test amps, and the K_t (test pulse constant in WH/count). There is also an area for the user to write in the CTR (current transformer ratio), VTR (voltage transformer ratio), and a multiply-by field.



JEMStar Front View; Globe Removed

Meter Configuration

All of the parameters that determine the meter's operation can be set by using the JEMWare configuration software. JEMWare includes a file-management system for storing configurations, configuration-editing screens for setting the various parameters, and communication channel setups to program the meter. JEMWare provides the ability to read the existing configuration from the meter and to read the time on the meter through serial communications. The JEMWare Instruction Manual 1083-602 describes each parameter that can be programmed.

NOTE: You may use the latest version of JEMWare to open a configuration file saved with a prior version, or to read the configuration from a JEMStar meter that was programmed with a prior version. If you do this, however, you must verify all settings in the configuration before saving it or programming it into a meter. Verify the settings by opening each item in the Meter Settings menu and reviewing the settings. This allows you to be confident that the correct settings are in place and also allows JEMWare to insert appropriate default settings for features that may not have been present in the older version of JEMWare.

User Interface

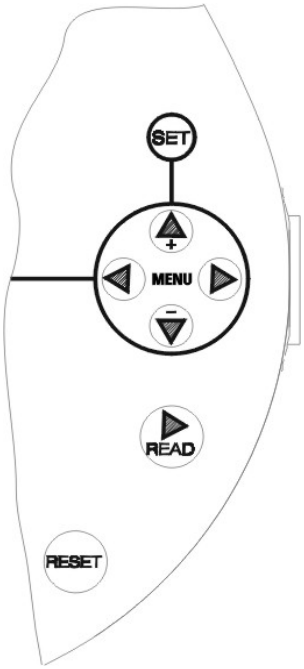
JEMStar includes a User Interface consisting of the *front panel display* and *keypad*. The User Interface is designed to facilitate all the tasks most commonly performed at the meter without need of a separate computer. Some configuration functions are settable directly from the meter, while others will require setup through the JEMWare software program.

The hardware Security Key must be installed in the Metrology board to access the keypad functions of the meter. Refer to "Chapter 5 – Maintenance" for a complete description of the Security Key features.

The keypad, located at the right side of the meter's faceplate, consists of seven buttons. With the meter cover (or globe) in place, you can only press the READ button, which allows you to scroll through and view the meter's display registers.

The RESET button performs a Billing Period Reset and is available on a closed meter. To use the button, you must first remove any external seals, and then twist the button 90º clockwise to unlock it. Also, a separate Security Key on the Metrology board is provided which can disable just the Reset button. Refer to Chapter 5 - Maintenance for further information.

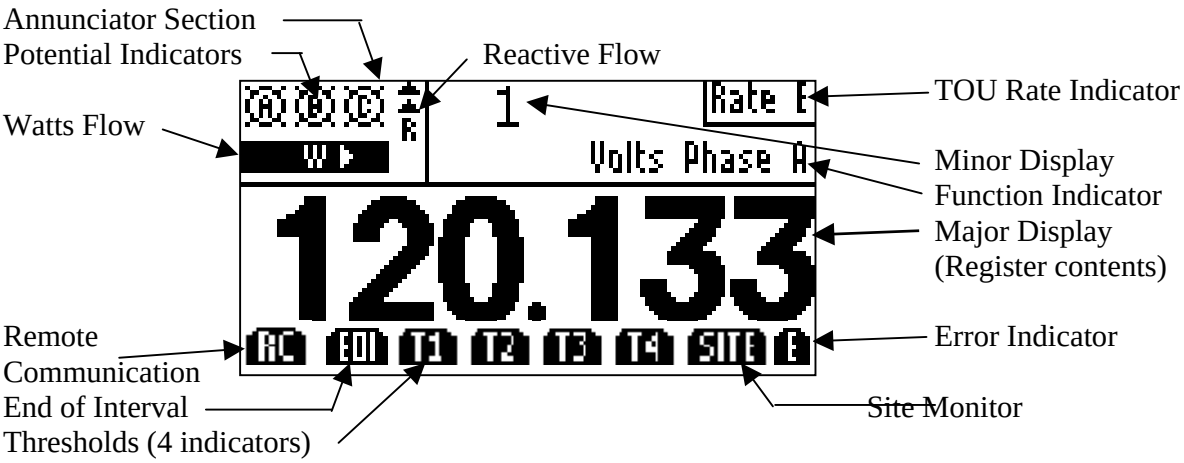
With the meter cover (or globe) removed, all configuration buttons are accessible to the user. This allows you to enter the setup menus by pressing any one of the four arrow buttons.



***JEMStar* Front Panel Controls**

The JEMStar Display

The display is divided into several sections that are dedicated to show specific meter functions or operations.



JEMStar LCD Display Layout

Backlight Option

As an option, the JEMStar display can be ordered with a backlighting feature. See the Model Number Description near the beginning of this manual to determine if your meter is equipped with this feature.

Major Display

The large 6 or 8-digit numeric display on the *JEMStar* is used for displaying measurement registers and the measurement quantity. Measurement registers shown on this display are configurable for up to 3 decimal places and for 3 or more significant digits (with lead zero blanking).

Minor Display

In the upper center, the smaller 3-digit numeric display on the *JEMStar* is used for identification codes, register sequence numbers, or other indications as configured by the user. For registers in user-defined display lists, the user can assign up to a 3-digit identifier to each displayed item.

Function Indicator

This section of the display indicates information relative to the highlighted menu item. The Function Indicator displays simple text and may be customized for each user-assigned register in *JEMWare*.

TOU Rate Indicator

The upper right section of the display can be programmed to indicate the Time of Use rate (A-H) associated with any displayed measurement. Registers associated with the Total rate leave this blank.

Annunciators

The display indicates the following items as symbols; they are visible regardless of what is being displayed on the major or minor numeric displays:

Potential Indicators

Each of the three possible voltage inputs (A, B, and C) on the *JEMStar* has a corresponding Potential Indicator, shown in the upper left corner of the display. The Potential Indicator is

visible whenever the corresponding voltage input exceeds 20 volts. The only time that a Potential Indicator turns off is:

- If the corresponding voltage input is below 20 (+5, -0) volts
- If the meter Auxiliary Power is off
- If a blank display is shown

Load Rate Indicator(s)
The upper left section of the display includes a sequentially moving arrow indication of the direction and rate of energy flow for Watts and Reactive (VAR or Q). Left to right arrows indicates Watts delivered; right to left indicates Watts received. In a similar manner, bottom to top arrows indicate Reactive Lagging; top to bottom indicates Reactive Leading.
End of Interval Indicator
The display provides a momentary indication of the end of a Demand Interval or Subinterval. Upon occurrence, a flag appears in the lower left for at least one second.
Error Indicator
When the meter detects an error, a flag will appear in the lower right corner of the display.
Register Threshold 1 - 4
Appears in the bottom row when one of the user-configured Threshold conditions is exceeded. There is a separate indicator for each of the four Threshold settings.
Site Monitor
Appears in the bottom row when one of the user-configured Site Monitor conditions is in effect.

COLD START

If *JEMStar* circuit boards have been replaced or software options have been installed, a cold start procedure must be performed. **A cold start erases all register and load profile data. The communication and configuration parameters are reset to factory defaults** (see Appendix A). Upgrading JEMStar operating firmware automatically performs a cold start at the end of the upgrade procedure. After a Cold Start is performed, the meter should be reconfigured using *JEMWare* configuration software to program the meter for your specific application.

Warning!
Performing a Cold Start will cause a loss of data.

To perform a cold start:

1. Remove power from the meter, and then remove the meter globe.
2. Simultaneously press the UP and DOWN arrow buttons while applying power to the meter, until the *JEMStar* logo is displayed.

Default Time Displays

When a Cold Start is performed, certain time and date displays in the meter (for example, Date of Peak Demand) contain a default time/date until the meter records an actual value. This "non-value" displays as midnight, January 1, 1970. In other words, a time register will show 00.00.00 and a date register will show 01.01.70.

If you see a display with this particular time and date, please note that this is simply an indication that the meter has not received a valid setting yet.

NAVIGATING THE DISPLAY MENUS

In standard operation, the *JEMStar* display is used to show the measured electrical quantities and various other monitored parameters. However, the display can easily be switched into the Setup mode, which uses a simple menu structure for access to the meter's multiple features. Some menu items are "read-only" such as health status indicators, while others can be edited (time, date, communications, etc.). Through a series of front panel button presses, you can directly configure many of the simpler meter functions. Note: the front panel keypad may be "locked out", depending on your company policy. See Section 5 – Maintenance for information on Security Keys.

The Display Menu is divided into logical groups of features and categories. The following chart shows all menu functions.

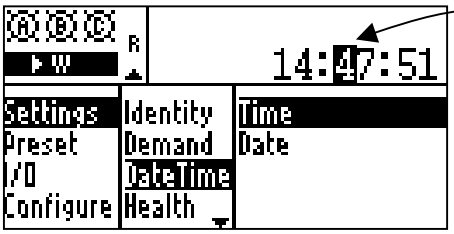
Display Menu Layout

Menu Column 1	Menu Column 2	Menu Column 3	Description of Operation	Editable Feature
Settings	Identity	VTR	<Voltage Transformer Ratio>:1	Y
		CTR	<Current Transformer Ratio>:1	Y
		Service	“4Wire-Y”, “4Wire-D”, “3Wire-D”, etc.	N
		Program ID	ID name from JEMWare	N
		Firmware Rev	<Revision Number>	N
		Display	Select 6-digit or 8-digit main display with leading zeroes or leading blanks	Y
	Demand	Interval	Time in hours/minutes	N
		Subinterval	Time in hours/minutes	N
	Date/Time	Time	XX:XX:XX (24 hour format)	Y
		Date	XX.XX.XX (format configured in JEMWare)	Y
	Health Status	Battery Status	“OK”, ”Warning”	N
		Configuration	“OK”, “Error”	N
		Site Monitor	“Normal”, “Alarm”	N
		Threshold 1	“Normal”, “Alarm”	N
		Threshold 2	“Normal”, “Alarm”	N
		Threshold 3	“Normal”, “Alarm”	N
		Threshold 4	“Normal”, “Alarm”	N
	Optical	Address	<Decimal address>	Y
		Baud	“300”, “1200”, “2400”, “9600”, “19200”	Y
		Protocol	“Binary”, “DNP”, “Modbus”, “ANSI Tables”	Y
	Serial 1	Type	“RS232”, “RS485”	N
		Address	<Decimal address>, “Not Installed”	Y
		Baud	“300”, “1200”, “2400”, “9600”, “19200”, “38400”, “Not Installed”	Y
		Protocol	JEM 2B, DNP, Modbus RTU, Modbus ASCII, ANSI Tables, Not Installed	Y
		RTS ON time	Time in mSec between RTS ON and Tx start	Y
		RTS OFF time	Time in mSec between Tx end and RTS OFF	Y
		Turnaround	Time in mSec between Tx end and Rx start (RS485 only)	Y
	Serial 2	Type	“RS232”, “RS485”, “Modem”	N
		Address	<Decimal address>, “Not Installed”	Y
		Baud	“300”, “1200”, “2400”, “9600”, “19200”, “38400”, “Not Installed”	Y
		Protocol	JEM 2B, DNP, Modbus RTU, Modbus ASCII, ANSI Tables, Not Installed	Y
		RTS ON time	Time in mSec between RTS ON and Tx start	Y
		RTS OFF time	Time in mSec between Tx end and RTS OFF	Y
		Idle Timer	Time in minutes with no comm activity before modem disconnects	Y
	Ethernet	Type	Indicates the presence of the Ethernet option	N
		IP Address	Current IP address	N
		Netmask	Current Netmask	N
		MAC Address	MAC address	N
Preset	Normal	<Register list>	<Value in each register>, Editable for numeric registers	Y
	Alternate	<Register list>	<Value in each register>, Editable for numeric registers	Y
I/O	Outputs	Channel 1	<Ke Value>, “EOI”, “Site Alarm”, “Threshold Alarm”, “Not Installed”	N
		Channel 2	<Ke Value>, “EOI”, “Site Alarm”, “Threshold Alarm”, “Not Installed”	N
		Channel 3	<Ke Value>, “EOI”, “Site Alarm”, “Threshold Alarm”, “Not Installed”	N
		Channel 4	<Ke Value>, “EOI”, “Site Alarm”, “Threshold Alarm”, “Not Installed”	N
	Inputs	Channel 1	“Counter”, “Interval Sync”, “TOU Override”, “Status”, “Not Installed”	N
		Channel 2	“Counter”, “Interval Sync”, “TOU Override”, “Status”, “Not Installed”	N
	Analogs	Channel 1	<Assigned measurement>, “Not Installed”	N
		Channel 2	<Assigned measurement>, “Not Installed”	N
		Channel 3	<Assigned measurement>, “Not Installed”	N
Configure	Test Mode	<Register list>	<Press SET to enter Test Mode> **	N
	Comm	Optical	“Press SET to send character out port”	N
		Serial 1	“Press SET to send character out port”, “Not Installed”	N
		Serial 2	“Press SET to send character out port”, “Not Installed”	N
	Site Check	Va, Vb, Vc	“Press SET for phasor diagram”	N
		Ia, Ib, Ic	“Press SET for phasor diagram”	N
		Va, Ia	“Press SET for phasor diagram”	N
		Vb, Ib	“Press SET for phasor diagram”	N
		Vc, Ic	“Press SET for phasor diagram”	N
	Display	Display Test	“Press SET for display pixel check”	N

**Only KWH and KVAR registers are editable and the value displayed while editing is the calibration adjustment (+/- 5%) not the reading

To access the Display Menus:

1. Remove the meter globe (this may require breaking a seal). Turn the globe counter-clockwise to disengage it from the base and set it aside.
2. Press any one of the four arrow buttons on the right front of the meter, and the display will immediately go to the Menu Mode. If it does not, the Security Key may be removed, thus restricting access. If your company procedures allow it, you can enable access to the front panel. Refer to "Chapter 5 – Maintenance" for information about Security Keys.
3. The lower portion of the display is now divided into three menu columns. Starting at the leftmost column, you will see the "Settings" category highlighted. Highlighted areas indicate the *selected* area that is presently active. Using the UP and DOWN arrow buttons, you can scroll through the first column choices. Note that the second column will adjust to the function selected in the first column.
4. Use the right arrow button to move the cursor to the second column. The third column choices are now visible. In this manner, you can scroll up, down, left, or right, to place the cursor on the specific function you want to view or edit. Familiarize yourself with this operation before proceeding. Press the READ button any time you want to return to the normal display.
5. Once you have selected the correct menu feature, the value will be displayed in the upper section. Press SET to edit the value. Note: Some functions can be edited, some cannot. If it is changeable, a highlighted cursor will appear in the upper right section.



Typical example of setting the meter's clock. Note the minute digit "4" is highlighted for change.

6. To increment the highlighted digit, press the + button; to decrement, press the - button. You may press the READ button at any time to cancel the operation without making any changes.
7. To select the next digit, press the right arrow button.
8. Continue selecting and incrementing/decrementing digits until the desired setting has been configured.
9. When the last digit has been changed, press the SET button. The meter accepts the change and automatically returns to the lower menu section. Use the left arrow to back through the menus and return to the normal display, or press the READ button to escape.

   Note: If the meter is left in the Menu Mode without user interaction (i.e. pressing buttons), it will automatically revert to normal display operation after 1 minute (factory default setting). The length of time can be configured for up to 60 minutes by changing the "Preset Mode timeout" under Display Setup in JEMWare.

Register Display Modes

The meter registers can be grouped in three different display modes: Normal, Alternate, and Test. *JEMStar* can display up to 50 Normal and 50 Alternate registers. Normal Mode is the "usual" display mode of the meter. If display Scrolling is enabled (via JEMWare), the Normal Mode registers are sequentially displayed at a user-configurable rate.

TIP: If the meter is configured for a scrolling display, you can halt it by pressing and holding the SET button for 5 seconds. This will stop the display indefinitely. Pressing the READ button will return the display to scroll mode.

Alternate Mode registers are a second group of registers that are not displayed in the Normal Mode. These registers could be used as a convenient method to group storage registers, or any other user purpose. They are accessible to the meter reader by pressing and holding the READ button for at least two seconds. To return to Normal registers, press and hold the READ button again for two seconds.

While in Normal or Alternate Mode, if the meter detects a System Error condition (for example, a Battery Warning), each time a new register is presented an error message will be displayed briefly before the actual register value. Performing a Billing Period Reset will clear the System Error reports.

Test Mode is used for testing the accuracy of the meter. Refer to Chapter 4, Test & Calibration for a complete explanation of Test Mode.

Note: When in Test Mode, only the Test Mode registers update. The standard metering registers and load-profile data do not accumulate. The normal metering functions are suspended until Test Mode is exited.

To manually scroll through Normal Mode registers:

The display registers defined in the Normal Mode can be manually scrolled by momentarily pressing the READ button to step to the next register.

To enter Alternate Mode displays:

Alternate Mode is entered by holding down the READ button for two or more seconds. The Alternate Mode registers can be scrolled through manually by momentarily pressing the READ button. To return the meter to Normal Mode from Alternate Mode, press and hold the READ button for two or more seconds and release.

Test Mode

The *JEMStar* meter has a special mode of operation, called Test Mode, that allows the operator to apply test voltages and currents to the meter without having them affect Normal or Alternate registers, or Load Profile. Test Mode also allows adjustment of meter registration.
During Test Mode, the following conditions exist:

1. Normal and Alternate registers stop accumulating. Peak, Coincident, and Time/Date of Peak registers may continue to update, but they behave as if there is zero power applied to the meter.
2. Load Profile stops accumulating and storing interval records. Any partial interval counts accumulated before entering Test Mode will be retained, and will be stored with a Test Mode event record when Test Mode ends.
3. Test Registers accumulate power, and behave as expected for the type of register. (E.g. Time-of-Use registers respond only during the correct rate period, Demand registers update on normal demand interval timing, etc.)
4. The Optical Port emits Test Pulses.
5. Analog Outputs continue to operate as before.
6. Energy (KYZ) pulses continue to operate as before.

Refer to “Chapter 4 - Test & Calibration” for a complete explanation of Test Mode operation.

Note: If the meter has been configured with a "Test Timeout" via JEMWare, the display will automatically revert to normal operation after the designated length of time without user interaction. The factory default setting is 30 minutes.

Display Format and Auto-Ranging

Because of the nature of register values, some register types are formatted differently than others. The user has the capability to configure the number of digits to be displayed and the number of digits to the right of the decimal point. However, in order to create the most flexibility, *non-accumulating* registers are displayed in an Auto Range style, where the value (including decimal point) is shifted to the right to make sure the most significant digits are displayed, despite the user's configuration.

For example, an Instantaneous Watt register may be configured by the user to show 6 total digits and 3 decimal places. Without auto ranging, this could be a problem if the quantity exceeds 999.999 W because the most significant digits would not be displayed. However, *JEMStar* will auto range by moving the decimal to the right and allowing a greater quantity to be displayed.

Therefore, each register type can be categorized into one of three behaviors:

Auto Ranging	**User-Configured Format (potential overflow)**	**Fixed Format (unaffected by user configuration)**
Instantaneous	Consumption	Time of Peak
Average PF	Cumulative Peak Demand	Date of Peak
Peak Demand	Continuous Cumulative Demand	
Coincident Demand		
Thermal Demand		
Peak Thermal Demand		
Predicted Demand		

The user may choose to display Consumption, Peak Demand, Coincident Demand, Cumulative Demand, Continuous Cumulative Demand, and Predicted Demand with leading zeroes. In this event, Auto Range is not applied to any of these register types.

CHANGING METER CONFIGURATIONS

The meter front panel offers some basic setup features, however you will use *JEMWare* software to make most changes in a meter configuration. Please refer to Publication 1083-602 for complete details about using the program.

Certain features of the JEMStar meter are forced to be re-initialized when portions of the meter's configuration are changed. This section summarizes the changes that will force a re-initialization. Note that when a new configuration is loaded into a meter, the meter determines individually if each section has changed from the currently stored configuration. These features are re-initialized ONLY if the particular configuration sections are different. Re-initialization means that the data in that particular register is set to zero.

Display Registers

The Display Registers feature includes the following parts of the JEMStar:

- Registers in the Normal display list
- Registers in the Alternate display list
- Registers in the Test display list
- Self Read registers
- Register Thresholds
- Site Monitor alarms
- Totalization registers

The following configuration sections, if modified, will cause the Display Registers feature to be re-initialized, erasing all previous data:

- Normal display list
- Alternate display list
- Test display list
- Demand settings
- Self Read settings
- Primary Scaling settings (including changing VT Ratio or CT Ratio from the meter front panel.)
- Register Threshold settings
- Demand, Load Profile Interval Timing settings
- Totalization channel setup

Load Profile

The Load Profile features (which does not include individual Event Logs) will be erased and re-initialized if these configuration sections are modified:

- Demand, Load Profile Interval Timing settings
- Load Profile channel assignments
- Primary Scaling settings (including changing VT Ratio or CT Ratio from the meter front panel)
- Totalization channels

Energy Pulses

The Energy Pulse feature will be re-initialized if these configuration sections are changed:

- Energy pulse channel assignments

DISPLAY MENUS

The following section details how to use the meter display menus. The categories are listed in the order they appear on the screen. Refer to the preceding chart "Display Menu Layout" for a full list of the available menus.

Some display menu features are read-only and some are directly editable. The meter settings that can be edited via the front panel are limited to the most common functions. ALL *JEMStar* settings can be configured using JEMWare software. Please refer to the JEMWare instruction manual 1083-602 to configure a meter via software.

JEMStar uses two security keys to limit access to the front panel pushbuttons. Depending upon your company's policy, you may need to "unlock" the keypad. Refer to Section 5 – Maintenance for instructions about Security Keys.

VTR/CTR

You can read and change the Voltage Transformer Ratio and the Current Transformer Ratio by going to the menu Settings | Identity | VTR (or) CTR. Edit the existing setting by pressing SET and using the arrow buttons to enter a new ratio. Be sure to update the front panel label to correspond to the new ratio that you entered.

> **NOTE 1:** Changing the meter's VT or CT Ratio will cause Load Profile pulse constants, Energy Pulse constants, Site Monitor thresholds, and Analog Output levels to be re-scaled **automatically** so that they will maintain the same settings in Primary units. It will also cause all numeric registers to be erased and re-initialized.
> **NOTE 2:** Changing the meter's VT or CT Ratio from the front panel will invalidate any Loss Compensation settings that may already be configured. If you use the Loss Compensation feature, enter the VT and CT Ratios via JEMWare configuration software to maintain your TLC settings.

Service, ID, Revision

You can read the following information about how the meter is configured by going to the menu: Settings | Identity | Service *or* Program ID *or* Firmware Rev.

Type of Service	Available types are 4-Wire Wye, 4-Wire Delta, 3-Wire Delta, Network, Open Delta, 3-Wire Wye
Program ID	This is the meter identification that will appear in the register list.
Firmware Rev	This is the version number of the firmware installed in the meter.

Demand Intervals

You can read the Demand Interval and Subinterval lengths in hours and minutes by going to menu: Settings | Demand | Interval *or* Subinterval. These settings can only be edited by using JEMWare software.

Date / Time

JEMStar uses a real-time clock capable of maintaining time and date with a very high resolution. With the on-board battery, it will maintain time even when auxiliary power is off.

The *JEMStar* clock can be configured to use the local power line frequency as a time synchronization method, or to use the internal frequency reference (crystal oscillator). If *JEMStar* is configured for line sync, it will continue to keep time even if the Phase A reference voltage disappears. If auxiliary power is absent, the meter will revert to the internal crystal time base.

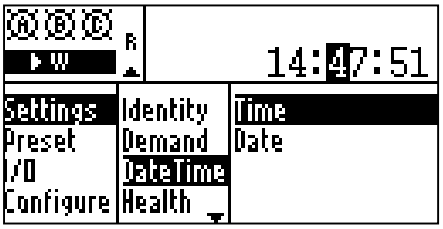
The *JEMStar* clock accuracy, when configured for line sync, is dependent on the line frequency accuracy. When configured for crystal sync, *JEMStar's* timekeeping accuracy is 3 minutes per month or better.

The date and time can be set from the front panel or via serial communication command. *JEMStar* will accommodate the differences in the way time is adjusted for daylight savings time internationally through the JEMWare program.

Note: Date and Time can only be edited through the Settings menu (not via Presets).

Setting the Date and Time

The date and time can be set either through the front panel, or through serial communications via JEMWare software. Since this may affect interval timing or TOU, this session is logged as a manual Time Set event. The front panel procedure is performed as follows.



Date Set

1. Remove the meter globe.
2. To enter the Date Set Mode, press any arrow key. Using the arrow keys, go to Settings | Date Time | Date, then press the SET button. The date appears as XX.XX.XX and is a configurable sequence through JEMWare. The first digit in the line is highlighted. (Highlighted digits are *selected* digits.)
3. To increment the highlighted digit, press the + button; to decrement, press the - button. You may press the READ button at any time to cancel the operation.
4. To select the next digit, press the right arrow button.
5. Continue selecting and incrementing/decrementing digits until the desired date has been entered.
6. Press the SET button to accept the new value. The meter automatically returns to the menu. Use the left arrow to back through the menus and return to the normal display, or press the READ button to escape.

Time Set

1. Remove the meter globe.
2. To enter the Time Set Mode, press any arrow key. Using the arrow keys, go to Settings | Date Time | Time, then press the SET button. The time appears as HH.MM.SS in 24-hour format. The first digit in the line is highlighted. (Highlighted digits are *selected* digits.)
3. To increment the highlighted digit, press the + button; to decrement, press the - button.
4. To select the next digit, press the right arrow button.
5. Continue selecting and incrementing/decrementing digits until the desired time has been entered.

6. Press the SET button to accept the new value. The meter automatically returns to the menu. Use the left arrow to back through the menus and return to the normal display, or press the READ button to escape.

Note: Automatic meter actions that are configured to activate on a non-existent date are automatically changed to occur at the same time on the first day of the following month.

Example: An auto-billing period reset configured to occur at midnight on the 30th day of each month will do so each month except February. In that instance, the BPR will occur at midnight on March 1st. A "day" is defined to begin at midnight (00:00:00 am) and end after 11:59:59.

Health Status

The meter has several internal safeguards that verify its' own operation. You can check the status of these monitors from the display menus by going to Settings | Health Status, and then choose a feature.

Battery Status	Monitors the internal RAM battery and advises if OK.
Configuration	Verifies if the meter's configuration is acceptable. Note that this only checks for conflicts in the setup; individual settings could still be incorrect for your specific application.
Site Monitor	Indicates if the parameter (assigned as a Site Monitor in JEMWare) is Normal or in the Alarm state.
Threshold 1/2/3/4	Indicates if a monitored parameter (assigned as a Threshold Alarm in JEMWare) is Normal or in the Alarm state.

Interpreting Status Register Values in the JEMStar Display

In addition to the Health Status display previously described, the user can assign Normal or Alternate registers to report various status functions. This configuration procedure is fully described in the JEMWare software manual 1083-602.

JEMStar Status Register values are displayed as eight-digit hexadecimal numbers, although only three digit positions are applicable to status reporting. All other digits will be zero and should be disregarded. The format of the displayed number is:

----MT-P

The digit in the M position reports **M**eter status.
The digit in the T position reports the **T**hreshold Alarm status.
The digit in the P position reports the **P**otential Indicator status.
The digits in the **–** position are always zero.

Meter Status

Four conditions are reported in the Meter status digit: Battery Warning, Configuration Default, Site Monitor Warning, and External Status Input.

Battery Warning occurs when the meter has spent more than a cumulative 2 years in a powered-down state, drawing battery power to maintain memory. This does NOT indicate that the battery is low, simply that the user should consider replacing it.

Configuration Default occurs when a non-recoverable error is detected in some part of the meter's Configuration tables, and the meter has switched that part to a default configuration.

Site Monitor Warning indicates that the meter has detected an alarm condition that the Site Monitor system was configured to report.

External Status reports the state of the optional contact input, when the input is configured as a Status indicator. If both contact inputs are configured as Status, then an operation of either one (or both) will produce the "On" indication.

The following chart should be used to interpret the hexadecimal code for Meter status, shown as the fifth digit from the left.

Meter Status Digit Value	Battery Warning	Config Default	Site Monitor	External Status
0				
1				On
2			Yes	
3			Yes	On
4		Yes		
5		Yes		On
6		Yes	Yes	
7		Yes	Yes	On
8	Yes			
9	Yes			On
A	Yes		Yes	
B	Yes		Yes	On
C	Yes	Yes		
D	Yes	Yes		On
E	Yes	Yes	Yes	
F	Yes	Yes	Yes	On

Threshold Alarm Status

This digit, displayed sixth from the left, reports the state of the four Register Threshold detectors in the JEMStar.

Threshold Alarm Digit Value	Threshold 1	Threshold 2	Threshold 3	Threshold 4
0				
1				Yes
2			Yes	
3			Yes	Yes
4		Yes		
5		Yes		Yes
6		Yes	Yes	
7		Yes	Yes	Yes
8	Yes			
9	Yes			Yes
A	Yes		Yes	
B	Yes		Yes	Yes
C	Yes	Yes		
D	Yes	Yes		Yes
E	Yes	Yes	Yes	
F	Yes	Yes	Yes	Yes

Potential Indicator Status

This digit, displayed eighth (or last) from the left, monitors the presence of up to three meter phase potential inputs.

Potential Indicator Digit Value	Phase C	Phase B	Phase A
0			
1			On
2		On	
3		On	On
4	On		
5	On		On
6	On	On	
7	On	On	On

Communication Settings

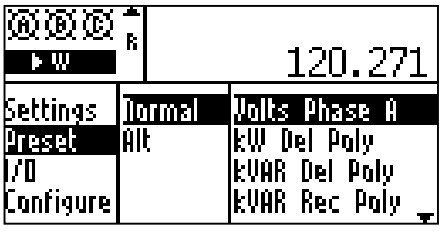
There are four basic methods of interfacing with *JEMStar:* Optical port, Serial data (RS-232/485), modem, and ethernet. The display menu allows reading and editing of basic communications port parameters such as:

Type	For Serial 1 and Serial 2, select whether communications are via RS232, RS485, or Modem*****
Port address	Entered as a hexadecimal number
Port baud rate	Use the arrow buttons to scroll through the available choices
Comm protocol	Use the arrow buttons to select either Binary, DNP, Modbus (RTU or ASCII), or ANSI Tables

Go to menu: Settings | Optical *or* Serial 1 *or* Serial 2, then choose one of the above parameters to read or edit.

* Note: When equipped with the Ethernet/Serial option, it will always indicate RS-232 regardless of how the hardware is configured. Refer to the manual section on Communication Ports for details on how the Ethernet board is jumpered for RS-232 or RS-485.

Preset Meter Registers



Register Preset enables the user to set meter registers at a predetermined value. This option is often used when meters are replaced, allowing the user to set the new meter with the previous meter's register settings.

Most quantity registers can be preset. This function can be performed directly from the front panel of the meter, or with the JEMWare configuration software. Since this may affect the correlation between Register and Load Profile readings, this session is logged as a Register Preset event.

To preset the meter registers from the front panel:

1. Press any arrow key to enter the menu screen.

2. Using the arrow keys, go to menu selection Preset | Normal *or* Alt | . The registers available for presetting appear in the far right column on the meter display.
3. Use the arrows to select a register from the right-hand column to preset, and then press the SET button. The first blinking digit in the setup field is the selected digit.
4. To increment the highlighted digit, press the + button; to decrement, press the - button. You may press the READ button at any time to cancel the operation.
5. To select the next digit, press the right arrow button.
6. Continue selecting and incrementing/decrementing digits until the desired quantity is shown on the display.
7. When the desired register value is reached, save that register value by pressing the SET button. The meter automatically returns to the menu.
8. Repeat Steps 3 through 7 to preset any other register quantities.
9. When all the necessary registers are preset, press the left arrow button repeatedly to exit out of the menu screen, or press READ.

Note: Pressing the READ button while editing a register will cancel the SET operation and restores the register to its' original value(s).

To preset the meter registers using JEMWare software:
Please refer to the JEMWare Instruction Manual 1083-602

Outputs

This is a view-only menu from the meter; all edits must be performed using JEMWare software. With the DI/DO or 5KYZ option for Contact Outputs installed, JEMStar can provide up to five separate output signals. Using JEMWare software, each output can be configured for one of the following:

- EOI (End Of Interval) pulse
- Constant: The amount of energy represented by each pulse, in either secondary or primary units (Ke value).
- Alarm: An output can be triggered either by a Site Alarm or Threshold Alarm.
- If the contact opens / closes when the register value exceeds the upper threshold.
  Note: By default, the contact reverts to its normal state once the corresponding register value recedes below the lower threshold.

To view the output settings, go to menu: I/O | Outputs, then select a Channel number that you want to view. The screen will display what each of the four channels has been configured to monitor.

Contact Input Option

This is a view-only menu from the meter; all edits must be performed using JEMWare software. With the DI/DO (or 5KYZ) option for Contact Inputs installed, JEMStar can accept up to two separate inputs from outside sources. Using JEMWare software, each input can be configured for one of the following:

Counter	Used to count any pulses
Interval Sync	Used to accept EOI output pulses from another meter, thus keeping demand intervals synchronized
TOU Override	An input pulse will cause the meter to revert to any predetermined Time Of Use rate.

Status	An input pulse is recorded as a Status event in Load Profile data
Totalization	An input pulse adds a configurable amount of energy to a Totalization channel's reading.

To view the input arrangement, go to menu: I/O | Inputs, then select a Channel number that you want to view. The screen will display how each of the two channels has been configured.

Analogs

Three current-output signals can be supplied as an option for external indication or to interface to other data systems. The output range is factory supplied as either 0-1mA or 4-20mA. Each analog output is configurable to one of the basic measured quantities: Watt, VAR (or Q), VA, A, V, PF, Frequency, or THD.
The analog-output connection is a pigtail cable located at the base of the meter on socket and A-base meters. The analog-output signals for switchboard-case meters are available through the screw terminal block at the rear of the case.

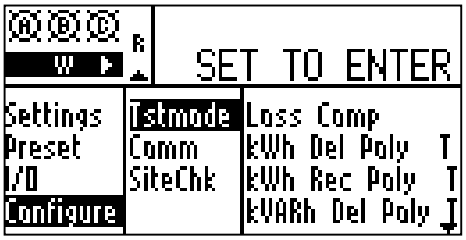
To view how the analog outputs are configured, go to display menu: I/O | Analogs, then select a Channel number that you want to view. The screen will display how each of the analog channels has been configured. To edit the configuration, you must use JEMWare software.

Configure

The Configure menus are used to put the meter in Test Mode, verify communications, check the meter installation using phasor diagrams, and perform a display pixel check. These features are described in the following sections.

TEST & CALIBRATION

Test Mode



You can test meter functions and accuracy from the front panel. Since this may temporarily inhibit registration, this session is logged as a Test Mode event. You must break a seal to perform this function.

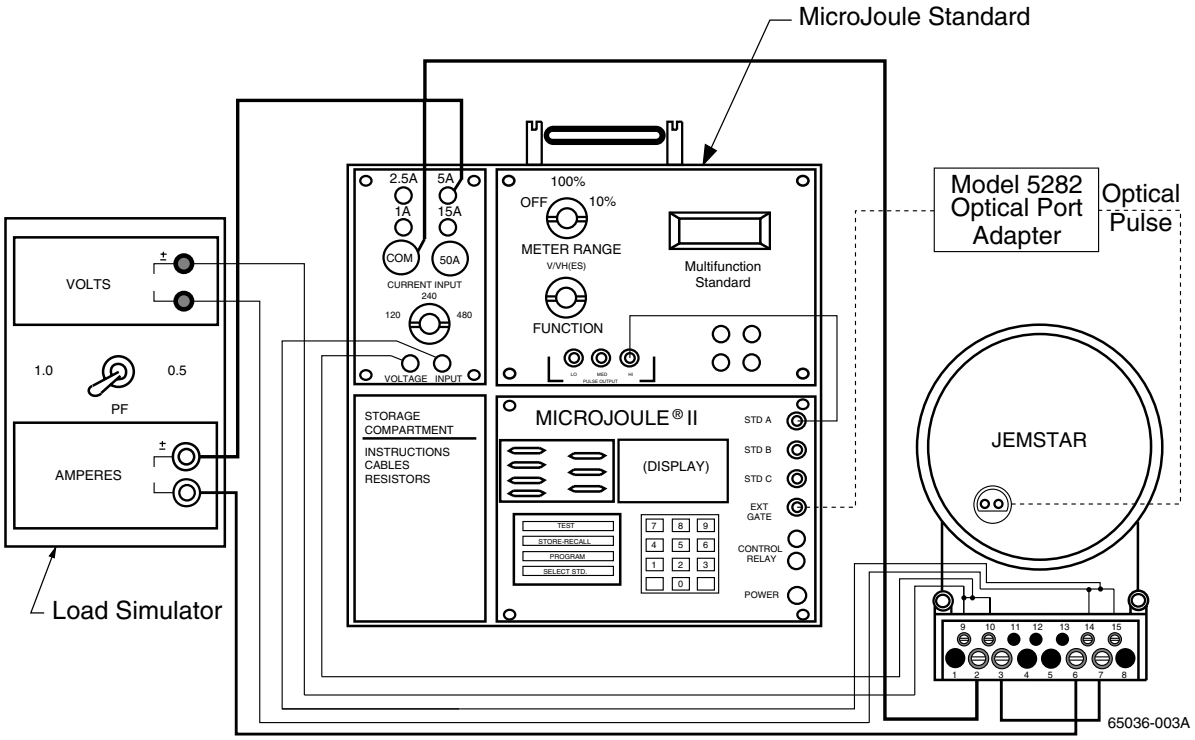
To enter the Test Mode, go to display menu: Configure | Tstmode, then select a parameter from the third column that you want to view. You must press the SET button to actually enter Test Mode. This action helps prevent accidentally entering into Test Mode and suspending registration.

Registration Adjustment

You can adjust the meter's Watt and VAR registration from the meter's front panel. This session is logged as a Calibration event and is performed in Test Mode. This is not a full meter calibration. If re-calibration is required, the meter must be returned to the factory.

The *JEMStar* optical port on the face of the meter performs two functions. During Standard Meter Mode, it is used for serial communications. In Test Mode, the optical port on the face of the meter sends out test pulses consistent with the test register that is being displayed (e.g. Watthour, Varhour). The pulse outputs are available even when the meter is in Test Mode, operating at their programmed K_e value. You may use a Scientific Columbus Model 5282 Optical Port Adapter or equivalent that will convert the optical pulses to contact closures. This can then be interfaced to a Watt standard's (such as Scientific Columbus' MicroJoule®II) external gate input.

The *JEMStar* is tested like any other electronic meter. It should be set up so the test standard sees the same voltage and current as the meter. This is done by connecting the *JEMStar* voltage elements in parallel and the current elements in series. Refer to the following example that shows how to connect a *JEMStar* and a Watt Standard to an external load source.



TYPICAL CONNECTION DIAGRAM FOR JEMSTAR and MICROJOULE II TO AN EXTERNAL LOAD SOURCE

The model number, serial number, firmware version, and calibration date are stored in nonvolatile memory and cannot be changed.

Test Mode

During Test Mode, the following conditions exist:

1. Normal and Alternate registers stop accumulating. Peak, Coincident, and Time/Date of Peak registers may continue to update, but they behave as if there is zero power applied to the meter.
2. Load Profile stops accumulating and storing interval records. Any partial interval counts accumulated before entering Test Mode will be retained, and will be stored with a Test Mode event record when Test Mode ends.
3. Test Registers accumulate power, and behave as expected for the type of register. (E.g. Time-of-Use registers respond only during the correct rate period, Demand registers update on normal demand interval timing, etc.)
4. The Optical Port emits Test Pulses.
5. Analog Outputs continue to operate as before.
6. Energy output pulses continue to operate as before.

Test Mode ends on any of these conditions:

1. The user manually leaves Test Mode.
2. The meter detects a period of inactivity and exits Test Mode automatically. (Test Mode timeout.)
3. The meter loses power.

When Test Mode ends, the following occurs:

1. Normal and Alternate registers resume normal operation, accumulating power that is applied to the meter. Demand and TOU scheduling is unaffected.
2. Load Profile records a Test Mode event with partial interval counts from the interval before Test Mode began, then resumes normal operation.
3. The Optical Test Pulse stops.
4. Loss Compensation is re-enabled if it had been disabled while in Test Mode.

Enter Test Mode

To enter Test Mode, perform the following steps:

1. Press any Arrow key to enter Menu Mode. A set of three list columns and a smaller numeric field will appear.
2. Press the Down Arrow key 3 times to select Configure.
3. Press the Right Arrow key once to select Tstmode.
4. Press the Right Arrow key once more to enter Test Mode. The display will show “SET TO ENTER.” Press the Set key to confirm entering Test Mode.

Exit Test Mode

To leave Test Mode:

1. Press the Left Arrow key from any Test register. The display will show “SET TO EXIT”. Press the Set key to confirm leaving Test Mode. Note: Pressing the Reset key while in Test Mode will zero out all cumulative Test registers.

Navigating in Test Mode

To view a Test Register:

1. Press the Up or Down Arrow keys as needed to select the desired register. The content of the register will be displayed in the numeric field above the menu lists.

To turn Loss Compensation on or off:

1. Press the Up Arrow key as needed to reach the first register in the Test list, which is the Loss Comp status. The field above the menu lists will show ENABLED. Note: This is a default Test setting only, and has no affect over the actual meter configuration. The configuration setting as sent from JEMWare governs whether TLC is actually enabled or disabled.
2. Press the Set key. The ENABLED / DISABLED will be highlighted. Press the Up or Down Arrow key to toggle between ENABLED and DISABLED state.
3. When the correct state is displayed, press the Set key to accept the new state.
   Note: After leaving Test Mode, Loss Compensation will automatically return to its' configured state.

To adjust the Watt / Watthour gain of the meter:

1. Select a Watt or Watthour Test register. (NOTE: Either one will take the user to the combined Watt / Watthour gain adjustment. The adjustment affects both functions.)
2. Press the Set key.
3. The field above the menu lists will show a number like this: +0.00%
4. The "+" sign will be highlighted. Toggle between "+" and "-" by pressing the Up or Down Arrow keys.
5. Select other digits to modify by pressing the Left and Right Arrow keys. Each highlighted digit may be incremented by pressing the Up Arrow key or decremented by pressing the Down Arrow key. The user may enter a percentage correction for Watt / Watthour registration between –9.99% and +9.99%.
6. When the desired amount of correction is displayed, press the SET key to accept it. Press READ if you want to cancel.
7. The gain correction entered applies to both Watts and Watthours on *all* phases (delivered and received), even though the register displayed may have been a single-phase register.
8. Watt / Watthour gain corrections entered in this way will remain in effect after Test Mode ends.

Note: Adjusting Watt/Watthour gain will affect VA, VAhour, Q, Qhour, and PF.

To adjust the VAR gain of the meter:

1. Select a VAR or VARhour Test register. (NOTE: Either one will take the user to the combined VAR / VARhour gain adjustment. The adjustment affects both functions.)
2. Press the Set key.
3. The field above the menu lists will show a number like this:
   +0.00%
4. The "+" sign will be highlighted. Toggle between "+" and "-" by pressing the Up or Down Arrow keys.
5. Select other digits to modify by pressing the Left and Right Arrow keys. Each highlighted digit may be incremented by pressing the Up Arrow key, or decremented by pressing the Down Arrow key. The user may enter a percentage correction for VAR / VARhour registration between –9.99% and +9.99%.
6. When the desired amount of correction is displayed, press the SET key to accept it. Press READ if you want to cancel.
7. The gain correction entered applies to both VARs and VARhours on *all* phases (delivered and received), even though the register displayed may have been a single-phase register.
8. VAR / VARhour gain corrections entered in this way will remain in effect after Test Mode ends.

Note: Adjusting VAR/VARhour gain will affect VA, VAhour, Q, Qhour, and PF.

To use the Optical Test Pulse:

The Optical Test Pulse is an energy pulse output, similar to a KYZ pulse, that repeats at a rate proportional to energy consumption. Each pulse is a brief (approximately 30 to 40 millisecond) burst of infrared light sent by the Optical Port transmitter.

Measurements that may be selected for output as a Test Pulse are:

- Watthours
- VARhours
- Vahours
- Qhours
- Amphours

Any direction (Delivered, Received, per-quadrant) and element (phase A, B, C, or total) that may be selected for one of these measurements in a display register may be output as a Test Pulse. The pulse weight (Kt) for each pulse is fixed.

The Test Pulse output is always assigned to match the currently displayed Test register, if the register is displaying one of the measurements listed above. In other words:

If the register displays:	**The Test Pulse output is:**
Watts or Watthours, per-phase or total, any direction	Watthours, per-phase or total, any direction, 1.8 Wh / pulse
VAR or VARhours, per-phase or total, any direction	VARhours, per-phase or total, any direction, 1.8 VARh / pulse
VA or VAhours, per-phase or total, any direction	VAhours, per-phase or total, any direction, 1.8 VAh / pulse
Q or Qhours, per-phase or total, any direction	Qhours, per-phase or total, any direction, 1.8 Qh / pulse
Amps or Amphours, per-phase or total	Amphours, per-phase or total, 0.02 Ah / pulse
Any other register type	No change from the previous Test Pulse assignment.

The Optical Test Pulse may be picked up with any Optical Port receiver, although we recommend the Scientific Columbus Model 5282 Optical Port Adapter. The 5282 allows the Optical Port to be used for serial communication with a computer as well as directing the Test Pulse to an external counter for accuracy testing.

If the Optical Port is being used for serial communication during Test Mode, a Test Pulse may occasionally interfere with the meter's response to commands. The meter *is* capable of receiving and executing commands during Test Mode – only the response may be garbled. The normal Binary Protocol error checking and retry mechanism will provide reliable communication in this situation.

JEMStar *Test Pulse Output*

It is important to wait 15 seconds after application of potential before entering Test Mode. Otherwise, the meter may not produce test pulses in Test Mode. If the meter is suspected of not producing test pulses, scroll through Test Mode to the function under test (after 15 seconds of power-on time).

MAINTENANCE

Any *JEMStar* option, except for those noted as "factory configuration" or "configured at manufacture," can be installed by a user with the following capabilities:

- Intermediate skill as an electronic technician, including knowledge of static-protection and electrical safety techniques.
- Familiar with the proper use of common tools (e.g. screwdrivers, wire strippers or cutters, wrenches, etc.) and equipment (e.g. voltmeter) used in electronics, including static reduction equipment such as grounding straps or mats. Soldering equipment is NOT required.

The *JEMStar* meter design, with its plug-together boards, requires few tools for maintenance.

Caution!

All meter work must be performed at static-protected workstations
WITH POWER REMOVED.
The technician must follow properly prescribed static-control practices.
Refer to Appendix C for more information.

JEMSTAR SERVICING

JEMStar meters are available in socket-base (S- and A-base), and switchboard mounting packages. The disassembly procedure for each type is described as follows.

Socket-base meters (S- and A-base)

Globe Removal

1. Remove power from meter!
2. Remove all wire seals from the locking ring of the meter globe, and then remove the ring. You do NOT need to remove any seals from the RESET button.
3. Turn the globe counter-clockwise approximately 1 inch to disengage it from the base.
4. Carefully slide the globe forward away from the base and set it aside.

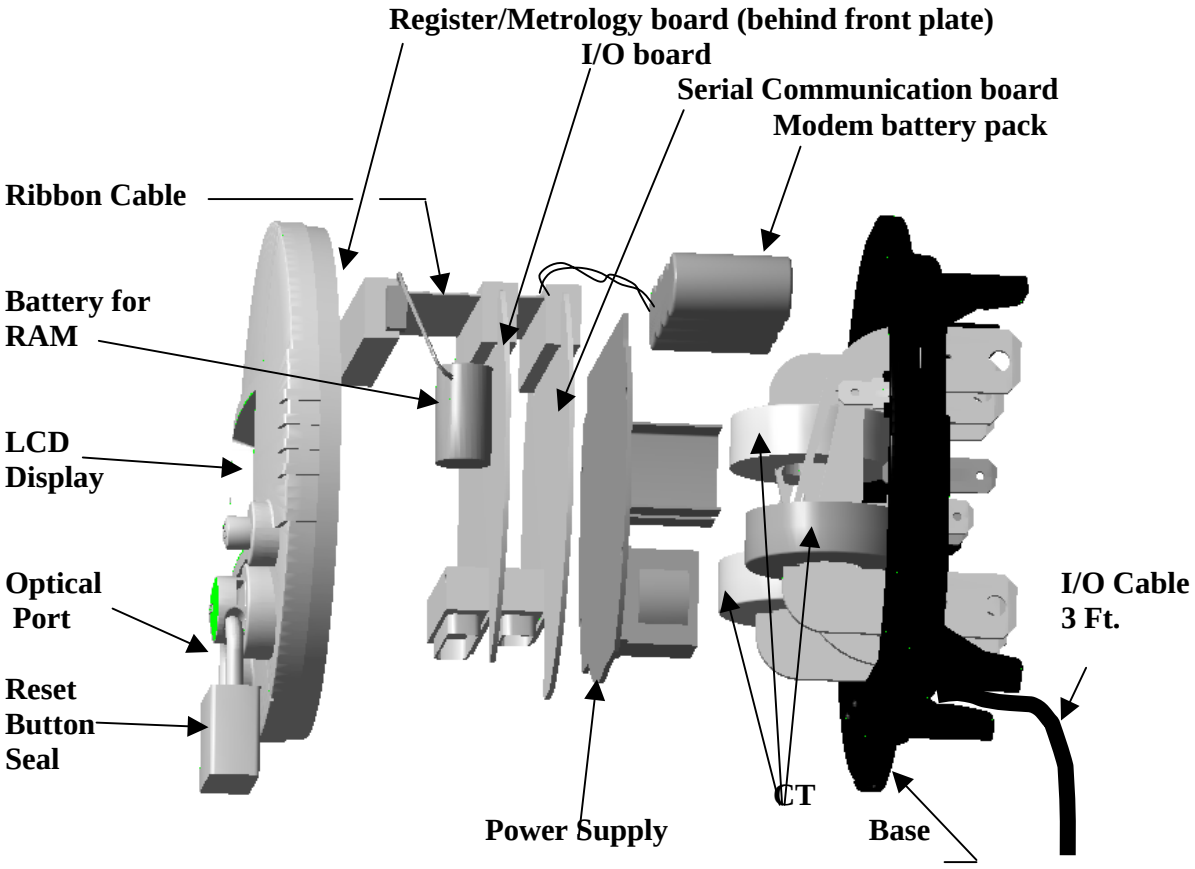
Internal Housing Disassembly

1. Remove the top cover of the housing by unscrewing three Phillips-head screws (below). Carefully lift the cover off, paying particular attention to the RAM battery wires. *Do not unplug the battery, or data will be lost!*

Top View of meter with globe removed

Remove screws at these locations, then lift the top cover off.

Be careful of the battery wires!



JEMStar S-Base, Exploded view, Internal Case removed

Switchboard Meters

Cover Removal

1. Remove power from the meter, if possible. It is not mandatory that power is removed because the Switchboard meter has its' own disconnect device. However, *caution is advised since live terminations exist inside the housing even after the paddle is removed.*
2. Remove the wire seal on the thumbscrew at the bottom center of the meter cover.
3. Unfasten the thumbscrew and lift the cover slightly while pulling forward from the bottom.

Internal Chassis Removal

1. Locate the black plastic paddle at the bottom of the chassis. Grasp the protruding handle section and firmly pull it toward you. This will safely disconnect and bypass the CT circuits from the meter.
2. Locate the upper and lower metal locking latches. At the same time, pull both the upper and lower tabs towards you until the levers are pointed straight out (about 90° swing).
3. Grasping the levers, gently rock the chassis while pulling forward. When the chassis is loose, remove it from the housing. You can now take the entire chassis to your service shop.

When re-installing the meter, note that the thumbscrew on the front cover has a small indentation on the head. This indicates the orientation of the hole in the screw for inserting the sealing wire. Turn the screw until the dot is in a horizontal position, and the hole in the screw will line up with the hole in the plastic cover.

Serviceable Parts

The *JEMStar*'s communication board and I/O board can be changed in the meter shop with a few simple procedures. Because the register/metrology board is calibrated to the current transformers and power supply board, Ametek Power Instruments recommends that the meter be returned to the factory if changes to these components are necessary.

The *JEMStar* clock/RAM battery is designed to last the life of the meter under normal storage and usage conditions. If the battery needs replacement, or you would like more information on any *JEMStar* components, call Ametek Power Instruments' Technical Support staff at 888-880-5361.

Serial Communication Board (Option)

➔ To remove the serial comm board:

1. Remove power from the meter.
2. Ensure proper grounding for static protection.
3. Remove the globe from the S-base or A-base meter. Remove the cover from the switchboard-case meter and pull the chassis out of the rack.
4. Remove the top housing cover as previously described (S-base and A-base only).
5. Disconnect the ribbon cable between the Register/Metrology and Comm board.
6. Pull the Comm board out part way.
7. Disconnect the modem cable from the Comm board (if included).
8. Pull the Comm board completely free of the meter.
9. Place the Comm board on an antistatic mat.

➔ **To replace the serial comm-option board:**

1. Reverse the procedure above.

I/O Board

➔ **To remove the I/O option board:**

1. Remove power from the meter.
2. Ensure proper grounding.
3. Remove the globe from the S-base or A-base meter. Remove the cover from the switchboard-case meter and pull the chassis out of the rack.
4. Remove the top housing cover as previously described (S-base and A-base only).
5. Remove the ribbon cable.
6. Firmly grasp the sides of the I/O board at the top of the board and remove.
7. Place the board on an antistatic mat.

➔ **To replace the I/O option board:**

1. Reverse the procedure above.
2. Use the software utility program (included on a diskette with the I/O board) to transfer the proper analog output calibration data into the meter.

Clock/RAM Battery

JEMStar contains an easily replaceable battery that is used to power the internal clock and RAM memory. The long life cell should provide support for 10 years, and its life can be checked from the front panel display. There is also a display register (Days on Battery) that can be read to determine how many days the battery has been used. If the meter is in service, the battery should be replaced while the meter is under power so that data is not lost (the battery is not used as long as service power is connected).

➔ **To replace the clock/RAM battery**:

1. Remove the outer globe from the S-base or A-base model. Remove the front cover from the switchboard model.
2. The battery is the 1" high cylinder located at the top, right side of the meter. Unplug the two-pin connector and lift the battery out of its holder.
3. Install a new, exact replacement battery, available from the factory. Specify part number 6005-254.
4. From the front panel menu, select Settings | Health | Batt Status, and then press the Set button until RESET is displayed. Press the Set button once more and verify the display changes to BATTERY OK. The Date and Time may also need to be set if the meter was taken out of service while changing the battery.

Phone Home on Power Outage Battery Pack (Option)

JEMStar incorporates a replaceable battery pack that is used to power the internal Phone Home modem during power outages. The battery will provide power to the modem for at least 8 hours of call time. It is recommended that the battery be changed every three years, or sooner if you experience numerous power outages.

➔ **To replace the Power Outage battery pack**:

1. Remove power from the meter.
2. Ensure proper grounding.
3. Remove the outer globe from the S-base or A-base model. Remove the front cover from the switchboard model.
4. On an S-based or A-base meter, remove the top cover. The battery pack is the four-cell assembly located in a holder directly under the cover. Unplug the two-pin connector and lift the battery up and out of its holder.
5. On the switchboard model, pull the chassis out of the rack by opening the upper and lower retaining latches. The battery pack is located under a retainer bracket near the back of the meter. Unplug the two-pin connector, loosen the bracket screws, and slide the battery out of its holder.
6. Install a new, exact replacement battery, available from the factory. Specify part number 15847-001.

Security Keys

JEMStar includes two security keys to protect the meter from tampering and unwanted access to certain meter functions. There are two removable jumpers (keys) located inside the meter on the Metrology board. One security key is used to disable all configuration changes from the front panel keypad menus, plus the following serial port commands when accessing the meter via JEMWare. Numbers in parentheses are the hex equivalent of the specific command in JEM binary (see Command Protocol manual 1083-603).

Enter Test Mode (4D 01)
Preset Normal Registers (57 01)
Preset Alternate Registers (57 02)
Configure Timekeeping (43 07)
Configure Interval Timing (43 08) (demand and Load Profile intervals)
Configure Demand Parameters (43 09) (subinterval length, outage deferral)
Configure Load Profile (43 0A)
Configure Pulse I/O (43 0B)
Configure Analog Outputs (43 0C)
Configure Primary Scaling (43 0D)
Configure Normal display List (43 0E)
Configure Alternate Display List (43 0F)
Configure Test Display List (43 10)
Configure TOU Schedules (43 12)
Configure TOU Seasons (43 13)
Configure TOU Holidays (43 14)
Configure Loss Compensation (43 15)
Configure Reactive Selection (43 16)
Configure Thermal Time Characteristic (43 18)
Configure Threshold Alarms (43 19)
Configure Site Monitor (43 1A)
Configure DST Schedule (43 1C)
Configure Energy Pulses (43 1D)
Calibrating/Loading Flash Memory

The other key is used to disable just the meter's front panel RESET pushbutton. The RESET button is used to perform a Billing Period Reset (see the Glossary for definition). With the jumpers installed, access is enabled. Remove the jumpers to restrict access.

The meter is provided with both keys factory installed. If you want to remove the key(s) after proper configuration in your meter shop, follow this procedure.

1. Remove power from the meter.
2. Remove the outer globe of the meter.
3. Remove the top cover of the housing by unscrewing three Phillips-head screws (below). Carefully lift the cover off, paying particular attention to the RAM battery wires. *Do not unplug the battery, or data will be lost!*

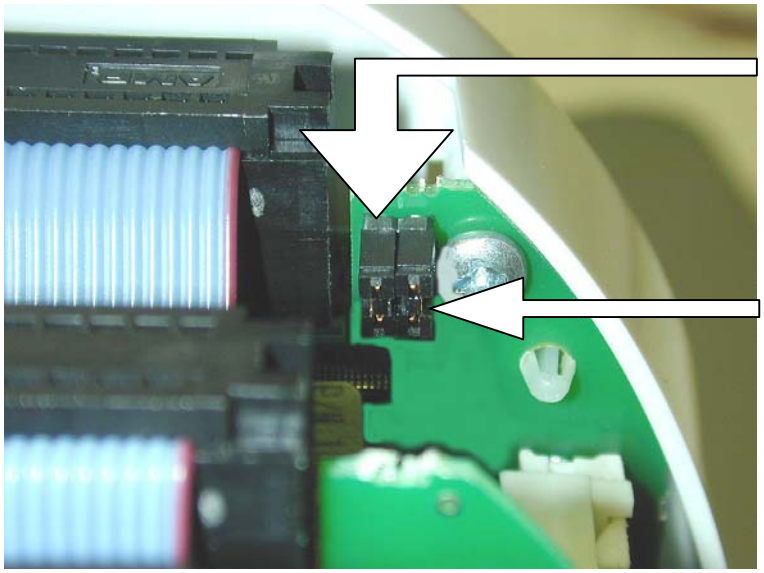
Top View of meter with globe removed

Remove screws at these locations, then lift the top cover off.

Be careful of the battery wires!

Jumper location beneath the cover

Looking from rear of the meter, with top cover removed



Remove this jumper to disable all configuration access from the meter keypad.

Remove this jumper to disable the meter's RESET pushbutton.

The jumpers are a standard 0.1" center, two-pin female shorting connector commonly used on most PC motherboards. Contact AMETEK and specify part number 4195-263, or ask your local computer shop for replacements.

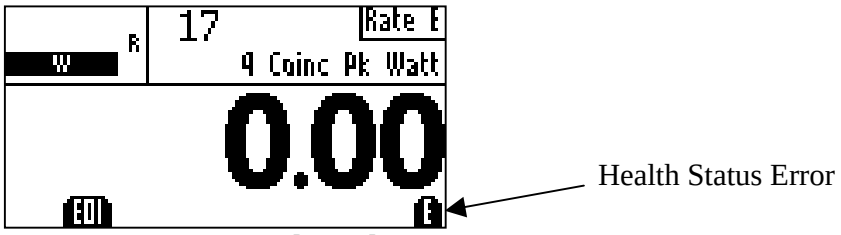
Tip: You can "park" the jumper in a disconnected position by just plugging it onto one contact. This will keep the jumper in the meter for future use.

Firmware Upgrades

New meter firmware can be downloaded remotely via the meter's serial port or modem (if equipped). This may be used to add optional features, product enhancements, or program upgrades. Contact the factory for more information and assistance.

Health Diagnostics

The *JEMStar* health-status register provides an indication of the operating ability of the meter. This is one of the status registers that can be displayed in either of the registering display modes (Normal or Alternate). An "E" on the *JEMStar*'s display indicates that a health condition is present and that the health-status register should be viewed.



***JEMStar* Front Panel Display**

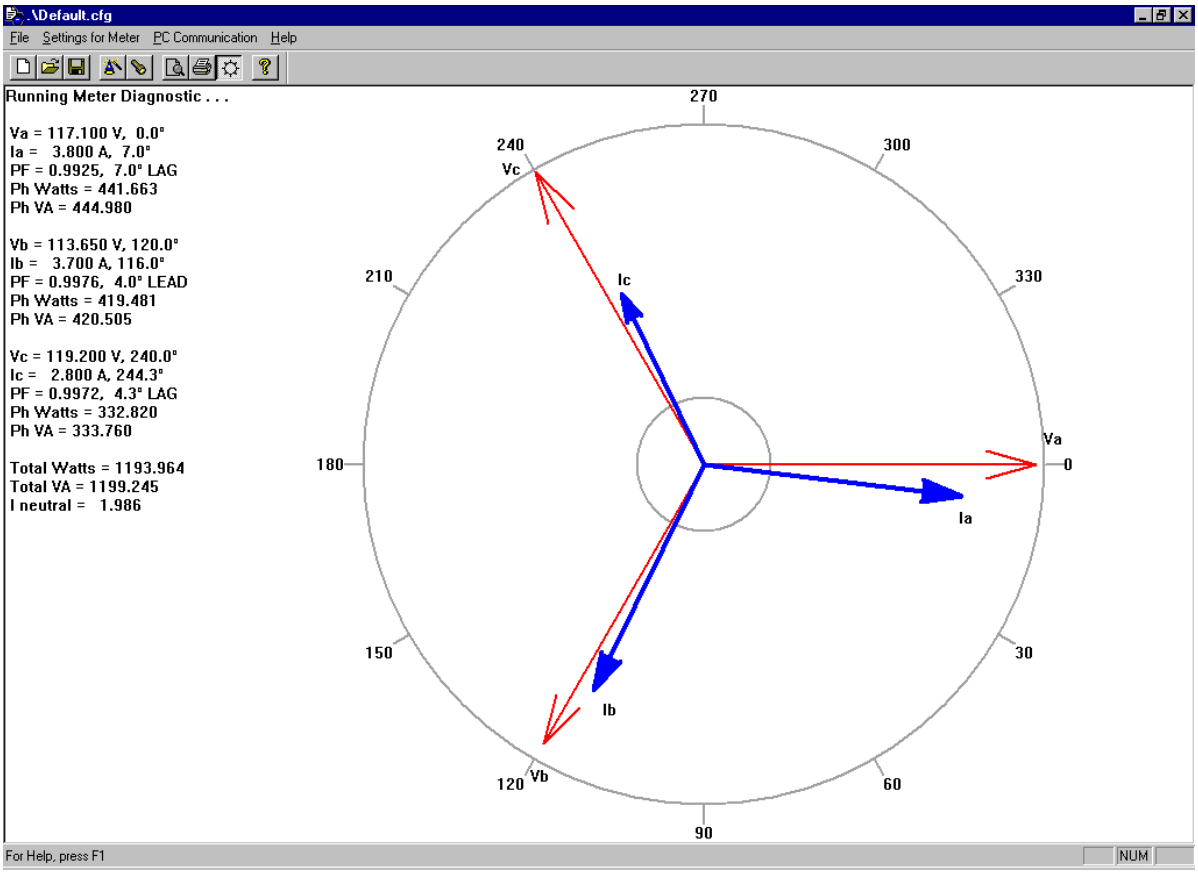
The *JEMStar* meter should never have a health-status error; however, in the unlikely event, contact AMETEK for assistance in interpreting the situation.

SITE DIAGNOSTICS

JEMStar can be configured to monitor its operating environment and report suspicious conditions. This monitoring occurs in two forms: Installation Verification and Installation Monitoring.

Installation (Site) Verification

JEMStar has an operating mode called Installation Verification, during which the meter makes and displays continuous readings of per-phase voltage, current, and their phase angles with respect to Volts Phase A. The user can enter this mode and read the information either from the front panel, or remotely via JEMWare software.



Diagnostic Display using JEMWare

Verification codes are used to interpret the information in light of the meter and service type. If the actual readings are inconsistent with the expected readings, the information will suggest possible remedies to be performed.

Installation (Site) Monitoring

JEMStar will check its present operating conditions on a regular basis and detect the following conditions:

- Per-phase instantaneous volts outside of configured thresholds (upper and lower)
- Per-phase instantaneous amps outside of configured thresholds (upper and lower)
- Per-phase power factor outside of configured range (upper and lower)
- Reverse power flow on any phase
- Phase voltage sequence out of order
- Internal meter error

Each test can be disabled or enabled during meter configuration. Any detected anomaly can be configured to report any combination of the following:

- Log to an event buffer, with the date and time when the condition was detected. If later on the condition is detected to have cleared, another event shall be logged noting the date and time.
- Set an indication in the Health Status summary register. This indication is removed when the detected condition has gone away.
- Latch an indication in the Health Status summary register. This indication will remain even when the detected condition has gone away.
- Activate an annunciator on the front panel. This indication is removed when the detected condition has gone away.
- Latch an annunciator on the front panel. This indication will remain even when the detected condition has gone away.
- Override the normal display with a status report that must be manually acknowledged before normal display operation can continue. This report always latches.
- Close a contact output on the *JEMStar*. The contact output will remain closed until the detected condition has gone away.

Notes:
Anomalies are reported only when first detected; persistent conditions are not re-reported unless they have cleared first.

A Billing Period Reset clears any latched anomaly reports that are no longer valid.

ADVANCED FEATURES

TIME OF USE

JEMStar maintains Time of Use (TOU) information for Consumption, Average PF, Peak Demand, Time of Peak Demand, Coincident Demand, and Coincident PF registers.

The meter can differentiate among up to 9 possible TOU rates, with registers for each rate, as configured by the user. *JEMStar* can have up to 8 rate changes per day. Each rate change is configured for the time of the change (resolved to 1 minute) and the rate code (A – H, or Total). Midnight is always assumed to be a rate change. The user must define the rate to begin at midnight of each day (midnight counts toward the limit of 8 changes per day).

JEMStar will recognize up to 9 day types per season: each day of the week (Sunday through Saturday) plus two Holiday types (Type 1 and Type 2). A rate change schedule must be defined for each day type.

A given day is recognized as a particular day of the week based on the *JEMStar* internal clock and calendar, unless that date is listed in the Holiday List. Any date in the Holiday List must be identified as a Type 1 or Type 2 Holiday. *JEMStar* can store up to 200 holidays in the Holiday List.

JEMStar is configurable for up to 4 season changes per year. The date (month, day, and year) of each season start, along with an indication of the season (Season 1, Season 2, Season 3, or Season 4) that starts on that date, is stored in the Season List. The Season List will hold up to 80 Season Start dates (4 per year for 20 years).

JEMStar can be configured to force the present TOU rate in effect to any other programmed rate by triggering a contact closure input. The user must select a rate (1-8, or Total) to switch to when a closure is detected on the input. The rate then reverts to the normal scheduled rate when the contact opens.

To configure a meter for Time of Use functions, consult the JEMWare instruction manual 1083-602.

LOAD PROFILE

JEMStar can record up to 4 Load Profile channels as a standard feature, or up to 12 channels as an added option. All Load Profile configurations are performed using JEMWare software. Load Profile storage is such that if the available memory becomes full, the oldest record(s) are deleted from memory to make room for the most recent. *JEMStar* stores one single record at the end of each Load Profile interval. A Load Profile interval may end on any of the following conditions:

- On the hour (if configured for "internal Load Profile synchronization") and each multiple of the configured Load Profile interval length after the hour. Load Profile intervals may be configured to be 1, 5, 10, 15, 20, 30, or 60 minutes in length.
- On any time set, Daylight Saving Time adjustment, recognizable power outage, or other event that would cause a discontinuity in interval timing.
- On any event that may cause a discontinuity in registration so that register readings and equivalent Load Profile readings could not be reconciled. (E.g. Register Freeze, Billing Period Reset, Register Preset, etc.)

The Load Profile intervals resemble demand intervals, but can be set independently. The interval closures occur on even increments within the hour. For example, a 15-minute interval will begin on the hour and will close at 00:15; the next interval will close at 00:30; the next interval will close at 00:45; etc. At the end of each interval, the meter records the number of pulses accumulated since the last Load Profile interval closure or special event. When the Load Profile data storage memory is full, the meter will overwrite the oldest information. The number of days of storage available is determined by the Load Profile interval length and number of channels stored.

Each Load Profile interval contains one or more channels of data. Each channel is configurable as to the quantity to be recorded, and the equivalent pulse constant (Km). Each channel can store up to 16,000 equivalent counts per interval.

JEMStar will store at least 60 days of data for 4 channels (up to 12 channels available) recorded every 5 minutes, along with all included Midnight records and reasonable numbers of Time Set, Billing Period Reset, and Power Outage intervals. By configuring fewer channels and/or longer intervals, you can increase the number of days of storage.

Each Load Profile channel can be configured to record one of the following:

- Any consumption quantity
- The number of pulses received in an interval on a contact closure input. Both make and break transitions are counted in the total.
- State of a contact input over the interval. If the contact was closed one or more times during the interval, the channel will record 1 count, otherwise zero.
- The average of any Instantaneous quantities over a Load Profile interval. In this case, the channel pulse count multiplied by the equivalent pulse constant shall give the average value, NOT the consumption in unit-hours, for the Load Profile interval.
- Accumulation in a Totalization channel.

  For example, for a 3-element meter operating at 120 volts, 5 amps, 1.0 PF on every element, an equivalent pulse constant of 1.0 on all channels, and 15 minute Load Profile intervals, the Watthour Delivered channel will report 450 counts (120V x 5A x 3

elements / 4 intervals per hour). The Average Instantaneous Watt Delivered channel will report 1800.

Table 1: Approximate Number of Days of Load Profile Storage (12-Channel Option)

Interval Length (minutes)	Number of Load Profile Channels Used											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	49	24	16	12	9	8	7	6	5	4	4	4
2	98	49	32	24	19	16	14	12	10	9	8	8
3	147	73	49	36	29	24	21	18	16	14	13	12
4	196	98	65	49	39	32	28	24	21	19	17	16
5	245	122	81	61	49	40	35	30	27	24	22	20
6	294	147	98	73	58	49	42	36	32	29	26	24
10	490	245	163	122	98	81	70	61	54	49	44	40
12	588	294	196	147	117	98	84	73	65	58	53	49
15	736	368	245	184	147	122	105	92	81	73	66	61
20	981	490	327	245	196	163	140	122	109	98	89	81
30	1472	736	490	368	294	245	210	184	163	147	133	122
60	2944	1472	981	736	588	490	420	368	327	294	267	245

Table 2: Approximate Number of Days of Load Profile Storage (4-Channel Standard)

Interval Length (minutes)	Number of Load Profile Channels Used			
	1	**2**	**3**	**4**
1	17	8	5	4
2	34	17	11	8
3	51	25	17	12
4	68	34	22	17
5	85	42	28	21
6	102	51	34	25
10	170	85	56	42
12	204	102	68	51
15	256	128	85	64
20	341	170	113	85
30	512	256	170	128
60	1024	512	341	256

JEMStar will record certain events in the Load Profile system intermixed with regular interval data. Any event that would end a Load Profile interval will be recorded, including the following:

■ Power Fail

Indicates that the meter has lost auxiliary power. If the meter does not have separate auxiliary power, Power Fail indicates the loss of Phase A power. The time of power failure and time of restoration are recorded.

■ Time Set

The beginning and end of a time set are recorded in load-profile memory. Time set can be performed at the meter or by use of serial communications.

■ Daylight-Saving Time

Adjustment events are stored. Changes are programmed via the JEMWare program. The DST change start and stop times are recorded.

■ Test Mode

Entries and exits are recorded as events. No load-profile data is recorded during the Test Mode. Test Mode can be initiated at the meter or through serial communications.

■ Configuration Event

A configuration event is stored in the load-profile memory. Load-profile data is erased when any load-profile-related parameter is configured. The configuration event is executed only through serial communications.

■ Freeze Event

A freeze event will cause the meter to take a snapshot of the Normal- and Alternate-Mode registers. When the meter reads these registers via serial communications, the value stored at the time of the most recent freeze event is returned. This event is executed only via serial commands.

■ Demand Reset

Indicates the time of storage-register updates and register clearing. This command can be initiated from the meter or through serial communications.

■ Register Preset

Indicates the time of storage-register presetting when used. This command can be initiated from the meter or through serial communications.

■ Midnight

Indicates when midnight occurs in the Load Profile sequence of events.

All recorded events include the following information:

- The date and time at which the event occurred
- A description of the type of event
- The counts for each configured channel from the beginning of the interval until the event occurred
- If applicable, the time at which the event ended (such as for a Time Set or power outage).

Load-Profile Retrieval

Load Profile may be retrieved in any of the following segments:

- All complete Load Profile records in memory, oldest first.

- All complete Load Profile records since the last Load Profile read, oldest first.
- All Load Profile records for the last N days, for N = 0 through 60. For any number of days requested, the meter will send that number of complete day's records plus whatever records have been stored in the current day.

  For example, requesting 0 days gives only today's records since midnight. Requesting 2 days gives all records for the preceding 2 days plus the present day's records. If the Load Profile memory does not contain enough days of records to fulfill the request, the meter will send all records presently stored.

Data can be retrieved with Ametek Power Instruments' *JemRead* software or by Itron's MV-90 software. Connection to the meter can be via the optical port, RS-232 / RS-485 serial port, or a modem.

The command protocol specifications that defines the data transfer method is public domain and can be obtained from the factory; ask for Publication 1083-603. Ametek Power Instruments recommends that only experienced programmers fluent in communication interfaces undertake such a task.

External-Synchronized Load-Profile Interval Closures

External interval tracking in the meter affects the load-profile channels. For that reason, load-profile interval length should match demand-interval length.

When configured for external synchronization, the meter uses two time sources—one for determining interval closure and one for the meter's real-time clock. Data skewing is possible if a synchronization pulse occurs on the load-profile interval boundary.

External Control of Load Profile Recording

JEMStar can be optionally configured to only record Load Profile data during externally triggered periods. This can be user-selected on a per channel basis, which means that some channels can record constantly, and some can record upon command from an external source. JEMWare can be used to configure any Load Profile channel to record when the TOU Rate Override contact input is ON.

To configure this operation in JEMWare:

1. Go to the Load Profile menu and either Add a new LP channel, or highlight an existing one to Edit.
2. In the setup screen, choose "Records During TOU Override Only". Choose OK.
3. Go to the Contact Input/Output menu and set one of the two Input channels for "TOU Rate Override".
4. Apply a signal to the Contact Input to begin LP recording on the designated channel.

Notes:

- The TOU Rate Override input does not affect interval timing in any way. It will only gate the collection of measurements in configured Load Profile channels.
- Load Profile channels configured to record only during TOU Rate Override are not associated with a given TOU rate. For example: If the meter is configured to use Rate C as the TOU Override rate, and Rate C also appears in the normal TOU schedule, the selected Load Profile channels record only while the TOU Rate Override input is on.
- Average Instantaneous Load Profile channels that are configured for TOU Rate Override are averaged over the period that the TOU Rate Override input is on. For example, with a constant 1000 watts applied to the meter and an Average Instantaneous Watt load profile

channel, if the TOU Rate Override input is active for one half of an interval the final value recorded in that interval will be 1000 watts, not 500 watts. If the TOU Rate Override input stays off for the entire interval, the channel will record 0. (An exception to this is Average Power Factor, which resets to 1.0 at the beginning of an interval and will remain there unless some actual measurements are collected.)

Typical Load Profile Printout

==========							
Load Profile Data Display							
==========							
No.	Event Type	Date	Time	-1-	-2-	-3-	-4-
851	Data	11-20-00	13:15:00	0	0	0	0
852	Data	11-20-00	13:20:00	0	0	0	0
853	Data	11-20-00	13:25:00	20	0	25	0
854	Test Mode	11-20-00	13:25:36	5	0	5	0
855	Test Mode End	11-20-00	13:26:13				
856	Time Set	11-20-00	13:28:55	19	0	24	0
857	Time Set End	11-20-00	23:54:52				
858	Data	11-20-00	23:55:00	1	0	1	0
859	Midnight	11-21-00	00:00:00	37	0	47	0
860	Data	11-21-00	00:05:00	42	0	52	0
861	Test Mode	11-21-00	00:08:02	26	0	32	0
862	Test Mode End	11-21-00	00:10:53				
863	Data	11-21-00	00:15:00	29	0	37	0
864	Power Failure	11-21-00	00:15:52	6	0	7	0
865	Power Failure End	11-21-00	00:17:14				
866	Data	11-21-00	00:20:00	19	0	24	0
867	Data	11-21-00	00:25:00	35	0	44	0
868	Data	11-21-00	00:30:00	35	0	44	0
869	Data	11-21-00	00:35:00	36	0	44	0
870	Data	11-21-00	00:40:00	35	0	43	0
871	Billing Reset	11-21-00	00:40:51	6	0	8	0
872	Data	11-21-00	00:45:00	29	0	36	0
873	LP Download	11-21-00	00:45:08				

DEMAND PREDICTION

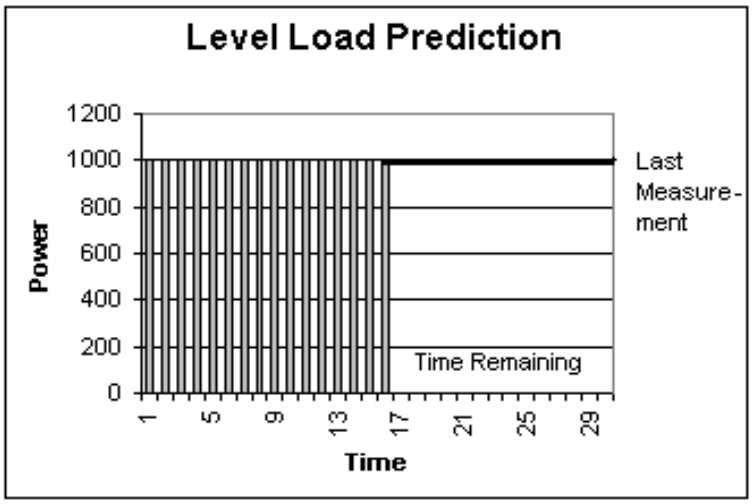
JEMStar can be purchased with an optional feature that will display a Demand Prediction for any measured Peak Demand quantity. This includes Watts delivered or received; VARs delivered, received, or per-quadrant; VA delivered or received; Q delivered or received; Amps; or Amps Squared.
A Demand Prediction is the Demand value that is expected at the end of the present demand interval. For example, if a level 1000 Watts is applied to the meter for a demand interval, the "predicted" demand at any time during that interval is 1000 Watts (See Example 1). At the end of the demand interval, the "actual" demand (which is based on actual measurements, not expected measurements) is 1000 watts.
JEMStar updates its internal Demand Prediction approximately every 50 milliseconds. Displayed Demand Predictions respond more slowly due to system and display timing constraints. Each update is based on the average of actual instantaneous readings taken in the current demand interval multiplied by the demand interval time that has already passed, plus the most recent instantaneous reading multiplied by the time remaining in the demand interval.
The result of this process is that a Demand Prediction register displays what will be the Demand at the end of the interval *if the load remains constant at its present value* until then. If the load does vary, the Demand Prediction register will reflect the new prediction and update the display within a second.
Demand Predictions may be used to monitor a load in order to prevent setting a new Peak Demand. If a Demand Prediction register shows a value that is higher than the existing Peak Demand, then a new Peak will occur at the end of the demand interval unless the load is reduced.
In the case of a sliding window (also known as rolling) demand, predictions are made in the last subinterval of the demand interval. In other words, JEMStar will not try to predict the demand beyond the present subinterval.

Demand Prediction Algorithm:
The calculation is performed at a rate of once every three power line cycles (about 50 ms):

$$\text{PredDmd} = \frac{(\text{Avg} \times \text{Sec}) + (\text{Pres} \times \text{Rem})}{\text{Int}}$$

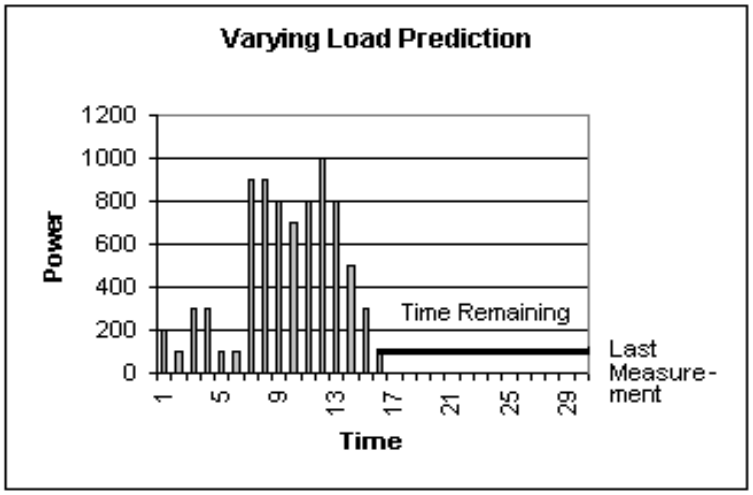
Where:
PredDmd = Demand Prediction
Avg = Average of Instantaneous Readings already taken in the present demand interval. The average is updated just before the Prediction is made.
Sec = Seconds that have already elapsed in the demand interval
Pres = Most recent Instantaneous Reading
Rem = Seconds remaining in Demand Interval
Int = Total number of seconds in Demand Interval

Examples:
(Graphs are not to scale. Assume one Instantaneous measurement per minute for illustration purposes.)



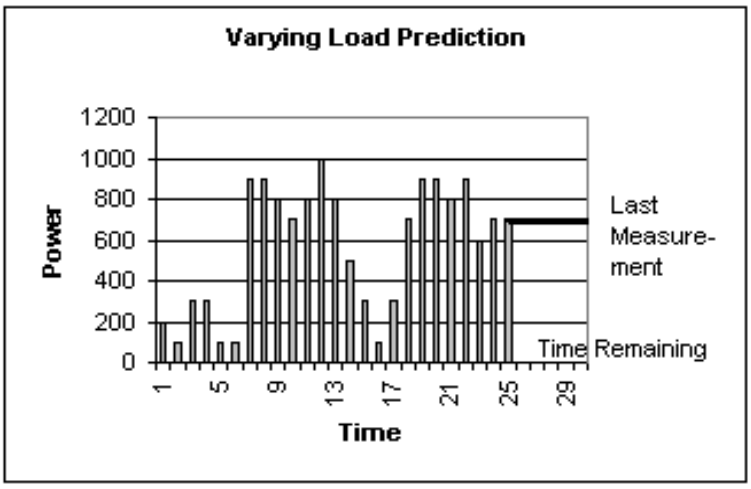
Example 1: Predicted demand with level load

At 16 minutes into the demand interval, every measurement was 1000 watts, which means the average power was also 1000 watts. One thousand watts times 16 minutes = 16,000 watt-minutes.
The most recent Instantaneous measurement (taken at 16 minutes into the interval) is 1000 watts. Assume the average power of the remaining 14 (of 30) measurements is 1000 watts. (I.e. a level load.) One thousand watts times 14 minutes = 14,000 watt minutes. Added to the 16,000 watt-minutes from before, the total is 30,000 watt-minutes. Divided by 30 total minutes, the Predicted Demand is 1000 watts.



Example 2: Predicted demand with varying load

At 16 minutes into the demand interval the average of 16 Instantaneous measurements was 493.75 watts. That average times 16 minutes equals 7900 watt-minutes.
The most recent Instantaneous measurement (taken at 16 minutes into the interval) is 100 watts. Assume the average power of the remaining 14 (of 30) measurements is 100 watts. (I.e. a level load.) One hundred watts times 14 minutes = 1400 watt minutes. Added to the 7900 watt-minutes from before, the total is 9300 watt-minutes. Divided by 30 total minutes, the Predicted Demand is 310 watts.



Example 3: Predicted demand with varying load – further update

Continuing in the same demand interval from Example 2: At 25 minutes into the demand interval the average of 25 Instantaneous measurements was 576 watts. That average times 25 minutes equals 14,400 watt-minutes.
The most recent Instantaneous measurement (taken at 25 minutes into the interval) is 700 watts. Assume the average power of the remaining 5 (of 30) measurements is 100 watts. (I.e. a level load.) Seven hundred watts times 5 minutes = 3500 watt minutes. Added to the 14,400 watt-minutes from before, the total is 17,900 watt-minutes. Divided by 30 total minutes, the Predicted Demand is 596.67 watts.

VOLTAGE AND CURRENT TRANSFORMER GAIN CORRECTION

The *JEMStar* meter may be adjusted to compensate for gain errors in external voltage and current circuitry; for example, ratio errors in external voltage or current transformers. This correction may be done without tampering with the actual meter calibration as established at the factory, or any local meter calibration adjustments made in Test Mode.

Transformer gain correction is set in JEMWare from the Primary Configuration screen. The user may enter a gain correction from -10.00% to +10.00% in 0.01% increments for each voltage and current input. These corrections are applied directly to measured voltages and currents before any further computation is performed; therefore they affect virtually all quantities in the meter.

Like the Test Mode calibration adjustments, the transformer gain correction is lost if a Cold Start or Firmware Upgrade is performed. Unlike the Test Mode calibration adjustment, the transformer gain correction is stored as part of a JEMWare configuration file. Therefore, it is important to check the gain correction figures whenever a configuration file is shared among several meters.

Changing the gain of a voltage or current input will cause any single-phase measurement using that input to increase or decrease by the amount of the change. For example, changing the Phase A Volts by +1.00% will cause all Phase A measurements to read 1% high (except for amp quantities). Polyphase measurements will change by the average of the changes made to each individual phase. For example, if Phase A Volts is changed by +1.00%, Phase B Volts by +2.00% and Phase C Volts by +4.00%, the change to polyphase watts is (1+2+4)/3=2.333%

VOLTAGE SAG / SWELL DETECTION AND LOG

The *JEMStar* meter may be purchased with an optional Voltage Sag and Swell detection and logging system. The Sag / Swell detector compares the RMS voltage of each cycle on each meter voltage input against user-configured upper and lower limits. Whenever a voltage crosses one of these limits an event is detected. If the event lasts longer than the user-specified minimum duration, it is recorded in the Sag / Swell Event Log.

The user must configure the following settings for the Sag / Swell Detector:

- Lower voltage (sag) limit for each phase voltage (A, B, and C)*. Voltages below this limit are detected as a sag event.
- Upper voltage (swell) limit for each phase voltage (A, B, and C) *. Voltages above this limit are detected as a swell event.
- Minimum duration of event (in cycles) to log. Events shorter than this duration are not logged. A single duration limit is applied to all phases for both sag and swell events.
- Enhanced resolution mode. This mode allows the ability to measure swell voltages and currents significantly higher than those normally encountered in the circuit at the expense of accurate power measurement at light loads.

* On 2- and 2 ½ element meters the B phase voltage is ignored.

In normal operation, the JEMStar adjusts its voltage and current input gain circuits to maximize power and energy measurement accuracy. A sudden increase in voltage (a swell) or current (such as that associated with a fault that causes a voltage sag) may temporarily overload the meter's inputs, causing clipped voltage and current readings and inaccurate measurements. The enhanced resolution mode causes the meter to run at lower gain, allowing accurate capture of voltage swells (up to 100% above nominal volts) and current (up to the rated input of the meter) at the expense of seriously reduced power and energy accuracy, especially at light loads.

NOTE: Do not use enhanced resolution mode unless you are willing to accept poor accuracy in your power and energy measurements. In enhanced resolution mode, all power measurements are made at accuracies listed here:

	Class 20 Input Current	**PF=1 Accuracy**	**PF=0.5 lagging Accuracy**
Watthours (per phase, polyphase total):	3.0 to 20 A	0.10 % RD	0.15 % RD
	2.0 to 3.0 A	0.15 % RD	0.15 % RD
	1.0 to 2.0 A	0.25 % RD	0.25 % RD
	0.5 to 1.0 A	0.40 % RD	0.50 % RD
	Class 20 Input Current	**PF=0 Accuracy**	**PF=0.5 lagging Accuracy**
VARhours (per phase, polyphase total):	2.0 to 20 A	0.25 % RD	0.25 % RD
	1.0 to 2.0 A	0.35 % RD	0.35 % RD
	0.5 to 1.0 A	0.50 % RD	0.50 % RD

VAhours, Qhours (per phase, polyphase total):	**Class 20 Input Current**	**PF=1 Accuracy**	**PF=0.5 lagging Accuracy**
	2.0 to 20 A	0.25 % RD	0.25 % RD
	1.0 to 2.0 A	0.35 % RD	0.35 % RD
	0.5 to 1.0 A	0.50 % RD	0.50 % RD
Instantaneous Watts (per phase, polyphase total):	**Class 20 Input Current**	**PF=1 Accuracy**	**PF=0.5 lagging Accuracy**
	2.0 to 20 A	0.15 % RD	0.15 % RD
	1.0 to 2.0 A	0.30 % RD	0.30 % RD
	0.5 to 1.0 A	0.50 % RD	0.50 % RD
Instantaneous VARs (per phase, polyphase total):	**Class 20 Input Current**	**PF=0 Accuracy**	**PF=0.5 lagging Accuracy**
	2.0 to 20 A	0.25 % RD	0.25 % RD
	1.0 to 2.0 A	0.40 % RD	0.40 % RD
	0.5 to 1.0 A	0.50 % RD	0.50 % RD
Instantaneous VA, Q (per phase, polyphase total):	**Class 20 Input Current**	**PF=1 Accuracy**	**PF=0.5 lagging Accuracy**
	2.0 to 20 A	0.25 % RD	0.25 % RD
	1.0 to 2.0 A	0.40 % RD	0.40 % RD
	0.5 to 1.0 A	0.50 % RD	0.50 % RD
Instantaneous Volts (per phase, polyphase total):	**Class 20**		
	0.15 % RD		
Instantaneous Amps (per phase, polyphase total, neutral):	**Class 20**		
	0.05 % RD + 0.040 % Iclass		
Amphours (per phase, polyphase total)	**Class 20 Input Current**	**Accuracy**	
	2 A to 20 A	0.3 % RD	
	0.5 A to 2 A	0.6 % RD	
Instantaneous Volts^2 (per phase):	Class 20		
	0.2 % RD		
Instantaneous Amps^2 (per phase, polyphase total):	Class 20		
	0.2 % RD + 0.005 % Iclass^2		
Volt^2 hours (per phase):	Class 20		
	0.2 % RD		

Amps^2 hours (per phase, polyphase total):	Class 20 Input Current	Accuracy	
	2 A to 20 A	0.3 % RD	
	1 A to 2 A	1.0 % RD	
	0.5 A to 1 A	3.0 % RD	
Instantaneous Power Factor (per phase):	0.004 * FS / VAphase		
Instantaneous Power Factor (system):	Form 5	Form 6, 8/9	
	0.004 * 2FS / VAsystem	0.004 * 3FS / VAsystem	
Volts THD:	1.0 % absolute		
Amps THD:	1.0 % absolute		
Frequency (phase A volts):	0.03 % RD		

The single-cycle RMS voltages and currents measured by the Sag / Swell detection system operate at an accuracy of 1% of reading regardless of the setting of the enhanced resolution mode.

The Sag / Swell Event Log records measurements of interest to engineers researching power quality issues. Each event records the following information:

For each of 3 phases:
- Maximum voltage
- Minimum voltage
- Average voltage
- Maximum current
- Minimum current
- Average current
- Average PF

For the entire event:
- Time at which it occurred or began (resolved to 1 second)
- Duration of the event in cycles
- Status (event type and phase) of the event

The Sag / Swell event system can detect and log voltage sags or swells on each phase that are up to 600 cycles in length as a single event. Sags or swells that exceed that length are logged as two events: the first records the time at which the sag or swell began and the voltages and currents associated with its first 600 cycles. The second logged event records the time at which the sag or swell ended and an indication that it is the end of a long event. The possible Status codes are therefore:

Events up to 600 cycles in length:
- Volts A sag
- Volts B sag
- Volts C sag
- Volts A swell

- Volts B swell
- Volts C swell

Events longer than 600 cycles:

- Volts A long sag
- Volts B long sag
- Volts C long sag
- Volts A long swell
- Volts B long swell
- Volts C long swell

End of long events:

- Volts A long sag end
- Volts B long sag end
- Volts C long sag end
- Volts A long swell end
- Volts B long swell end
- Volts C long swell end

TOTALIZATION

The *JEMStar* meter may be purchased with an optional Totalization system. Totalization is ability to sum the energy readings from several different instruments and display the result. *JEMStar* has 12 totalization channels. Each channel may be displayed as a register in the Normal, Alternate, or Test lists and / or recorded as a Load Profile channel.

Each Totalization channel behaves as a Consumption register with several added features. Details on how to configure Totalization channels are contained in the JEMWare User Manual, (document 1083-602). For each channel the user must configure the following:

- Measurement quantity: choice of Watthours, VARhours, VAhours, Qhours, Amphours, Volt Squared hours, Amp Squared hours* or Zero (which accumulates only external energy)
- Phase: A, B, C, or Polyphase*
- Direction: Delivered, Received, or a single quadrant for VARhours*
- Time of Use Rate: A through H or Total*
- Compensated or Uncompensated*
- Test Mode
- Enabled
- Load Profile Km in Primary (i.e. at VT and CT input) units
- Up to 2 external energy inputs (contact inputs)
- Pulse Weight in Primary units for each external energy input. Negative pulse weights will be deducted from the Totalization channel's reading, but it will never fall below zero.

* These settings are identical to those of a Consumption register.

Most of these settings are self-explanatory, but a few require further description.

The Test Mode setting causes the Totalization channel to operate only while the meter is in Test Mode. If a Totalization register is to be displayed in the meter's Test list, it must have the Test Mode selection enabled.

Enabled means the Totalization channel is active.

Load Profile Km is the pulse weight of counts recorded in Load Profile if a Profile channel is selected to record this Totalization channel's contents. This bypasses the normal Load Profile pulse constant configuration for that channel.

External energy inputs are pulse inputs on the JEMStar configured to be Totalization inputs. Any transition (make or break) on one of these inputs can be detected by any Totalization channel and cause that channel to add the associated Pulse Weight to the Totalization's contents. Note that input Pulse Weights are configured independently for each Totalization channel. For example, Totalization Channel 1 may count each transition on input one as 1.0 MWh, while Totalization Channel 2 may count each transition on input one as -3.8 MWh.

A Totalization channel may be displayed, recorded as a Load Profile channel, or both. To display a Totalization channel, add a register to the desired Display List (Normal, Alternate, or Test) in JEMWare with a Category of "Totalization" and select the desired Totalization channel number in the Type field. You may then set up the number of digits and decimal places, storage type, and label as for any other

numeric register.

To record a Totalization channel in Load Profile, add a Profile channel in JEMWare. In the Quantity field select the desired Totalization channel number. The Km, Direction, and Phase settings will be bypassed, but you may still select whether to record always or only during TOU Rate Override.

*TIP***:** Normally Load Profile channels may not be associated with Time of Use rates other than Total. However, you may simulate a Load Profile channel that records only during a given rate period by assigning it to a Totalization channel with the correct rate. The Totalization channel need not record any external energy, making it essentially identical to an integrated Load Profile channel.

APPENDIX A
JEMSTAR DEFAULT SETTINGS

The following is a list of the factory default settings that will be seen in a *JEMStar* meter after a Cold Start is performed. Use JEMWare software to program the meter with your custom configuration.

Meter Identification

ID String 1:	(meter name)
ID String 2:	(administrator)
ID String 3:	(location)
ID String 4:	(config id)
ID String 5:	(acct number)
ID Label 1:	Meter Name
ID Label 2:	Administrator
ID Label 3:	Location
ID Label 4:	Config ID
ID Label 5:	Acct Number

Primary Configuration

Nominal Voltage:	120V
Connection Type:	4-Wire Y
Reactive Power Unit:	VAR
VT Ratio:	120:120
CT Ratio:	5:5
Register Scaling:	
Watt, VA:	Units
VAR, Q:	Units
Volt:	Volts
Amp:	Amps

Display Registers

Normal Registers

Num	Type	Qty	Dir	Phase	Disp	Rate	Digits	Decimal	Label
001	Instant	Volt		A	Working		6	2	Volts Phase A
002	Instant	Volt		B	Working		6	2	Volts Phase B
003	Instant	Volt		C	Working		6	2	Volts Phase C
004	Instant	Amp		A	Working		6	3	Amps Phase A
005	Instant	Amp		B	Working		6	3	Amps Phase B
006	Instant	Amp		C	Working		6	3	Amps Phase C
007	Instant	Watt	Del	Poly	Working		6	2	Watts Del Total
008	Instant	VAR	Del	Poly	Working		6	2	VARs Del Total
009	Instant	Freq			Working		6	3	Line Freq
010	Instant	VTHD		A	Working		6	3	Volts THD A
011	Instant	VTHD		B	Working		6	3	Volts THD B
012	Instant	VTHD		C	Working		6	3	Volts THD C
013	Instant	ATHD		A	Working		6	3	Amps THD A
014	Instant	ATHD		B	Working		6	3	Amps THD B
015	Instant	ATHD		C	Working		6	3	Amps THD C
016	Instant	Amp		N	Working		6	3	Amps Neutral
017	Time	Time			Working				Present Time
018	Time	Date			Working				Present Date

Alternate Registers

Num	Type	Qty	Dir	Phase	Disp	Rate	Digits	Decimal	Label
101	Consumpt	Watt	Del	Poly	Working	Total	6	3	kWh Del Poly R
102	Consumpt	Watt	Rec	Poly	Working	Total	6	3	kWh Rec Poly R
103	Consumpt	VAR	Del	Poly	Working	Total	6	3	kVARh Del Poly R
104	Consumpt	VAR	Rec	Poly	Working	Total	6	3	kVARh Rec Poly R
105	Consumpt	VA	Del	Poly	Working	Total	6	3	kVAh Del Poly R
106	Consumpt	VA	Rec	Poly	Working	Total	6	3	kVAh Rec Poly R
107	Consumpt	Q	Del	Poly	Working	Total	6	3	kQh Del Poly R
108	Consumpt	Q	Rec	Poly	Working	Total	6	3	kQh Rec Poly R
109	Consumpt	Amp		Poly	Working	Total	6	3	Amph Poly R
110	Instant	Watt	Del	Poly	Working		6	1	kW Del Poly R
111	Time	Demand			Working				Demand Time Remain
112	Time	Battery			Working				Days on Battery
113	Status	BPR Ct			Working				BPR Count

Test Registers

Num	Type	Qty	Dir	Phase	Disp	Rate	Digits	Decimal	Label
201	Consumpt	Watt	Del	Poly	Working	Total	6	3	kWh Del Poly T
202	Consumpt	Watt	Rec	Poly	Working	Total	6	3	kWh Rec Poly T
203	Consumpt	VAR	Del	Poly	Working	Total	6	3	kVARh Del Poly T
204	Consumpt	VAR	Rec	Poly	Working	Total	6	3	kVARh Rec Poly T
205	Consumpt	VA	Del	Poly	Working	Total	6	3	kVAh Del Poly T
206	Consumpt	VA	Rec	Poly	Working	Total	6	3	kVAh Rec Poly T
207	Consumpt	Q	Del	Poly	Working	Total	6	3	KQh Del Poly T
208	Consumpt	Q	Rec	Poly	Working	Total	6	3	KQh Rec Poly T
209	Consumpt	Amp		Poly	Working	Total	6	3	Amph Poly T
210	Instant	Watt	Del	Poly	Working		6	1	Inst kW Del Poly T
211	Time	Test			Working				Test Time Remaining

Load Profile

Interval Length:	15 minutes
Number of channels:	12 (only 4 are operational unless the Extended Load Profile option is installed)
Interval Sync:	Internal
Freeze Markers:	Enabled
Channel 1:	Watthours delivered polyphase, 0.5 Wh/count
Channel 2:	VARhours delivered polyphase, 0.1 VARh/count
Channel 3:	VAhours received polyphase: 0.5 VAh/count
Channel 4:	Qhours delivered polyphase: 0.5 Qh/count
Channel 5:	Amphours polyphase, 0.005 Ah/count
Channel 6:	Average PF delivered phase A, 0.001 PF/count
Channel 7:	Average Volts polyphase, 0.05 V/count
Channel 8:	Average Amps polyphase, 0.015 A/count
Channel 9:	Average Watts delivered polyphase, 1.8W/count
Channel 10:	Average Frequency: 0.01 Hz/count
Channel 11:	Average Volts distortion phase A, 0.01%/count
Channel 12:	Average Amps distortion phase A, 0.01%/count

Time of Use Setup

No Seasons or Time of Use schedules configured
No Override Rate
No Holidays schedules

Timekeeping and DST Changes

Meter Clock Sync:	Internal
Auto Register Freeze:	none
Auto Billing Period Reset:	none
Self Read:	hourly
Register 001:	Instantaneous, Volts, Phase A, working
Register 002:	Instantaneous, Volts, Phase B, working
Register 003:	Instantaneous, Volts, Phase C, working
Register 004:	Instantaneous, Amps, Phase A, working
DST dates:	none

Alarms

Site Monitor Alarms:	none assigned
Threshold 1:	none assigned
Threshold 2:	none assigned
Threshold 3:	none assigned
Threshold 4:	none assigned

Contact Input / Output

Input channel 1:	TOU Rate Override
Input channel 2:	TOU Rate Override
Output Channel 1:	Energy Output, Normally Open, 1.8 Wh/pulse
Output Channel 2:	Energy Output, Normally Open, 1.8 VARh/pulse
Output Channel 3:	Energy Output, Normally Open, 1.8 VAh/pulse
Output Channel 4:	Energy Output, Normally Open, 1.8 Qh/pulse
Output Channel 5:	End of Interval (5-KYZ Option board only)

Analog Outputs

Analog Output 1:	Volts Phase A, 0 - 530 V
Analog Output 2:	Volts Phase B, 0 - 530 V
Analog Output 3:	Volts Phase C, 0 - 530 V

Demands

Interval length:	15 minutes
Subinterval length:	15 minutes
Deferral intervals:	1 subinterval
Power Outage:	Recognition after 8 seconds
Interval Sync:	Internal
Thermal Time Characteristic:	1 minute

Serial Communication

Optical:	9600 baud JEM2 Binary protocol Address = 01 Password timeout 15 min.
Serial 1:	RS232 9600 baud JEM2 Binary protocol Address = 05 Password timeout 15 min. TX start delay: 0mS (RS-232); 80mS (RS-485) TX end delay: 0mS (RS-232); 20mS (RS-485)
Serial 2:	Modem 9600 baud JEM2 Binary protocol Address = 02 Password timeout 15 min. Initialization String: ATH

Modem answer schedule:

	Frequency:	daily
	Start time:	0030
	End time:	0100
	Answer:	after 1 ring in-window
	Answer:	after 1 ring out-of-window

Modem Phone Home settings: none

Modem Power Fail Phone Home settings: none

Ethernet	DHCP:	Not selected
	IP Address:	0.0.0.0
	Subnet Mask:	0.0.0.0
	Default Gateway:	0.0.0.0
	IP Port #:	2000
	Max Connections:	4
	Device Address:	04
	Protocol:	JEM Binary

Display Setup

Preset mode timeout:	15 minutes
Test Mode timeout:	30 minutes
Demand Reset lockout:0	
Display's Number of Digits:	6
Scroll rate:	5 seconds
Date Format:	MM/DD/YY
Threshold 1 alarm action:	Ignore
Threshold 2 alarm action:	Ignore
Threshold 3 alarm action:	Ignore
Threshold 4 alarm action:	Ignore
Site alarm action:	Ignore

Passwords / Permissions

Master Password permissions are always "all"
Password 2 permissions: none
Password 3 permissions: none
Password 4 permissions: none
All passwords set to "000000" (six zeros)

TLC

Loss Compensation disabled

Internal Modem Initialization Commands

Modes of Operation
The Xecom™ XE1414B uses "AT" commands for control and configuration. The XE1414B operates in three modes; Command Mode, Fax Mode and Data Mode. Extensions to the AT command set support fax operation.

Data Mode: The modem enters data mode after it establishes a link and issues a "CONNECT" result code.
In Data Mode the modem modulates all signals on Transmit Data, Pin 13, and sends them to the remote modem. The modem demodulates the signal from the remote modem and places it onto Received Data, Pin 3, for the host equipment. When the modem exits data mode, it issues a "NO CARRIER" result code.

Command Mode: The XE1414B enters command mode on application of power, reset, loss of the connection, or receipt of the escape sequence. In command mode the modem accepts commands from the host on Transmit Data. Appropriate result codes are returned on Received Data at the same speed and parity as the commands.

Fax Mode: The modem enters fax mode on receipt of the AT+FCLASS=1 command. Fax commands and responses are issued at 19,200 bits per second; the character format is 8 bits no parity. The modem accepts Class 1 Fax commands only in fax mode. The A/, ATO, AT&T and escape commands are not valid in fax mode.

Commands
The modem is configured and controlled with AT commands. AT commands follow a strict format. The command line is stored in the command buffer and executed upon receipt of a carriage return. Until executed, the command line can be edited with the backspace key.

Command Format - Each command, except A/, begins with the AT prefix. The "A" and "T" may be both upper case or both lower case but cannot be of different cases. The modem uses the prefix to identify the host's speed and parity. The modem determines speed by measuring the width of the incoming bits and parity by comparing the parity bits of the "A" and "T." The modem then returns result codes at the host's speed and parity.

Command Line - A command line may include multiple commands. The modem executes the commands in the sequence they appear in the command line. Spaces, inserted to improve legibility, do not fill space in the command buffer. A carriage return terminates the command line and causes the commands to be executed.
Register S3 allows the user to select a character other than a carriage return to terminate the command line.

Command Buffer - The command buffer holds 40 characters, including the AT prefix. If it overflows, the modem issues an "ERROR" result code and commands are not executed.

Command Line Editing - A backspace can be used to edit the command any time before it is executed. The backspace character, Control and H simultaneously on some systems, erases the previous character in the command line. Any character except for the "A" and "T" can be erased. Register S5 allows the user to select a character other than a backspace to edit the command line.

Re-Execute Last Command - The A/ command causes the modem to re-execute the command line stored in the command buffer. This is the only command that does not require the "AT" prefix.

Omitted Parameters - Most commands include a parameter which determines the command function. When the parameter is omitted from the command string, it is assumed to be a 0.

Escape Characters - A three character escape sequence, entered while in data mode, will switch the modem into command mode while remaining on line. The escape character, set by Register S2, is entered 3 times in succession to execute the escape. The default escape sequence is "+++."

Result Codes - The modem issues a result code after each action. Result codes may be provided as full words, numeric codes or may be disabled. Each result code ends with a carriage return when numeric result codes are chosen. When full word result codes are chosen, a Line Feed and Carriage Return precede and follow each result code.

List of Commands

An asterisk indicates the default setting of the command for the XE1414B.

A - Answer Command - ATA forces the modem to immediately go off-hook and begin transmitting the answer tone sequence.

Bn - Select Communications Standard - ATBn selects the
modulation scheme used for connections below 2400 bits per
second
n=0 Selects CCITT standards
n=1 Selects Bell standards*

D - Dial Command - Below are the characters accepted in a
dialing command.
0-9, #, * = Dialing Digits
L = Re-dial last number
P = Pulse dial
T = Tone dial
S=n = Dial stored number
W = Wait for dial tone
^ = Toggles state of calling tone
, = Pause for the duration of S8
@ = Wait for silence
! = Switch hook flash
; = Return to the command state

En - Command Echo - ATEn determines whether commands will be echoed back to the host.
n=0 Do not echo commands
n=1 Enable command echo*

Hn - Switch Hook Control - ATHn opens and closes the modem's hook switch.
n=0 Switch hook relay opens
n=1 The switch hook relay closes

In - Modem Identification - ATIn Identifies the version of
the modem.

Ln - Speaker Volume - ATLn sets the amplitude of the modem's audio output.
n=0 Lowest speaker volume
n=1 Low speaker volume*
n=2 Moderate speaker volume
n=3 High speaker volume

Mn - Speaker Activity - ATMn determines when the modem's audio output is active.
n=0 Speaker off
n=1 Speaker on until carrier received*
n=2 Speaker remains on
n=3 Speaker off during dialing, on until carrier

Nn - Data Rate - ATNn selects whether or not the modem
will negotiate a lower data link speed.
n=0 Handshake only at DTE rate
n=1 Negotiate highest common speed*

On - On Line - ATOn switches the modem from the command mode to the data mode.
n=0 Return On Line with no retrain*
n=1 Initiate retrain returning On Line.

Qn - Responses - ATQn determines if the modem will issue
responses.
n=0 Send responses*
n=1 No Responses

Sr? - Interrogate Register - ATSr? requests the current value in register Sr.
Sr=n - Set Register Value - ATsr=n sets the value of register Sr to n.

Vn - Result Codes - ATVn sets the modem to issue Numeric
or Full Word result codes.
n=0 Numeric Result Codes
n=1 English Word Result Codes*

Wn - Connect Message Rate - ATWn determines whether
the data rate reported in the Connect response is the host data
rate, the link data rate or whether both are provide along with
the error control and data compression protocols negotiated.
n=0 Send "CONNECT" at DTE Rate*
n=1 Report line speed, DTE speed and Link protocol
n=2 "CONNECT" Reports Link speed

Xn - Result Code Set - ATXn selects which set of result codes the modem may send.
n=0 Result codes 0 to 4
n=1 Result codes 0 to 5 and 10
n=2 Result codes 0 to 6 and 10
n=3 Result codes 0 to 5, 7 and 10
n=4 Full Result codes*

Yn - Long Space Disconnect - ATYn determines if the modem will automatically disconnect if a continuous space is received for 1.6 seconds.
n=0 Long Space Disconnect Disabled*
n=1 Disconnect on long space

Zn - Reset - ATZn executes a soft reset to the modem and resets the modem configuration.
n=0 Reset to user profile 0*
n=1 reset to user profile 1

&Cn - DCD Operation - AT&Cn determines the operation
of the DCD output.
n=0 DCD is forced active.
n=1 DCD indicates a valid carrier*

&Dn - DTR - AT&Dn determines how the modem will respond to changes to DTR.
n=0 DTR is ignored by the modem.
n=1 Enter command mode if DTR revoked.
n=2 Disconnect if DTR revoked.*
n=3 Soft reset when DTR revoked

&Fn - Return to Factory Defaults - AT&Fn returns the modem configuration to one of two factory configurations.
n=0 Restore configuration 0*
n=1 Restore configuration 1

&Gn - Guard Tone - AT&Gn controls the guard tone produced by the modem
n=0 Guard Tone Disabled*
n=1 Guard Tone Disabled
n=2 1800 Hz Guard Tone

&Kn - Flow Control - AT&Kn selects the flow control method used by the modem.
n=0 Disabled
n=3 RTS/CTS
n=4 XON/XOFF
n=5 Transparent XON/XOFF
n=6 RTS/CTS and XON/XOFF

&Pn - Dial Pulse Make/Break Ratio - AT&Pn determines
the specific pulse dialing parameters used by the modem.
n=0 39/61% @ 10 pps*
n=1 33/67% @ 10 pps
n=2 39/61% @ 20 pps

&Qn - Line Connection - AT&Qn determines if error control or data buffering are active on the link.
n=0 Direct mode (no data buffering)*
n=5 Use Error Correction
n=6 Normal Mode (Speed buffering)

&Sn - DSR Operation - AT&Sn sets the operation of the
DSR signal.
n=0 DSR always active*
n=1 DSR in accordance with V.25.

&Tn - Test Modes - AT&T selects modem test modes.
n=0 Exit test mode
n=1 Local analog loopback
n=3 Initiate local digital loopback
n=4 Respond to remote loop request*
n=5 Deny remote loop request
n=6 Initiate a Remote Digital loopback
n=7 Remote digital loopback w self-test
n=8 Local analog loopback w self-test

&Vn - View Configuration Profiles - AT&V permits the
user to check on the modems current configuration.
n=0 View active profile & user profile 0*
n=1 View active profile & user profile 1

&Wn - Store Active Profile - AT&Wn stores the current modem configuration in NVRAM.
n=0 Store active profile as profile 0*
n=1 Store active profile as profile 1

&Yn - Recall Stored Profile - AT&Yn sets the stored modem configuration to be used after a hard reset.
n=0 Recall profile 0 on power-up*
n=1 Recall profile 1 on power-up

&Zn=x - Store telephone number "x" in memory location "n"

%En - Line Quality Monitor/Auto Retrain - AT%En determines if the modem will monitor line quality during a
connection and initiate a retrain if quality drops below acceptable levels.
n=0 Disabled
n=1 Enabled
n=2 Line quality, fallback, fall forward
n=3 33/67% @ 20 pps

%L - Read Received Signal Level - AT%L permits the user to read the magnitude of the receive signal in dBm.

%Q - Read Line Signal Quality - AT%Q permits the user
to read the EQM value of the received signal.

\An - MNP Block Size - AT|An sets the block size for MNP
data packets.
n=0 Maximum 64 characters
n=1 Maximum 128 characters
n=2 Maximum 192 characters
n=3 Maximum 256 characters*

\Bn - Transmit Break - AT\Bn selects the duration of the break signal sent. Break = n x 100 msec.

\Gn - Modem Port Flow Control –
n=0 No Modem Port Flow Control
n=1 XON/XOFF Port Flow Control

\Kn - Break control - AT\Kn determines how the modem will
handle a break signal.

Break received from host with Reliable link.
n=0 Enter on-line command mode; do not transmit break
n=1 Purge buffers, immediately transmit break
n=2 Same as n=0
n=3 Immediately send break
n=4 same as n=0
n=5 Send break in sequence with data*

Break received from host with Direct link .
n=0 Immediately transmit break, then enter on-line command mode
n=1 Immediately send break
n=2 Enter command mode but do not transmit break signal
n=3 same as n=1
n=4 ame as n=0
n=5 same as n=1*

Break received from modem w Normal link.
n=0 Purge buffers, Immediately send break to the host
n=1 same as n=0
n=2 Immediately send break to the host
n=3 Same as n=2
n=4 Send break in sequence with data.
n=5 Same as n=2*

Host initiates break with \B command on Reliable link.
n=0 Purge buffers and immediately transmit break
n=1 Same as n=0
n=2 Immediately transmit break
n=3 Same as n=1
n=4 Transmit break in sequence w data
n=5 Same as n=4

\Nn - Error Control Selection - AT\Nn determines how the
modem will handle error control negotiations.
n=0 Normal mode, no error correction
n=1 Direct mode, no buffering, no error correction
n=2 Reliable mode, error correction required for connection
n=3 V.42 Auto-reliable mode, accept either an error controlled or non-error controlled link*
n=4 V.42 Reliable mode, LAPM required
n=5 MNP required

-Kn - MNP Extended Services - AT-Kn determines how the
modem handles MNP10.
n=0 No LAPM to MNP10 conversion
n=1 LAPM to MNP10 conversion*
n=2 LAPM to MNP10 conversion but no MNP Extended Service during V.42 LAPM answer mode detect.

S0 **Answer on nth Ring:** S0 sets the modem to automatically
answer on the nth ring. Setting S0 to 0 disables automatic answer.
Range: 0 to 255
Units Rings
Default 0

S1 **Ring Count:** S1 is a read-only register showing the number of rings detected. If a ring is not detected within 8 seconds, S1 is reset to zero.
Range: 0 to 255
Units Rings
Default 0

S2 **Escape Character:** S2 determines the ASCII escape character. Values of 0-127 select valid ASCII escape characters; values from 128 to 255 disable the escape sequence.
Range: 0 to 255
Units ASCII Character
Default 43 (+)

S3 **Carriage Return Character:** S3 determines the ASCII character to serve as a carriage return to terminate commands and modem responses.
Range: 0 to 127
Units ASCII Character
Default 13 (Carriage Return)

S4 **Line Feed Character:** S4 sets the ASCII character to act as a line feed character in modem responses.
Range: 0 to 127
Units ASCII Character
Default 10 (Line Feed)

S5 **Back Space Character:** S5 defines the ASCII character
used as a backspace to edit the command line.
Range: 0 to 32
Units ASCII Character
Default 8 (Back Space)

S6 **Dial Tone Wait Time:** S6 determines how long the modem waits for dial tone before dialing begins. The Dial Tone Wait Time cannot be set to less than two seconds.
Range: 2 to 255
Units Seconds
Default 2

S7 **Wait for Carrier after Dialing:** S7 determines how long the modem waits for a valid carrier signal after dialing is completed.
Range: 1 to 255
Units Seconds
Default 50

S8 **Comma Pause Time:** S8 defines the duration of the pause initiated by a comma in the dialing string. The pause is generally used when waiting for a second dial tone.
Range: 1 to 255
Units Seconds
Default 50

S9 **Carrier Detect Response Time:** S9 establishes the length of time the remote modem's carrier must be present to be recognized as valid.
Range: 1 to 255
Units 0.1 Seconds
Default 6

S10 **Carrier Off Disconnect Dela**y: S10 selects how long carrier must be lost before the modem disconnects. Note: If S10 is smaller than the value of S9, the modem will not automatically disconnect on loss of carrier.
Range: 1 to 255
Units 0.1 Seconds
Default 14

S11 **Tone Dialing Speed:** S10 sets the duration and spacing
of the dialing tones. S11 does not affect the pulse dialing rate.
Range: 50 to 255
Units 1 Millisecond
Default 95

S12 **Escape Code Guard Timer:** S12 sets the escape sequence guard timer. If characters are received before or after the escape sequence, within the guard timer, the modem aborts the escape attempt and remains in data mode.
Range: 0 to 255
Units 0.02 Seconds
Default 50

S14 **General Bit-Mapped Options:** S14 reflects the state of several "AT" commands.

Bit 0,4,6	Not Used
Bit 1	0 = Echo Disabled (ATE0)
	1 = Echo Active (ATE1)
Bit 2	0 = Send Result Codes (ATQ0)
	1 = No Result Codes (ATQ1)
Bit 3	0 = Numeric Result Codes (ATV0)
	1 = Full Word Result Codes (ATV1)
Bit 5	0 = Tone Dialing Selected (T)
	1 = Pulse Dialing Selected (P)
Bit 7	0 = Answer
	1 = Originate

S16 **Test Status:** S16 shows the modem test status.

Bit 0	0 = No Local Analog Loopback
	1 = Local ALB Active
Bit 1	Not Used
Bit 2	0 = Local Digital Loopback Disabled
	1 = Local DLB Enabled
Bit 3	0 = No Remote Digital Loopback
	1 = Remote DLB Active
Bit 4	0 = Remote DLB not requested
	1 = Remote DLB Requested
Bit 5	0 = Remote DLB w Self-Test Disabled
	1 = Remote DLB w Self-Test Enabled
Bit 6	0 = Local ALB w Self-Test Disabled
	1 = Local ALB w Self-Test Enabled
Bit 7	Not Used

S18 **Test Timer**: S18 sets the duration of any test. If S18 equals 0, AT&T0 terminates the test.

Range:	0 to 255
Units	Seconds
Default	0

S21 **General Bit-Mapped Options:** S21 reflects the state
of several "AT" commands.

Bit 0-2	Not Used
Bit 3,4	0 = DTR ignored (&D0)
	1 = Enter command mode on DTR off (&D1)
	2 = Disconnect on DTR off (&D2)
	3 = Reset on DTR off (&D3)
Bit 5	0 = DCD always active (&C0)
	1 = DCD on with Carrier (&C1)

S22 **General Bit-Mapped Options**: S22 reflects the state of several "AT" commands.

Bit 0-1 0 = Low speaker volume (ATL0)
1 = Low speaker volume (ATL1)
2 = Moderate speaker volume (ATL2)
3 = High speaker volume (ATL3)

Bit 2-3 0 = Speaker off (ATM0)
1 = Speaker off with carrier (ATM1)
2 = Speaker always on (ATM2)
3 = Speaker on during handshake (ATM3)

Bit 4-6 0 = Basic Result codes (ATX0)
4 = Connect speed result codes (ATX1)
5 = No Blind Dial (ATX2)
6 = Busy Detection (ATX3)
7 = Full result codes (ATX4)

Bit 7 Not Used

S23 **General Bit-Mapped Options:** S23 reflects the state
of several "AT" commands.

Bit 0 0 = Remote DLB Disabled (AT&T5)
1 = Remote DLB Allowed (AT&T4)

Bit 1-3 0 = Host Interface at 300 bps
1 = Host Interface at 600 bps
2 = Host Interface at 1200 bps
3 = Host Interface at 2400 bps
4 = Host Interface at 4800 bps
5 = Host Interface at 9600 bps
6 = Host Interface at 19200 bps
7 = Host I/F at 38400 bps or higher

Bit 4-5 0 = Even parity in use
1 = Not used
2 = Odd Parity in use
3 = No Parity in use

Bit 6-7 0 = No Guard Tone (AT&G0)
1 = No Guard Tone (AT&G1)
2 = 1800 Hz guard tone (AT&G2)
3 = Not Used

S27 **General Bit-Mapped Options:** S27 reflects the state of several "AT" commands.

Bit 0 1 3
0 0 0 = Normal Mode (AT&Q0)
1 0 1 = Error control enabled (AT&Q5)
0 1 1 = Direct Mode (AT&Q6)

Bit 2, 4-5, 7 Not Used

Bit 6 0 = CCITT Protocols (ATB0)
1 = Bell Protocols (ATB1)

S28 **Pulse Dialing Bit-Mapped Options:** S28 stores the **modem's** pulse dialing configuration.

Bit 0-2, 5-7 Not Used

Bit 3-4 0 = Make/Break ratio 39%/61%; 10 pulses per second (AT&P0)
1 = Make/Break ratio 33%/67%; 10 pulses per second (AT&P1)
2 = Make/Break ratio 39%/61%; 20 pulses per second (AT&P2)
3 = Make/Break ratio 33%/67%; 20 pulses per second (AT&P3)

S29 **Hook Flash Timer:** S29 determines the length for time the modem closes its off-hook relay on receipt of the "!" dial modifier to simulate a switch hook flash.

Range: 0 to 255
Units 10 milliseconds
Default 70

S30 **Disconnect on Inactivity Timer:** S30 sets the period and the modem is idle before it disconnects. A 0 disables the inactivity timer.

Range: 0 to 255
Units 10 Seconds
Default 0

S31 **General Bit-Mapped Options:** S31 stores the status of various AT commands.

Bit 0 0 = No single-line Connect messages (AT\V0)
1 = Use single-line connect messages (AT\V1)

Bit 1 0 = No Automode detection (ATN0)
1 = Automode detection active (ATN1)

Bit 2-3 0 = Report host speed (ATW0)
1 = Report all parameters (ATW1)
2 = Report modem speed only (ATW2)

Bit 4-7 Not Used

S32 **XON Character:** S32 determines the ASCII character
to be sent as XON for in-band flow control.

Range: 0 to 255
Units ASCII Character
Default 11 (VT)

S33 **XOFF Character:** S32 determines the ASCII character
to be recognized as XOFF for in-band flow control.

Range: 0 to 255
Units ASCII Character
Default 19 (DC3)

S36 **LAPM Failure:** S36 instructs the modem what to do if the error control negotiations fail.

Bit 0-2	0 = Modem Disconnects 1 = Establish Direct Connection 3 = Establish normal Connection 4 = Disconnect if MNP handshake fails 5 = Establish Direct Connection if MNP handshake fails. 7 = Establish Normal Connection if MNP handshake fails.
Bit 3-7	Not Used

S38 **Forced Disconnect Timer:** S38 sets the delay between receipt of the command to disconnect and the actual opening of the switch hook. If S38 is set to 255, the modem disconnects only after its buffers are empty.

Range:	0 to 255
Units	1 Second
Default	20

S39 **Flow Control Bit-Mapped Options:** S39 shows the modem's flow control status, AT&K.

Bit 0-2	0 = Flow Control Disabled 3 = Hardware Flow Control, RTS/CTS 4 = In-Band Flow Control XON/XOFF 5 = Transparent In-Band Flow Control 6 = Both Hardware and In-Band Flow Control
Bit 3-7	Not used

S40 **MNP Bit-Mapped Options:** S40 shows the status of the modem's MNP commands, .

Bit 0-1	0 = No LAPM to MNP10 conversion (AT-K0) 1 = Enable LAPM to MNP10 conversion (AT-K1) 2 = Enable LAPM to MNP10 conversion except for LAPM answer mode (AT-K1)
Bit 2	Not Used
Bit 3-5	0 = AT\K0 break handling selected 1 = AT\K1 break handling selected 2 = AT\K2 break handling selected 3 = AT\K3 break handling selected 4 = AT\K4 break handling selected 5 = AT\K5 break handling selected
Bit 6-7	0 = MNP Block size 64 characters 1 = MNP Block size 128 characters 2 = MNP Block size 192 characters 3 = MNP Block size 256 characters

S41 **General Bit-Mapped Options:** S41 stores the condition of various "AT" commands.

Bit 0-1	0 = No Data Compression (AT%C0) 1 = MNP5 Data Compression (AT&C1) 2 = V.42bis Data Compression (AT&C2) 3 = Either MNP5 or V.42bis Data Compression (AT&C3)
Bit	2, 6 0 0 = No Fallback/Forward (AT%E0) 1 0 = Retrain Enabled (AT%E1) 0 0 = Fallback/Forward Enabled (AT%E2)
Bit 3-5, 7	Not Used

S46 **Data Compression Control:** S46 selects whether or not the modem will support data compression with error control.

S46=136	No data compression
S46=138	Data Compression selected
Default	38

S48 **V.42 Negotiations:** S48 determines the modem's V.42 negotiation process.

S48=0	Proceed with LAPM
S48=7	Negotiate per V.42
S48=128	Assume LAPM failure
Default	7

S86 **Call Failure Code:** S86 shows why the last "NO CARRIER response was issued.

S86=0	Normal Disconnect
S86=4	Loss of Carrier
S86=5	V.42 Negotiation Failure
S86=9	Modem Handshake Failure
S86=12	Disconnect Initiated by remote modem
S86=13	No response after 10 retries
S86=14	Protocol Violation

S95 **Extended Result Codes:** S95 permits the user to customize the extended result codes.

Bit 0	Connect result code shows link speed
Bit 1	Add /ARQ to connect response
Bit 2	Add /VFC to Carrier response
Bit 3	Enable Protocol response
Bit 4	Not Used
Bit 5	Enable Compression Result Code
Bit 6	Not used
Bit 7	Not Used

AT+FCLASS? - Service Class Indication

0 = Configured as a data modem
1 = Configured for Service Class 1.

AT+FCLASS=? - Service Class Capability

0 = Configured as a data modem
1 = Configured for Service Class 1.

AT+FCLASS=n - Set Service Class

0 = Configured as a data modem
1 = Configured for Service Class 1.

AT+FAE=n - Data/Fax Auto Answer

0 = Answer as a fax modem only
1 = Either a fax or data modem

AT+FF - Enhanced Flow Control

AT+FRH<mod> - Receive HDLC Data

3	V.21 Channel 2, 300 bps
24	V.27ter, 2400 bps
48	V.27ter, 4800 bps
72	V.29, 7200 bps
96	V.29, 9600 bps
97	V.17, 9600 bps
98	V.17 short train, 9600 bps
121	V.17, 12,000 bps
122	V.17 short train, 12,000 bps
145	V.17, 14,400 bps
146	V.17 short train, 14,400 bps

AT+FRM<mod> - Receive Fax
(see AT+FRH for "mod" values)

AT+FRS<time> - Receive Silence

AT+FRTn - Receive Test Data

AT+FTH<mod> - Transmit HDLC Data
(see AT+FRH for "mod" values)

AT+FTM<mod> - Transmit Fax
(see AT+FRH for "mod" values)

AT+FTS<time> - Transmit Silence

AT+FTTn - Transmit Test Data

Digits	Verbose	Description
0	OK	Successfully executed command line
1	CONNECT	300 bps connection
2	RING	Ring signal detected
3	NO CARRIER	Carrier not detected/lost
4	ERROR	Error in command line
5	CONNECT	
6	NO DIAL TONE	No dial tone detected
7	BUSY	Busy signal detected
8	NO ANSWER	5 second silence not detected
10	CONNECT 2400	2400 bps Connection
11	CONNECT 4800	4800 bps Connection
12	CONNECT 9600	9600 bps Connection
13	CONNECT 7200	7200 bps Connection
14	CONNECT 12000	12,000 bps Connection
15	CONNECT 14400	14,400 bps Connection
16	CONNECT 19200	19,200 bps Connection
17	CONNECT 38400	38,400 bps Connection
18	CONNECT 57600	57,600 bps Connection
19	CONNECT 115200	115200 bps Connection
22	CONNECT 75TX/1200RX	V.23 originate connection
23	CONNECT 1200TX/75RX	V.23 answer connection
33	FAX	Fax connection
35	DATA	Connection in Fax mode
40	CARRIER 300	300 bps carrier received
44	CARRIER 1200/75	V.23 reverse channel carrier received
45	CARRIER 75/1200	V.23 forward channel carrier received
46	CARRIER 1200	1200 bps carrier received
47	CARRIER 2400	2400 bps carrier received
48	CARRIER 4800	4800 bps carrier received
49	CARRIER 7200	7200 bps carrier received
50	CARRIER 9600	9600 bps carrier received
51	CARRIER 12000	12,000 bps carrier received
52	CARRIER 14400	14,400 bps carrier received
53	CARRIER 16800	16,800 bps carrier received
54	CARRIER 19200	19,200 bps carrier received
55	CARRIER 21600	21,600 bps carrier received
56	CARRIER 24000	24,000 bps carrier received
57	CARRIER 26400	26,400 bps carrier received
58	CARRIER 28800	28,800 bps carrier received
59	CONNECT 16800	16,800 bps Connection
61	CONNECT 21600	21,600 bps Connection
62	CONNECT 24000	24,000 bps Connection
63	CONNECT 26400	26,400 bps Connection
64	CONNECT 28800	28,800 bps Connection
66	COMPRESSION: CLASS 5	MNP5 data compression
67	COMPRESSION: V.42bis	V.42bis data compression
69	COMPRESSION: NONE	No data compression
76	PROTOCOL: NONE	No error correction
77	PROTOCOL: LAPM	LAPM error correction
80	PROTOCOL: ALT	MNP error correction
81	PROTOCOL: ALT CELLULAR	MNP10 error correction
+F4	+FCERROR	Fax carrier error

APPENDIX B
ACCESSORIES

The following is a list of user replaceable parts. Please contact the factory for further information.

Description	**Part Number**
Phone Home Power Outage battery pack	15847-001
Non-Volatile RAM backup battery	6005-254
Security jumpers (for front panel lockout)	4195-263
S-base outer globe (w/pushbuttons)	1082-419
S-base to A-base adapter assembly	6002-656
A-base adapter locking ring	12648-001
Switchboard front cover assembly	1083-452
Switchboard case thumbscrew	1083-425
Optical Pickup Assembly	Consult factory
Modem cable (3 ft.), S-base unit	1082-448
I/O interface cable (3 ft.), S-base unit	1082-447
JEMStar User Manual	1083-600
JEMWare Meter Configuration Software Manual	1083-602
JEMRead Data Retrieval Software Manual	1083-601
JEMStar Firmware Command Set Manual	1083-603
Replacement Circuit Boards*	Consult factory

*When ordering spare or replacement circuit boards, please have the meter's Model Number and Serial Number available.

APPENDIX C
ELECTROSTATIC DISCHARGE

ELECTROSTATIC DISCHARGE PREVENTION

Static, by definition, is designating or producing stationary electrical charges such as those resulting from friction. An electrostatic potential is produced by friction between nonconductive materials and can best be visualized as a field between two charged plates. The electrostatic potential will exist until the difference in the potential is overcome.

All meter shop work must be performed at static-protected work stations following properly prescribed static-control practices. Unless controlled, electrostatic discharge can destroy or weaken solid-state electronic components and assemblies.

Failure Mode

Failure of a solid-state component due to static discharge is characterized by partial or complete destruction of a semiconductor junction or a microscopic resistive or capacitive element within a circuit device. Failure is most common in CMOS, very low-energy devices.

Destruction of a circuit is immediately detectable and is remedied by normal troubleshooting and repair methods. However, the common condition of partial damage induced by low-level static discharge is not immediately detectable. Thus, the damaged component may continue to operate normally, but in a weakened state. Repeated exposure of the same component to similar low levels of static discharge may produce cumulative damage, ultimately leading to failure.

Static damage can be avoided by practical methods accessible to anyone handling solid-state components or assemblies.

Completely assembled products are only minimally vulnerable to static damage, and then only under the most severe of static-prone environments. Consequently, completely assembled products can usually be handled in normal work environments, indoors and outdoors, with little risk of static damage.

If a product is disassembled to any level, all exposed or removed electronic modules must be considered vulnerable to static damage and handled accordingly. There is no truly safe level of exposure to electrostatic discharge. However, the presence of a static charge or static field is not, in itself, damaging to electronic components.

Subassemblies from a dismantled product should not be considered static protected by design. In fact, depending on the design and conductive mass of the connected circuitry, components in subassemblies may be more vulnerable to static damage than loose components of the same type. Therefore, the objectives of static control cannot be met by indiscriminate handling of subassemblies or loose components.

Handling a printed-circuit-board assembly by its edges without employing static protection does not preclude the risk of static damage to its components. Effective static- control methods cannot be executed without proper tools and equipment.

All static-control methods relate to one simple principle: provide alternate, intentional paths for grounding electrostatic charges away from or around the devices to be protected. Static control is the employment of tools and equipment to predetermine the flow path of this current.

Any two physical bodies, conductive or nonconductive, can be the source of an electrostatic discharge if either is charged to a different level of electrostatic potential. As these two physical bodies come in contact or proximity, equilibrium is achieved by a sudden flow of current.

Most people associate a static discharge with a small blue arc and a sharp snapping noise. It is important to note that static charges of a level too low to produce a detectable arc can still damage unprotected electronic components.

Another important consideration is that even though a safe encounter has been achieved between two physical bodies, any subsequent encounter with a third, fourth, or more bodies must be protected in the same manner since a static potential difference may exist between the, now combined, first two bodies and any unknown new body.

Warning!

The first step in the above example is to de-energize the meter so that the meter is completely isolated from all service lines. Never dismantle an energized meter.

The following static-control equipment is required:

1. Conductive work mat
2. Ground cord attached to true earth ground
3. Conductive wrist strap
4. Electrically conductive bag

Caution!

Unless you are certain that the meter enclosure is properly earth bonded, do not attach the ground cord to the meter enclosure. Never attach a ground cord to the distribution system neutral or any other point inside the meter enclosure, as this can present a serious safety hazard.

Attach the conductive work mat and the conductive wrist strap to the ground cord. Put on the wrist strap and remove the assembly from the meter. If work is to be performed on the assembly at the metering site, perform it on the grounded work mat.

If the assembly is to be transported to the meter shop or other off-site location, insert the assembly into a conductive, antistatic bag for safe transportation. If the assembly has a battery installed, remove the battery before inserting into the bag for transportation. Conductive, antistatic bags can cause a battery to discharge during the transportation process.

If sensitive components are removed from the assembly at the meter site and are to be reused, insert the components—with all component leads piercing into a piece of conductive foam carrier—into an antistatic bag for safe transportation.

Static kits including mat, wrist strap, cord, and clip are available through your local electronics supplier.

APPENDIX D
DNP SERIAL COMMUNICATIONS

INTRODUCTION

Distributed Network Protocol (DNP 3.0) is an industry standard protocol for SCADA communications between Master Stations, Host computers, Remote Terminal Units, and Intelligent Electronics Devices (such as the JEMStar meter). It is a public domain, non-proprietary protocol based on the IEC-870 standards, and is intended primarily for use in SCADA-like systems.

DNP as a protocol provides efficient, robust data communications through a system of 32-bit data link CRCs (Cyclical Redundancy Checks) and confirmation messages. However, DNP is much more than an error-detection-and-correction scheme. A DNP-compliant device, from the protocol's point of view, is considered a group of data "objects", each of which contains one or more "points". The DNP protocol specification defines the allowable object types and what constitutes a "point" for that object type.

DNP is *not* intended to be a general-purpose two-way communications link. Rather, it is highly optimized for SCADA and automation applications involving relatively small amounts of near-real-time data that is often read by the DNP master every few seconds. In the case of the JEMStar, it is *not* used as a means of controlling or reconfiguring the meter.

DNP V3.00 DEVICE PROFILE

The purpose of this document is to describe the specific implementation of the **D**istributed **N**etwork **P**rotocol (DNP) 3.0 within the JEMStar meter. This document, in conjunction with the DNP 3.0 Basic 4 Document Set, and the DNP Subset Definitions Document, provides complete information on how to communicate with the JEMStar meter via the DNP 3.0 protocol.

JEMStar uses the Triangle MicroWorks™, Inc. DNP 3.0 Slave Source Code Library Version 2.19. This implementation of DNP 3.0 is fully compliant with DNP 3.0 Subset Definition Level 2, contains many Subset Level 3 features, and contains some functionality even beyond Subset Level 3.

The following sections, in conjunction with the Device Profile Document, provide a complete interoperability/configuration guide for the JEMStar meter:

- the Implementation Table
- the Point List Tables
- Configuration methods

DNP V3.00

DEVICE PROFILE DOCUMENT

Vendor Name: **AMETEK Power Instruments**	
Device Name: **JEMStar, using the Triangle MicroWorks, Inc. DNP 3.0 Slave Source Code Library, Ver 2.19**	
Highest DNP Level Supported: For Requests: **Level 2** For Responses: **Level 2**	Device Function: ☐ Master ☒ **Slave**
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table): **For static (non-change-event) object requests, request qualifier codes 00 and 01 (start-stop), 07 and 08 (limited quantity), and 17 and 28 (index) are supported in addition to request qualifier code 06 (no range – or all points). Static object requests received with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests received with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event object requests, qualifiers 17 or 28 are always responded.** **The read and write function code for Object 50 (Time and Date), variation 1, is supported.**	
Maximum Data Link Frame Size (octets): Transmitted: **292** Received **292**	Maximum Application Fragment Size (octets): Transmitted: **2048** Received: **2048**
Maximum Data Link Re-tries: **Configurable from 0 to 255 – Via JEMWare**	Maximum Application Layer Re-tries: **None**
Requires Data Link Layer Confirmation: **Configurable as: Never, Only for multi-frame messages, or Always via JEMWare**	
Requires Application Layer Confirmation: **When sending multi-fragment responses** **Sometimes**	

DNP V3.00

DEVICE PROFILE DOCUMENT

Timeouts while waiting for:

Data Link Confirm:	**Configurable via JEMWare**
Complete Appl. Fragment:	**None**
Application Confirm:	**Configurable via JEMWare**
Complete Appl. Response:	**None**

Others:

Transmission Delay:	**Configurable, via JEMWare**
Inter-character Timeout:	**1 sec.**
Need Time Delay:	**Configurable, via JEMWare**
Frozen Counter Event scanning period:	**FIXED AT 5 seconds**

Sends/Executes Control Operations:

WRITE Binary Outputs	**Never**
SELECT/OPERATE	**Never**
DIRECT OPERATE	**Never**
DIRECT OPERATE – NO ACK	**Never**
Count > 1	**Never**
Pulse On	**Never**
Pulse Off	**Never**
Latch On	**Never**
Latch Off	**Never**
Queue	**Never**
Clear Queue	**Never**

Reports Binary Input Change Events when no specific variation requested: **Never**	Reports time-tagged Binary Input Change Events when no specific variation requested: **Never**
Sends Unsolicited Responses: **Never**	Sends Static Data in Unsolicited Responses: **Never** No other options are permitted.
Default Counter Object/Variation: **Default Object: 20** **Default Variation: 5** **Point-by-point list attached**	Counters Roll Over at: **32 Bits** **Other Value: 999,999,999** **Point-by-point list attached**

Sends Multi-Fragment Responses:

Yes

THE JEMSTAR IMPLEMENTATION

The JEMStar DNP implementation conforms to the standard for a Level II slave device, with some additions. Implementation consists of the following **static** objects:

- Up to 40 Single-bit Binary Input without flag (Object 1 Variation 1)
- Up to 120 32-bit analog input without flag points (Object 30 Variation 3)
- A configurable number (up to 64) of 32-bit counters (Object 20 Variation 5) that can be assigned to any register in the Normal or alternate display set
- A corresponding number of 32-bit frozen counter without flag (Object 21 variation 5) that represent the values of the counter points at the time of the last meter freeze

IMPLEMENTATION TABLE

The following table identifies the variations, function codes, and qualifiers supported by the JEMStar meter in both request messages and in response messages.
For static (non-change-event) objects, requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests sent with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event objects, qualifiers 17 or 28 are always responded.
In the table below text shaded as Subset Level 3 indicates Subset Level 3 functionality (beyond Subset Level 2), and text shaded as beyond Subset Level 3 indicates functionality beyond Subset Level 3.

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
1	0	Binary Input (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
1	1	Binary Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
20	0	Binary Counter (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
20	5	32-Bit Binary Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
21	0	Frozen Counter (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
21	9	32-Bit Frozen Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
23	0	Frozen Counter Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
23	5	32-Bit Frozen Counter Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
30	0	Analog Input (Variation 0 is used to request default variation)	(read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
30	3	32-Bit Analog Input without Flag	(read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	5	short floating point	(read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
50	0	Time and Date	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
50	1	Time and Date	1 (read) 2 (write)	00, 01 (start-stop) 06 (no range, or all) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
52	2	Time Delay Fine			129 (response)	07 (limited qty) (qty = 1)
60	0	Class 0, 1, 2, and 3 Data	1 (read)	06 (no range, or all)		
60	1	Class 0 Data	1 (read)	06 (no range, or all)		
60	2	Class 1 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
60	3	Class 2 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
60	4	Class 3 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
80	1	Internal Indications	2 (write)	00 (start-stop) (index must =7)		
No Object (function code only) –See Note 3			13 (cold restart)			
No Object (function code only)			14 (warm restart)			
No Object (function code only)			23 (delay meas.)			

Note 1: For static (non-change-event) objects, qualifiers 17 or 28 are only responded when a request is sent with qualifiers 17 or 28, respectively. Otherwise, static object requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. (For change-event objects, qualifiers 17 or 28 are always responded.)

Note 2: A cold restart is implemented as a warm restart – the JEMStar meter is not restarted, but the DNP process is restarted.

Point List

The tables in the following sections identify all the individual data points provided by the implementation of DNP 3.0 in the JEMStar meter.

Binary Input Points

The Binary input points represent such things as:

- Contact input status
- Threshold alarm conditions
- Site monitor alarm conditions
- Phase potential status

JEMStar may be configured with up to 40 Binary Input Points in DNP. You may assign any of the following Binary Inputs to any Binary Input Point:

- Contact Input 1 status
- Contact Input 2 status
- Voltages out of sequence alarm
- Neutral over current alarm
- Neutral current swell alarm
- Phase C under current alarm
- Phase C over current alarm
- Phase C power reversed alarm
- Phase C PF high alarm
- Phase C PF low alarm
- Phase C voltage sag alarm
- Phase C under voltage alarm
- Phase C voltage swell alarm
- Phase C over voltage alarm
- Phase B under current alarm
- Phase B over current alarm
- Phase B power reversed alarm
- Phase B PF high alarm
- Phase B PF low alarm
- Phase B voltage sag alarm
- Phase B under voltage alarm
- Phase B voltage swell alarm
- Phase B over voltage alarm
- Phase A under current alarm
- Phase A over current alarm
- Phase A power reversed alarm
- Phase A PF high alarm
- Phase A PF low alarm
- Phase A voltage sag alarm
- Phase A under voltage alarm
- Phase A voltage swell alarm
- Phase A over voltage alarm
- Threshold Alarm 1
- Threshold alarm 2
- Threshold alarm 3
- Threshold alarm 4
- Phase A potential status
- Phase B potential status
- Phase C potential status
- Loss of Phase Potential
- End of Demand Interval
- Fatal Error
- Non-fatal Error

JEMStar's default configuration is to have these Binary Input Points assigned:

Point Index	Binary Input Name/Description
0	Contact Input 1 status
1	Contact Input 2 status
2	Voltages out of sequence alarm
3	Neutral over current alarm
4	Neutral current swell alarm
5	Phase C under current alarm
6	Phase C over current alarm
7	Phase C power reversed alarm
8	Phase C PF high alarm
9	Phase C PF low alarm
10	Phase C voltage sag alarm
11	Phase C under voltage alarm
12	Phase C voltage swell alarm
13	Phase C over voltage alarm
14	Phase B under current alarm
15	Phase B over current alarm
16	Phase B power reversed alarm
17	Phase B PF high alarm
18	Phase B PF low alarm
19	Phase B voltage sag alarm
20	Phase B under voltage alarm
21	Phase B voltage swell alarm
22	Phase B over voltage alarm
23	Phase A under current alarm
24	Phase A over current alarm
25	Phase A power reversed alarm

Point Index	Binary Input Name/Description
26	Phase A PF high alarm
27	Phase A PF low alarm
28	Phase A voltage sag alarm
29	Phase A under voltage alarm
30	Phase A voltage swell alarm
31	Phase A over voltage alarm
32	Threshold Alarm 1
33	Threshold alarm 2
34	Threshold alarm 3
35	Threshold alarm 4
36	Phase A potential status
37	Phase B potential status
38	Phase C potential status

Counters

Counters are implemented as 32-bit counter without flag (Object 20 Var 5). For the counter point list, the user may select any Normal, Alternate, or Internal (not Test) display register to map to each point in the counter list. Note that display registers may contain demand or instantaneous readings as well as consumption totals. This list can be configured to contain up to 64 counter points. In addition to the Normal and Alternate register set, JEMStar has an internal register list consisting of 49 various measurements. Using JEMWare, the counter point list can be configured to be any mix of Normal, Alternate or Internal registers (up to a total of 64 points). Each numeric counter point value is represented as the corresponding register value times a user-selected scaling factor.

Registers in the Normal and Alternate display lists are set by the user. The Internal list contains these registers:

- Watthours Delivered
- Watthours Received
- VARhours Delivered
- VARhours Received
- VAhours Delivered
- VAhours Received
- Qhours Delivered
- Qhours Received
- Amphours
- Volt Squared hours
- Amp Squared hours
- Average PF Delivered Phase A
- Average PF Delivered Phase B
- Average PF Delivered Phase C
- Average PF Delivered Polyphase
- Average PF Received Phase A
- Watt Delivered Past Interval Demand
- VAR Delivered Past Interval Demand
- VA Delivered Past Interval Demand
- Amp Phase A Past Interval Demand
- Amp Phase B Past Interval Demand
- Amp Phase C Past Interval Demand
- Neutral Amp Past Interval Demand
- Peak Demand Watt Delivered
- Peak Demand VAR Delivered
- Peak Demand VA Delivered
- Peak Demand Amp Phase A
- Peak Demand Amp Phase B
- Peak Demand Amp Phase C
- Peak Demand Neutral Amp
- Peak Demand Watt Delivered at last BPR
- Peak Demand VAR Delivered at last BPR
- Peak Demand VA Delivered at last BPR
- Time of Peak Demand Watt Delivered
- Time of Peak Demand VAR Delivered
- Time of Peak Demand VA Delivered
- Time of Peak Demand Amp Phase A
- Time of Peak Demand Amp Phase B
- Time of Peak Demand Amp Phase C
- Time of Peak Demand Neutral Amp
- Time of Peak Watt Delivered at last BPR
- Time of Peak VAR Delivered at last BPR
- Time of Peak VA Delivered at last BPR
- PF at Peak Watt Delivered at last BPR
- PF at Peak VAR Delivered at last BPR
- PF at Peak VA Delivered at last BPR
- Watt Delivered Predicted Demand
- VAR Delivered Predicted Demand
- VA Delivered Predicted Demand

Other data formats that may be assigned to display registers include:

- Time and Date registers are represented as seconds since midnight 1/1/70
- Diagnostic and String register types will be represented as 0
- Status registers will be represented as a direct 32-bit mask value.

The corresponding frozen counter object is implemented as Object 21 Variation 9. The values of the points in this object represent the values of the corresponding counter points at the time of the last register freeze.

In JEMStar, all static data is permanently assigned to Class 0.

A JEMStar register configured as a DNP Counter point may contain a value as large as 999,999,999 (nine digits). Some DNP master devices cannot accept counter values this large. You may configure JEMStar to restrict the reported value of counter points to 3, 4, 5, 6, 7, or 8 digits, or allow the full 9-digit precision to be reported. Restricting the number of digits reported affects only DNP counter points, not the actual display registers.

JEMStar's default configuration is to have these Counter Points assigned:

Point Index	Counter Name/Description
0	Internal – system Watthrs delivered x selected scale
1	Internal – system Watthrs received x selected scale
2	Internal – system VARhrs delivered x selected scale
3	Internal – system VARhrs received x selected scale
4	Internal – system VAhours delivered x selected scale
5	Internal – system VAhours received x selected scale
6	Internal – system Qhrs delivered x selected scale
7	Internal – system Qhrs received x selected scale
8	Internal – system Amphrs x selected scale
9	Internal – system V2h x selected scale
10	Internal – system A2H x selected scale

Analog Inputs

Analog Inputs are implemented as 32-bit analog input without flag (object 30 Var 5) points, or 16-bit analog input without flag (object 30 Var 4) points. A total of up to 140 points are supported, which represent such things as:

- Instantaneous Per phase Watts, VARs, VA, Volts, Amps, and Power Factor
- Line frequency
- Per-phase THD for volts and Amps
- Per-phase V^2 and A^2
- Bi-directional Watts and VARs

32-Bit Inputs

These inputs are represented in SECONDARY units, and up to 3 decimal places of precision may be obtained by entering a scale value of 1000. For conversion to primary units, the point value should be multiplied by the appropriate PT and/or CT ratio.

JEMStar's default configuration is to have these Analog Input Points assigned:

Point Index	Analog Input Name/Description	Scaling
0	Instantaneous Watts, Phase A, Del	x1000
1	Instantaneous Watts, Phase A, Rec	x1000
2	Instantaneous Watts, Phase B, Del	x1000
3	Instantaneous Watts, Phase B, Rec	x1000
4	Instantaneous Watts, Phase C, Del	x1000
5	Instantaneous Watts, Phase C, Rec	x1000
6	Instantaneous Watts, Poly, Del	x1000
7	Instantaneous Watts, Poly, Rec	x1000
8	Instantaneous VARs, Phase A, Del	x1000
9	Instantaneous VARs, Phase A, Rec	x1000
10	Instantaneous VARs, Phase B, Del	x1000
11	Instantaneous VARs, Phase B, Rec	x1000
12	Instantaneous VARs, Phase C, Del	x1000
13	Instantaneous VARs, Phase C, Rec	x1000
14	Instantaneous VARs, Poly, Del	x1000
15	Instantaneous VARs, Poly, Rec	x1000
16	Instantaneous VA, Phase A, Del	x1000
17	Instantaneous VA, Phase A, Rec	x1000
18	Instantaneous VA, Phase B, Del	x1000
19	Instantaneous VA, Phase B, Rec	x1000
20	Instantaneous VA, Phase C, Del	x1000
21	Instantaneous VA, Phase C, Rec	x1000
22	Instantaneous VA, Poly, Del	x1000
23	Instantaneous VA, Poly, Rec	x1000
24	Instantaneous Amps, Phase A	x1000
25	Instantaneous Amps, Phase B	x1000
26	Instantaneous Amps, Phase C	x1000
27	Instantaneous Amps, Neutral	x1000
28	Instantaneous Volts, Phase A	x1000

Point Index	Analog Input Name/Description	Scaling
29	Instantaneous Volts, Phase B	x1000
30	Instantaneous Volts, Phase C	x1000
31	Frequency	x1000
32	Instantaneous PF, Phase A, Del	x1000
33	Instantaneous PF, Phase A, Rec	x1000
34	Instantaneous PF, Phase B, Del	x1000
35	Instantaneous PF, Phase B, Rec	x1000
36	Instantaneous PF, Phase C, Del	x1000
37	Instantaneous PF, Phase C, Rec	x1000
38	Instantaneous PF, Poly, Del	x1000
39	Instantaneous PF, Poly, Rec	x1000
40	Volts THD, Phase A	x1000
41	Volts THD, Phase B	x1000
42	Volts THD, Phase C	x1000
43	Amps THD, Phase A	x1000
44	Amps THD, Phase B	x1000
45	Amps THD, Phase C	x1000
46	$Volts^2$ Phase A	x1000
47	$Volts^2$ Phase B	x1000
48	$Volts^2$ Phase C	x1000
49	$Amps^2$ Phase A	x1000
50	$Amps^2$ Phase B	x1000
51	$Amps^2$ Phase C	x1000
52	$Amps^2$ Poly	x1000
53	Instantaneous Watts, Phase A, Bidirectional	x1000
54	Instantaneous Watts, Phase B, Bidirectional	x1000
55	Instantaneous Watts, Phase C, Bidirectional	x1000
56	Instantaneous Watts, Polyphase, Bidirectional	x1000
57	Instantaneous VARs, Phase A, Bidirectional	x1000
58	Instantaneous VARs, Phase B, Bidirectional	x1000
59	Instantaneous VARs, Phase C, Bidirectional	x1000
60	Instantaneous VARs, Polyphase, Bidirectional	x1000
61	Instantaneous Uncompensated Watts, Phase A, Del	x1000
62	Instantaneous Uncompensated Watts, Phase A, Rec	x1000
63	Instantaneous Uncompensated Watts, Phase B, Del	x1000
64	Instantaneous Uncompensated Watts, Phase B, Rec	x1000
65	Instantaneous Uncompensated Watts, Phase C, Del	x1000
66	Instantaneous Uncompensated Watts, Phase C, Rec	x1000
67	Instantaneous Uncompensated Watts, Poly, Del	x1000
68	Instantaneous Uncompensated Watts, Poly, Rec	x1000
69	Instantaneous Uncompensated VARs, Phase A, Del	x1000

Point Index	Analog Input Name/Description	Scaling
70	Instantaneous Uncompensated VARs, Phase A, Rec	x1000
71	Instantaneous Uncompensated VARs, Phase B, Del	x1000
72	Instantaneous Uncompensated VARs, Phase B, Rec	x1000
73	Instantaneous Uncompensated VARs, Phase C, Del	x1000
74	Instantaneous Uncompensated VARs, Phase C, Rec	x1000
75	Instantaneous Uncompensated VARs, Poly, Del	x1000
76	Instantaneous Uncompensated VARs, Poly, Rec	x1000
77	Instantaneous Uncompensated VA, Phase A, Del	x1000
78	Instantaneous Uncompensated VA, Phase A, Rec	x1000
79	Instantaneous Uncompensated VA, Phase B, Del	x1000
80	Instantaneous Uncompensated VA, Phase B, Rec	x1000
81	Instantaneous Uncompensated VA, Phase C, Del	x1000
82	Instantaneous Uncompensated VA, Phase C, Rec	x1000
83	Instantaneous Uncompensated VA, Poly, Del	x1000
84	Instantaneous Uncompensated VA, Poly, Rec	x1000
85	Instantaneous Uncompensated PF, Phase A, Del	x1000
86	Instantaneous Uncompensated PF, Phase A, Rec	x1000
87	Instantaneous Uncompensated PF, Phase B, Del	x1000
88	Instantaneous Uncompensated PF, Phase B, Rec	x1000
89	Instantaneous Uncompensated PF, Phase C, Del	x1000
90	Instantaneous Uncompensated PF, Phase C, Rec	x1000
91	Instantaneous Uncompensated PF, Poly, Del	x1000
92	Instantaneous Uncompensated PF, Poly, Rec	x1000
93	Instantaneous Uncompensated Watts, Phase A, Bidirectional	x1000
94	Instantaneous Uncompensated Watts, Phase B, Bidirectional	x1000
95	Instantaneous Uncompensated Watts, Phase C, Bidirectional	x1000
96	Instantaneous Uncompensated Watts, Polyphase, Bidirectional	x1000
97	Instantaneous Uncompensated VARs, Phase A, Bidirectional	x1000
98	Instantaneous Uncompensated VARs, Phase B, Bidirectional	x1000
99	Instantaneous Uncompensated VARs, Phase C, Bidirectional	x1000
100	Instantaneous Uncompensated VARs, Polyphase, Bidirectional	x1000

16-Bit Inputs

These inputs are represented in SECONDARY units and scaled so that the meter's full-scale value is represented by 32767. The list is the same as that configured for the 32-bit Analog Input points, but the user-entered scale values are not used.

Example:
At 60 Hz, the raw value represented for frequency may be 19640. Dividing by 32767 and then multiplying by the full-scale engineering units value (see the following table), gives the following reading:

$$\frac{19640}{32767} \times 100.0 = 59.94 Hz$$

To obtain primary units, multiply by the appropriate PT and/or CT ratios.

JEMStar's default configuration is to have these Binary Input Points assigned:

Point Index	Analog Input Name/Description	Engineering Units Range	Scaled Range
0	Instantaneous Watts, Phase A, Del	0 – 10600 W	0 - 32767
1	Instantaneous Watts, Phase A, Rec	0 – 10600 W	0 - 32767
2	Instantaneous Watts, Phase B, Del	0 – 10600 W	0 - 32767
3	Instantaneous Watts, Phase B, Rec	0 – 10600 W	0 - 32767
4	Instantaneous Watts, Phase C, Del	0 – 10600 W	0 - 32767
5	Instantaneous Watts, Phase C, Rec	0 – 10600 W	0 - 32767
6	Instantaneous Watts, Poly, Del	0 – 31800 W	0 - 32767
7	Instantaneous Watts, Poly, Rec	0 – 31800 W	0 - 32767
8	Instantaneous VARs, Phase A, Del	0 – 10600 VAR	0 - 32767
9	Instantaneous VARs, Phase A, Rec	0 – 10600 VAR	0 - 32767
10	Instantaneous VARs, Phase B, Del	0 – 10600 VAR	0 - 32767
11	Instantaneous VARs, Phase B, Rec	0 – 10600 VAR	0 - 32767
12	Instantaneous VARs, Phase C, Del	0 – 10600 VAR	0 - 32767
13	Instantaneous VARs, Phase C, Rec	0 – 10600 VAR	0 - 32767
14	Instantaneous VARs, Poly, Del	0 – 31800 VAR	0 - 32767
15	Instantaneous VARs, Poly, Rec	0 – 31800 VAR	0 - 32767
16	Instantaneous VA, Phase A, Del	0 – 10600 VA	0 - 32767
17	Instantaneous VA, Phase A, Rec	0 – 10600 VA	0 - 32767
18	Instantaneous VA, Phase B, Del	0 – 10600 VA	0 - 32767
19	Instantaneous VA, Phase B, Rec	0 – 10600 VA	0 - 32767
20	Instantaneous VA, Phase C, Del	0 – 10600 VA	0 - 32767
21	Instantaneous VA, Phase C, Rec	0 – 10600 VA	0 - 32767
22	Instantaneous VA, Poly, Del	0 – 31800 VA	0 - 32767
23	Instantaneous VA, Poly, Rec	0 – 31800 VA	0 - 32767
24	Instantaneous Amps, Phase A	0 –20 A	0 - 32767
25	Instantaneous Amps, Phase B	0 –20 A	0 - 32767
26	Instantaneous Amps, Phase C	0 –20 A	0 - 32767
27	Instantaneous Amps, Neutral	0 –20 A	0 - 32767
28	Instantaneous Volts, Phase A	0 – 530 V	0 - 32767
29	Instantaneous Volts, Phase B	0 – 530 V	0 - 32767
30	Instantaneous Volts, Phase C	0 – 530 V	0 - 32767
31	Frequency	0 – 100 Hz	0 - 32767
32	Instantaneous PF, Phase A, Del	0 – 1.00	0 - 32767

Point Index	Analog Input Name/Description	Engineering Units Range	Scaled Range
33	Instantaneous PF, Phase A, Rec	0 – 1.00	0 - 32767
34	Instantaneous PF, Phase B, Del	0 – 1.00	0 - 32767
35	Instantaneous PF, Phase B, Rec	0 – 1.00	0 - 32767
36	Instantaneous PF, Phase C, Del	0 – 1.00	0 - 32767
37	Instantaneous PF, Phase C, Rec	0 – 1.00	0 - 32767
38	Instantaneous PF, Poly, Del	0 – 1.00	0 - 32767
39	Instantaneous PF, Poly, Rec	0 – 1.00	0 - 32767
40	Volts THD, Phase A	0 – 100 %	0 - 32767
41	Volts THD, Phase B	0 – 100 %	0 - 32767
42	Volts THD, Phase C	0 – 100 %	0 - 32767
43	Amps THD, Phase A	0 – 100 %	0 - 32767
44	Amps THD, Phase B	0 – 100 %	0 - 32767
45	Amps THD, Phase C	0 – 100 %	0 - 32767
46	$Volts^2$ Phase A	0 – 280900 V^2	0 - 32767
47	$Volts^2$ Phase B	0 – 280900 V^2	0 - 32767
48	$Volts^2$ Phase C	0 – 280900 V^2	0 - 32767
49	$Amps^2$ Phase A	0 – 400 A^2	0 - 32767
50	$Amps^2$ Phase B	0 – 400 A^2	0 - 32767
51	$Amps^2$ Phase C	0 – 400 A^2	0 - 32767
52	$Amps^2$ Poly	0 – 1200 A^2	0 - 32767
53	Instantaneous Watts, Phase A, Bidirectional	-10600 to +10600 W	-32768 to +32767
54	Instantaneous Watts, Phase B, Bidirectional	-10600 to +10600 W	-32768 to +32767
55	Instantaneous Watts, Phase C, Bidirectional	-10600 to +10600 W	-32768 to +32767
56	Instantaneous Watts, Polyphase, Bidirectional	-31800 to +31800 W	-32768 to +32767
57	Instantaneous VARs, Phase A, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
58	Instantaneous VARs, Phase B, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
59	Instantaneous VARs, Phase C, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
60	Instantaneous VARs, Polyphase, Bidirectional	-31800 to +31800 VAR	-32768 to +32767
61	Instantaneous Uncompensated Watts, Phase A, Del	0 – 10600 W	0 - 32767
62	Instantaneous Uncompensated Watts, Phase A, Rec	0 – 10600 W	0 - 32767
63	Instantaneous Uncompensated Watts, Phase B, Del	0 – 10600 W	0 - 32767
64	Instantaneous Uncompensated Watts, Phase B, Rec	0 – 10600 W	0 - 32767
65	Instantaneous Uncompensated Watts, Phase C, Del	0 – 10600 W	0 - 32767
66	Instantaneous Uncompensated Watts, Phase C, Rec	0 – 10600 W	0 - 32767
67	Instantaneous Uncompensated Watts, Poly, Del	0 – 31800 W	0 - 32767
68	Instantaneous Uncompensated Watts, Poly, Rec	0 – 31800 W	0 - 32767
69	Instantaneous Uncompensated VARs, Phase A, Del	0 – 10600 VAR	0 - 32767
70	Instantaneous Uncompensated VARs, Phase A, Rec	0 – 10600 VAR	0 - 32767
71	Instantaneous Uncompensated VARs, Phase B, Del	0 – 10600 VAR	0 - 32767
72	Instantaneous Uncompensated VARs, Phase B, Rec	0 – 10600 VAR	0 - 32767

Point Index	Analog Input Name/Description	Engineering Units Range	Scaled Range
73	Instantaneous Uncompensated VARs, Phase C, Del	0 – 10600 VAR	0 - 32767
74	Instantaneous Uncompensated VARs, Phase C, Rec	0 – 10600 VAR	0 - 32767
75	Instantaneous Uncompensated VARs, Poly, Del	0 – 31800 VAR	0 - 32767
76	Instantaneous Uncompensated VARs, Poly, Rec	0 – 31800 VAR	0 - 32767
77	Instantaneous Uncompensated VA, Phase A, Del	0 – 10600 VA	0 - 32767
78	Instantaneous Uncompensated VA, Phase A, Rec	0 – 10600 VA	0 - 32767
79	Instantaneous Uncompensated VA, Phase B, Del	0 – 10600 VA	0 - 32767
80	Instantaneous Uncompensated VA, Phase B, Rec	0 – 10600 VA	0 - 32767
81	Instantaneous Uncompensated VA, Phase C, Del	0 – 10600 VA	0 - 32767
82	Instantaneous Uncompensated VA, Phase C, Rec	0 – 10600 VA	0 - 32767
83	Instantaneous Uncompensated VA, Poly, Del	0 – 31800 VA	0 - 32767
84	Instantaneous Uncompensated VA, Poly, Rec	0 – 31800 VA	0 - 32767
85	Instantaneous Uncompensated PF, Phase A, Del	0 – 1.00	0 - 32767
86	Instantaneous Uncompensated PF, Phase A, Rec	0 – 1.00	0 - 32767
87	Instantaneous Uncompensated PF, Phase B, Del	0 – 1.00	0 - 32767
88	Instantaneous Uncompensated PF, Phase B, Rec	0 – 1.00	0 - 32767
89	Instantaneous Uncompensated PF, Phase C, Del	0 – 1.00	0 - 32767
90	Instantaneous Uncompensated PF, Phase C, Rec	0 – 1.00	0 - 32767
91	Instantaneous Uncompensated PF, Poly, Del	0 – 1.00	0 - 32767
92	Instantaneous Uncompensated PF, Poly, Rec	0 – 1.00	0 - 32767
93	Instantaneous Uncompensated Watts, Phase A, Bidirectional	-10600 to +10600 W	-32768 to +32767
94	Instantaneous Uncompensated Watts, Phase B, Bidirectional	-10600 to +10600 W	-32768 to +32767
95	Instantaneous Uncompensated Watts, Phase C, Bidirectional	-10600 to +10600 W	-32768 to +32767
96	Instantaneous Uncompensated Watts, Polyphase, Bidirectional	-31800 to +31800 W	-32768 to +32767
97	Instantaneous Uncompensated VARs, Phase A, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
98	Instantaneous Uncompensated VARs, Phase B, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
99	Instantaneous Uncompensated VARs, Phase C, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
100	Instantaneous Uncompensated VARs, Polyphase, Bidirectional	-31800 to +31800 VAR	-32768 to +32767

Events

The JEMStar DNP implementation includes frozen counter event objects. These are implemented as Object 23 Var 5, 32-Bit frozen counter with time. These provide a time-stamped snapshot of the corresponding counters at the time of freeze. The JEMStar has storage for 5 frozen event objects when all 64 points are configured (possibly more if less points are used). An event is generated at each register freeze. Each event includes all corresponding registers at the time the freeze occurred.

If event data is not desired, the generation of events can be disabled using JEMWare.

In JEMStar, all event data is permanently assigned to Class 1.

Time and Date

Time and Date (object 50) is supported both for read and write. Using JEMWare, you can configure the "Write Time Interval", which is the interval after which the JEMStar will set the "Need Time" bit in the Internal Indications.

Configuration

JEMWare software must be used to set up the configurable parameters that relate to DNP 3.0 in the JEMStar, as well as configurable point assignments for Object 20. Please refer to the section in this manual titled “Protocols” for detailed procedures.

APPENDIX E
MODBUS COMMUNICATIONS

MODBUS INTRODUCTION

The MODBUS protocol defines a message structure that electronic communications equipment will recognize and use, regardless of the type of networks over which they communicate. It describes the procedure a host piece of equipment called the MASTER uses to request access to another device called the SLAVE, how it will respond to requests from other devices, and how errors will be detected and reported. A common format is defined for the layout and contents of message fields.

The MODBUS protocol has two distinct forms, RTU mode and ASCII mode. RTU mode essentially means binary mode, where each byte of information is transmitted as an actual 8-bit binary byte. ASCII mode packages each byte in two ASCII coded hexadecimal characters. In addition, the two modes use different methods to calculate their checksums and message packet boundaries. These methods are detailed later in this section.

Further information concerning MODBUS implementation standards can be found at the following website:

www.modicon.com/techpubs/toc7.html

The MODBUS Device Address, timeout, and communications parameters are configured via the *JEMWare* software. **JEMStar will always be a MODBUS slave device.**

Communications

The following MODBUS communications parameters are configurable via *JEMWare:*

- ASCII or RTU mode
- Baud Rate (1200,9600,19200,38400)
- RS-232 (full duplex) or RS-485 (half duplex) signal levels

Note: MODBUS communications are always 8-bit, no parity.

Serial Port Connections

MODBUS Point-to-Point Connection Using RS232

This method is used for connecting the JEMStar MODBUS directly to a MODBUS Master device. The transmit and receive data pins on the MODBUS host system may vary between pin 2 and pin 3 according to the type of equipment used. In applications where an IBM compatible PC with a 9-pin D-Type connector is used, TXD is pin 3 and RXD is pin 2.

MODBUS Master	Direction	JEMStar I/O cable
DTE RXD or DCE TXD	←	BLUE/GREEN
DTE TXD or DCE RXD	→	BLUE/RED
Comm GND	—	PURPLE/WHITE

MODBUS Multidrop Connection Using RS485 (differential)

MODBUS Master	Direction	JEMStar I/O cable
XMT/RCV -	↔	BLUE/RED
XMT/RCV+	↔	BLUE/GREEN

Notes:

- JEMStar does not implement hardware handshaking signals with RS-232 or RS-485 serial data.
- The MODBUS port is connected via a pigtail I/O cable for S-base and A-Base meters (wire colors shown above). See the section labeled “Serial Communications” for wiring details of Switchboard meters (terminal block connections). Refer to the section “Dual Communications Option” for connections if your meter has this feature.

Data Transfers using MODBUS (RTU or ASCII)

The JEMStar MODBUS implementation will fully support all data transfers with the following commands:

Read Output Status (Function code 01)
Read Input Status (Function code 02)
Read Holding Registers (Function code 03)
Read Input Registers (Function code 04)
Force Single Coil (Function code 05)
Force Multiple Coils (Function code 15)
Preset Multiple Registers (Function code 16)

As implied by the **Read Holding Registers** command, all JEMStar available data will be stored in 16-bit Holding Registers. However, these registers will either hold the High Order or Low Order 16 bits (word) of a 32-bit quantity. Whenever a 32-bit quantity is accessed, the registers containing both the High Order & Low Order words must be included in the request, or the command will be rejected.

The JEMStar MODBUS interface can access data in either RTU or ASCII mode. The supported Register Sets and the MODBUS Function Codes (FC) used to retrieve the data are as follows.

Function Code (FC)	**Register Set**
01	Read Discrete Outputs
02	Read Discrete Inputs
03	Read Holding Registers (native data types)
04	Read Input Registers (Scaled and Cascaded)
05	Force Single Discrete Outputs
15	Force Multiple Discrete Outputs
16	Preset Multiple Holding Registers

LRC Calculation (ASCII mode)

When the JEMStar MODBUS interface operates in ASCII mode, it uses LRC for error checking. The LRC value is one byte, contained in two ASCII characters. The LRC consists of the 2's complement of the byte sum of all the binary byte values (after each pair of ASCII coded hex characters are converted to a byte) of the Device Address through the last Data byte. Neither the Start of Message colon (':') nor the carriage return – line feed pair is included in the LRC calculation.

The LRC value is calculated by the transmitting device that appends the LRC to the message. The receiving device recalculates the LRC and compares it to the value in the message. If the values are not the same, the receiver ignores the message.

CRC Calculation (RTU mode)

The MODBUS interface also operates in RTU mode and uses CRC for error checking. The CRC value is two bytes, containing a 16 bit binary value. The CRC value is calculated by the transmitting device that appends the CRC to the message. The receiving device recalculates the CRC and compares it to the value in the message. If the values are not the same, the receiver will not process the message.
The CRC value is calculated according to the following procedure.

1. Initialize a 16 bit *CRC register* to 0xFFFF
2. Place the first 8 bit character from the message and place it into a *test register*.
3. Exclusive OR the *test character* with the *CRC register*, leaving the result in the *CRC register*.
4. The *CRC register* is shifted one bit toward the least significant bit, the least significant bit is saved into a *carry register*, and the most significant bit is zero filled.
5. If the old least significant bit was zero, go to step 6, if it was one, the *CRC register* is exclusive ORed with 0xa001.
6. Repeat steps 4 and 5, seven times.
7. Using each successive character in the message, repeat steps 3 through 6.
8. The CRC is the value in the CRC register.
9. The CRC value is placed into the message in hexadecimal format with the most significant byte going into the first CRC byte and the least significant byte going into the last CRC byte.

RTU Message Framing

In RTU mode, messages start with a silence interval of at least 3.5 character times. If the SLAVE device can monitor the network bus continuously, this silence interval can be used to identify the beginning of a new message, with the first field of a new message being the Device Address. Devices that use the silence interval to detect a new message expect the entire message frame to be transmitted continuously, and do not allow a silent interval of more than 1.5 characters to occur before completion of the entire message.

The JEMStar MODBUS implementation will not monitor the network bus continuously, and thus will not detect any silence interval. Consequently, the strict rules about silence intervals will not be enforced. The start of a new message will be detected using a synchronization algorithm.

Typical JEMStar RTU Queries:

Query Field	**Read Holding Regs**	**Force Single Coil**
Device Address	05	05
Function	03	05
Register Address	00 04	00 01
# Regs/Preset Value	00 06	FF 00
Error Check (CRC)	XX XX	XX XX

ASCII Message Framing

In ASCII mode, messages start with a ‘colon’ (:) character (ASCII 3A hex) and end with a ‘carriage return – line feed’ pair (ASCII 0D & 0A hex). The carriage return – line feed pair is optional.

The allowable characters transmitted for all other fields are hexadecimal 0-9 and A-F. SLAVE Devices monitor the network bus continuously for the colon character. When one is received, each device decodes the next field (the address field) to determine if the query is directed at it.

Intervals of up to one second can elapse between characters within the message. If a greater interval occurs, the receiving device assumes that an error has occurred.

Typical JEMStar ASCII Queries:

Query Field	**Read Holding Regs**	**Force Single Coil**
Start character	**‘:’**	**‘:’**
Device Address	‘0’ ‘5’	‘0’ ‘5’
Function	‘0’ ‘3’	‘0’ ‘5’
Register Address	‘0’ ‘0’ ‘0’ ‘4’	‘0’ ‘0’ ‘0’ ‘1’
# Regs/Preset Value	‘0’ ‘0’ ‘0’ ‘6’	‘F’ ‘F’ ‘0’ ‘0’
Error Check (LRC)	‘X’ ‘X’	‘X’ ‘X’
End characters	**CR LF**	**CR LF**

Communication Errors

Communication errors, consisting of an illegal character in ASCII mode, a Parity, LRC or CRC error, will result in the message causing the error to be ignored by the meter. The MASTER Device will timeout and retransmit the message.

Exception Responses

The JEMStar MODBUS implementation can produce 1 of 3 possible exceptions:

- **Illegal Function** (Exception Code 01)
- **Illegal Data Address** (Exception Code 02)
- **Illegal Data Value** (Exception Code 03)

An **Illegal Function** is self-explanatory. If the meter receives a MODBUS query that contains a function that it does not support (anything other than 01, 02 03, 04, 05, 15 or 16), an Illegal Function (Exception 01) will be returned.

The **Data Address** is the *Holding Register* or *Input Register* address. For example, an Illegal Data Address for a Function 03 command would be either a register value greater that 0xE7 or a register value that begins at the second word (Lo Order Word) of a 32-bit quantity. An Illegal Data Address for a Function 06 command would be any register other that 0x16.

The meaning of the **Data Value** depends upon the command. The Data Value for a Function 03 command is the number of Holding registers requested, starting with the first (Data Address) register. If the sum of the first register and the number of registers is either greater that 0x3F, or results in the request of only one word of any 32-bit quantity, an Illegal Data Value exception is generated.

An Exception Response is the JEMStar's Device Address, the function value with the High Order Bit set to 1, and the Exception Code followed by either the LRC (ASCII mode) or the CRC (RTU mode). For example, in RTU mode an **Illegal Data Address** exception to a function 03 request would be:

Exception Byte	Contents	Example
1	JEMStar Device Address	5
2	Marked Function Code	83
3	Exception Code	02
4	High Order Byte CRC	XX
5	Low Order Byte CRC	XX

Timeouts

RTU Mode

The timeout period from the reception of a matching Device Address until that message is completed is software assignable using *JEMWare* software. If a timeout occurs, the portion of the message already processed is discarded and the meter will again look for a matching Device Address. The default timeout is 1 second.

ASCII Mode

In ASCII mode, the timeout is meaningless to the JEMStar since it is always the SLAVE Device. Whenever a colon (**':'**) character is encountered, the MODBUS logic automatically interprets it as the start of a new message and discards any portion of the previous message. Similarly, if a timeout were to occur, any portion of the previous message would be discarded and the logic would wait for the next colon (**':'**) character, which essentially accomplishes the same purpose.

However, since the Carriage Return – Line Feed pair is optional at the end of a query message, a 1 second timer is automatically started at the end of the CRC to allow for these optional characters. If the Carriage Return – Line Feed pair is not received at the end of this 1 second timeout, the logic proceeds with processing the message.

Register Presets

In the JEMStar Modbus implementation, meter registers (Normal and Alternate) may be cleared or set to a given value with the Preset Multiple Registers command (Function Code 15). Note that the start register specified in the command must be the Hi-order register number of the appropriate register pair. In addition, **"Allow Register Presets" must be specifically enabled in the meter with JEMWare** (Use menu Meter Settings/Protocols/ Modbus). If not enabled, Modbus exception 01 (illegal function) will be returned if register presets are attempted.

Digital Output Control

The JEMStar digital outputs may be forced to a high or low state via MODBUS using either the Force Single coil or Force Multiple Coils command. To use this feature, **"Allow Digital Output Control"** must be enabled in the meter with JEMWare. If not enabled, Modbus exception 01 (illegal function) will be returned if this is attempted.

MODBUS REGISTER MAPS

JEMStar contains 4 Discrete Output registers, 39 Discrete Input Registers, 232 Holding registers, and 61 Input registers. All Holding Registers contain 32-bit data values in consecutive pairs. Thus, the individual Holding Registers 40001 through 40232 will contain either the High Order Word or the Low Order Word of a 32-bit data type.

The Input Registers of the meter are stored as signed and unsigned 16-bit integers. These integers represent a value in some Engineering Unit, with a 'Scale Factor' of some number of decimal places.

The JEMStar register values are visible via MODBUS as MODBUS Holding Registers. The 32-bit register values are mapped as two consecutive MODBUS registers, with the High Order 16-bit segment first. Any or all of these MODBUS Registers can be accessed via the MODBUS Read Holding Registers (03) command.

The following pages show the MODBUS memory map in table form.

Read Output (Coil) Status (function 01) Point list

MODBUS Address	PLC Address	Register Contents
REG 00	10001	Digital Output 1
REG 01	10002	Digital Output 2
REG 03	10003	Digital Output 3
REG 04	10004	Digital Output 4

Read Input Status (function 02) Point List

MODBUS Address	PLC Address	Register Contents
REG 00	20001	Contact Input 1 status
REG 01	20002	Contact Input 2 status
REG 02	20003	Voltages out of sequence alarm
REG 03	20004	Neutral over current alarm
REG 04	20005	Neutral current swell alarm
REG 05	20006	Phase C under current alarm
REG 06	20007	Phase C over current alarm
REG 07	20008	Phase C power reversed alarm
REG 08	20009	Phase C PF high alarm
REG 09	20010	Phase C PF low alarm
REG 0A	20011	Phase C voltage sag alarm
REG 0B	20012	Phase C under voltage alarm
REG 0C	20013	Phase C voltage swell alarm
REG 0D	20014	Phase C over voltage alarm
REG 0E	20015	Phase B under current alarm
REG 0F	20016	Phase B over current alarm
REG 10	20017	Phase B power reversed alarm
REG 11	20018	Phase B PF high alarm
REG 12	20019	Phase B PF low alarm
REG 13	20020	Phase B voltage sag alarm
REG 14	20021	Phase B under voltage alarm
REG 15	20022	Phase B voltage swell alarm
REG 16	20023	Phase B over voltage alarm
REG 17	20024	Phase A under current alarm
REG 18	20025	Phase A over current alarm
REG 19	20026	Phase A power reversed alarm
REG 1A	20027	Phase A PF high alarm
REG 1B	20028	Phase A PF low alarm
REG 1C	20029	Phase A voltage sag alarm
REG 1D	20030	Phase A under voltage alarm
REG 1E	20031	Phase A voltage swell alarm
REG 1F	20032	Phase A over voltage alarm
REG 20	20033	Threshold alarm 1
REG 21	20034	Threshold alarm 2
REG 22	20035	Threshold alarm 3
REG 23	20036	Threshold alarm 4
REG 24	20037	Phase A potential status
REG 25	20038	Phase B potential status
REG 26	20039	Phase C potential status

Read Holding Registers (function 03) Point List

MODBUS Address	PLC Address	Signed/ Unsigned	Scale Factor	Register Contents
REG 00	40001	S	1000	PT Ratio Hi
REG 01	40002	S	1000	PT Ratio Lo
REG 02	40003	S	1000	CT Ratio Hi
REG 03	40004	S	1000	CT Ratio Lo
REG 04	40005			Reserved
REG 05	40006			Reserved
REG 06	40007			Reserved
REG 07	40008			Reserved
REG 08	40009			Reserved
REG 09	40010			Reserved
REG 0A	40011	S	1000	Normal Reg 0 Hi
REG 0B	40012	S	1000	Normal Reg 0 Lo
REG 0C	40013	S	1000	Normal Reg 1 Hi
REG 0D	40014	S	1000	Normal Reg 1 Lo
REG 0E	40015	S	1000	Normal Reg 2 Hi
REG 0F	40016	S	1000	Normal Reg 2 Lo
REG 10	40017	S	1000	Normal Reg 3 Hi
REG 11	40018	S	1000	Normal Reg 3 Lo
REG 12	40019	S	1000	Normal Reg 4 Hi
REG 13	40020	S	1000	Normal Reg 4 Lo
REG 14	40021	S	1000	Normal Reg 5 Hi
REG 15	40022	S	1000	Normal Reg 5 Lo
REG 16	40023	S	1000	Normal Reg 6 Hi
REG 17	40024	S	1000	Normal Reg 6 Lo
REG 18	40025	S	1000	Normal Reg 7 Hi
REG 19	40026	S	1000	Normal Reg 7 Lo
REG 1A	40027	S	1000	Normal Reg 8 Hi
REG 1B	40028	S	1000	Normal Reg 8 Lo
REG 1C	40029	S	1000	Normal Reg 9 Hi
REG 1D	40030	S	1000	Normal Reg 9 Lo
REG 1E	40031	S	1000	Normal Reg 10 Hi
REG 1F	40032	S	1000	Normal Reg 10 Lo
REG 20	40033	S	1000	Normal Reg 11 Hi
REG 21	40034	S	1000	Normal Reg 11 Lo
REG 22	40035	S	1000	Normal Reg 12 Hi
REG 23	40036	S	1000	Normal Reg 12 Lo
REG 24	40037	S	1000	Normal Reg 13 Hi
REG 25	40038	S	1000	Normal Reg 13 Lo
REG 26	40039	S	1000	Normal Reg 14 Hi
REG 27	40040	S	1000	Normal Reg 14 Lo
REG 28	40041	S	1000	Normal Reg 15 Hi
REG 29	40042	S	1000	Normal Reg 15 Lo
REG 2A	40043	S	1000	Normal Reg 16 Hi
REG 2B	40044	S	1000	Normal Reg 16 Lo
REG 2C	40045	S	1000	Normal Reg 17 Hi

MODBUS Address	PLC Address	Signed/ Unsigned	Scale Factor	Register Contents
REG 2D	40046	S	1000	Normal Reg 17 Lo
REG 2E	40047	S	1000	Normal Reg 18 Hi
REG 2F	40048	S	1000	Normal Reg 18 Lo
REG 30	40049	S	1000	Normal Reg 19 Hi
REG 31	40050	S	1000	Normal Reg 19 Lo
REG 32	40051	S	1000	Normal Reg 20 Hi
REG 33	40052	S	1000	Normal Reg 20 Lo
REG 34	40053	S	1000	Normal Reg 21 Hi
REG 35	40054	S	1000	Normal Reg 21 Lo
REG 36	40055	S	1000	Normal Reg 22 Hi
REG 37	40056	S	1000	Normal Reg 22 Lo
REG 38	40057	S	1000	Normal Reg 23 Hi
REG 39	40058	S	1000	Normal Reg 23 Lo
REG 3A	40059	S	1000	Normal Reg 24 Hi
REG 3B	40060	S	1000	Normal Reg 24 Lo
REG 3C	40061	S	1000	Normal Reg 25 Hi
REG 3D	40062	S	1000	Normal Reg 25 Lo
REG 3E	40063	S	1000	Normal Reg 26 Hi
REG 3F	40064	S	1000	Normal Reg 26 Lo
REG 40	40065	S	1000	Normal Reg 27 Hi
REG 41	40066	S	1000	Normal Reg 27 Lo
REG 42	40067	S	1000	Normal Reg 28 Hi
REG 43	40068	S	1000	Normal Reg 28 Lo
REG 44	40069	S	1000	Normal Reg 29 Hi
REG 45	40070	S	1000	Normal Reg 29 Lo
REG 46	40071	S	1000	Normal Reg 30 Hi
REG 47	40072	S	1000	Normal Reg 30 Lo
REG 48	40073	S	1000	Normal Reg 31 Hi
REG 49	40074	S	1000	Normal Reg 31 Lo
REG 4A	40075	S	1000	Normal Reg 32 Hi
REG 4B	40076	S	1000	Normal Reg 32 Lo
REG 4C	40077	S	1000	Normal Reg 33 Hi
REG 4D	40078	S	1000	Normal Reg 33 Lo
REG 4E	40079	S	1000	Normal Reg 34 Hi
REG 4F	40080	S	1000	Normal Reg 34 Lo
REG 50	40081	S	1000	Normal Reg 35 Hi
REG 51	40082	S	1000	Normal Reg 35 Lo
REG 52	40083	S	1000	Normal Reg 36 Hi
REG 53	40084	S	1000	Normal Reg 36 Lo
REG 54	40085	S	1000	Normal Reg 37 Hi
REG 55	40086	S	1000	Normal Reg 37 Lo
REG 56	40087	S	1000	Normal Reg 38 Hi
REG 57	40088	S	1000	Normal Reg 38 Lo
REG 58	40089	S	1000	Normal Reg 39 Hi
REG 59	40090	S	1000	Normal Reg 39 Lo
REG 5A	40091	S	1000	Normal Reg 40 Hi
REG 5B	40092	S	1000	Normal Reg 40 Lo

MODBUS Address	PLC Address	Signed/ Unsigned	Scale Factor	Register Contents
REG 5C	40093	S	1000	Normal Reg 41 Hi
REG 5D	40094	S	1000	Normal Reg 41 Lo
REG 5E	40095	S	1000	Normal Reg 42 Hi
REG 5F	40096	S	1000	Normal Reg 42 Lo
REG 60	40097	S	1000	Normal Reg 43 Hi
REG 61	40098	S	1000	Normal Reg 43 Lo
REG 62	40099	S	1000	Normal Reg 44 Hi
REG 63	40100	S	1000	Normal Reg 44 Lo
REG 64	40101	S	1000	Normal Reg 45 Hi
REG 65	40102	S	1000	Normal Reg 45 Lo
REG 66	40103	S	1000	Normal Reg 46 Hi
REG 67	40104	S	1000	Normal Reg 46 Lo
REG 68	40105	S	1000	Normal Reg 47 Hi
REG 69	40106	S	1000	Normal Reg 47 Lo
REG 6A	40107	S	1000	Normal Reg 48 Hi
REG 6B	40108	S	1000	Normal Reg 48 Lo
REG 6C	40109	S	1000	Normal Reg 49 Hi
REG 6D	40110	S	1000	Normal Reg 49 Lo
REG 6E	40111	S	1000	Alternate Reg 0 Hi
REG 6F	40112	S	1000	Alternate Reg 0 Lo
REG 70	40113	S	1000	Alternate Reg 1 Hi
REG 71	40114	S	1000	Alternate Reg 1 Lo
REG 72	40115	S	1000	Alternate Reg 2 Hi
REG 73	40116	S	1000	Alternate Reg 2 Lo
REG 74	40117	S	1000	Alternate Reg 3 Hi
REG 75	40118	S	1000	Alternate Reg 3 Lo
REG 76	40119	S	1000	Alternate Reg 4 Hi
REG 77	40120	S	1000	Alternate Reg 4 Lo
REG 78	40121	S	1000	Alternate Reg 5 Hi
REG 79	40122	S	1000	Alternate Reg 5 Lo
REG 7A	40123	S	1000	Alternate Reg 6 Hi
REG 7B	40124	S	1000	Alternate Reg 6 Lo
REG 7C	40125	S	1000	Alternate Reg 7 Hi
REG 7D	40126	S	1000	Alternate Reg 7 Lo
REG 7E	40127	S	1000	Alternate Reg 8 Hi
REG 7F	40128	S	1000	Alternate Reg 8 Lo
REG 80	40129	S	1000	Alternate Reg 9 Hi
REG 81	40130	S	1000	Alternate Reg 9 Lo
REG 82	40131	S	1000	Alternate Reg 10 Hi
REG 83	40132	S	1000	Alternate Reg 10 Lo
REG 84	40133	S	1000	Alternate Reg 11 Hi
REG 85	40134	S	1000	Alternate Reg 11 Lo
REG 86	40135	S	1000	Alternate Reg 12 Hi
REG 87	40136	S	1000	Alternate Reg 12 Lo
REG 88	40137	S	1000	Alternate Reg 13 Hi
REG 89	40138	S	1000	Alternate Reg 13 Lo
REG 8A	40139	S	1000	Alternate Reg 14 Hi

MODBUS Address	PLC Address	Signed/ Unsigned	Scale Factor	Register Contents
REG 8B	40140	S	1000	Alternate Reg 14 Lo
REG 8C	40141	S	1000	Alternate Reg 15 Hi
REG 8D	40142	S	1000	Alternate Reg 15 Lo
REG 8E	40143	S	1000	Alternate Reg 16 Hi
REG 8F	40144	S	1000	Alternate Reg 16 Lo
REG 90	40145	S	1000	Alternate Reg 17 Hi
REG 91	40146	S	1000	Alternate Reg 17 Lo
REG 92	40147	S	1000	Alternate Reg 18 Hi
REG 93	40148	S	1000	Alternate Reg 18 Lo
REG 94	40149	S	1000	Alternate Reg 19 Hi
REG 95	40150	S	1000	Alternate Reg 19 Lo
REG 96	40151	S	1000	Alternate Reg 20 Hi
REG 97	40152	S	1000	Alternate Reg 20 Lo
REG 98	40153	S	1000	Alternate Reg 21 Hi
REG 99	40154	S	1000	Alternate Reg 21 Lo
REG 9A	40155	S	1000	Alternate Reg 22 Hi
REG 9B	40156	S	1000	Alternate Reg 22 Lo
REG 9C	40157	S	1000	Alternate Reg 23 Hi
REG 9D	40158	S	1000	Alternate Reg 23 Lo
REG 9E	40159	S	1000	Alternate Reg 24 Hi
REG 9F	40160	S	1000	Alternate Reg 24 Lo
REG A0	40161	S	1000	Alternate Reg 25 Hi
REG A1	40162	S	1000	Alternate Reg 25 Lo
REG A2	40163	S	1000	Alternate Reg 26 Hi
REG A3	40164	S	1000	Alternate Reg 26 Lo
REG A4	40165	S	1000	Alternate Reg 27 Hi
REG A5	40166	S	1000	Alternate Reg 27 Lo
REG A6	40167	S	1000	Alternate Reg 28 Hi
REG A7	40168	S	1000	Alternate Reg 28 Lo
REG A8	40169	S	1000	Alternate Reg 29 Hi
REG A9	40170	S	1000	Alternate Reg 29 Lo
REG AA	40171	S	1000	Alternate Reg 30 Hi
REG AB	40172	S	1000	Alternate Reg 30 Lo
REG AC	40173	S	1000	Alternate Reg 31 Hi
REG AD	40174	S	1000	Alternate Reg 31 Lo
REG AE	40175	S	1000	Alternate Reg 32 Hi
REG AF	40176	S	1000	Alternate Reg 32 Lo
REG B0	40177	S	1000	Alternate Reg 33 Hi
REG B1	40178	S	1000	Alternate Reg 33 Lo
REG B2	40179	S	1000	Alternate Reg 34 Hi
REG B3	40180	S	1000	Alternate Reg 34 Lo
REG B4	40181	S	1000	Alternate Reg 35 Hi
REG B5	40182	S	1000	Alternate Reg 35 Lo
REG B6	40183	S	1000	Alternate Reg 36 Hi
REG B7	40184	S	1000	Alternate Reg 36 Lo
REG B8	40185	S	1000	Alternate Reg 37 Hi
REG B9	40186	S	1000	Alternate Reg 37 Lo

MODBUS Address	PLC Address	Signed/ Unsigned	Scale Factor	Register Contents
REG BA	40187	S	1000	Alternate Reg 38 Hi
REG BB	40188	S	1000	Alternate Reg 38 Lo
REG BC	40189	S	1000	Alternate Reg 39 Hi
REG BD	40190	S	1000	Alternate Reg 39 Lo
REG BE	40191	S	1000	Alternate Reg 40 Hi
REG BF	40192	S	1000	Alternate Reg 40 Lo
REG C0	40193	S	1000	Alternate Reg 41 Hi
REG C1	40194	S	1000	Alternate Reg 41 Lo
REG C2	40195	S	1000	Alternate Reg 42 Hi
REG C3	40196	S	1000	Alternate Reg 42 Lo
REG C4	40197	S	1000	Alternate Reg 43 Hi
REG C5	40198	S	1000	Alternate Reg 43 Lo
REG C6	40199	S	1000	Alternate Reg 44 Hi
REG C7	40200	S	1000	Alternate Reg 44 Lo
REG C8	40201	S	1000	Alternate Reg 45 Hi
REG C9	40202	S	1000	Alternate Reg 45 Lo
REG CA	40203	S	1000	Alternate Reg 46 Hi
REG CB	40204	S	1000	Alternate Reg 46 Lo
REG CC	40205	S	1000	Alternate Reg 47 Hi
REG CD	40206	S	1000	Alternate Reg 47 Lo
REG CE	40207	S	1000	Alternate Reg 48 Hi
REG CF	40208	S	1000	Alternate Reg 48 Lo
REG D0	40209	S	1000	Alternate Reg 49 Hi
REG D1	40210	S	1000	Alternate Reg 49 Lo
REG D2	40211	U	1000	Sys Wh Del Hi
REG D3	40212	U	1000	Sys Wh Del Lo
REG D4	40213	U	1000	Sys Wh Rec Hi
REG D5	40214	U	1000	Sys Wh Rec Lo
REG D6	40215	U	1000	Sys VARh Del Hi
REG D7	40216	U	1000	Sys VARh Del Lo
REG D8	40217	U	1000	Sys VARh Rec Hi
REG D9	40218	U	1000	Sys VARh Rec Lo
REG DA	40219	U	1000	Sys VAh Del Hi
REG DB	40220	U	1000	Sys VAh Del Lo
REG DC	40221	U	1000	Sys VAh Rec Hi
REG DD	40222	U	1000	Sys VAh Rec Lo
REG DE	40223	U	1000	Sys Qh Del Hi
REG DF	40224	U	1000	Sys Qh Del Lo
REG E0	40225	U	1000	Sys Qh Rec Hi
REG E1	40226	U	1000	Sys Qh Rec Lo
REG E2	40227	U	1000	Sys AMPh Hi
REG E3	40228	U	1000	Sys AMPh Lo
REG E4	40229	U	1000	Sys V2H Hi
REG E5	40230	U	1000	Sys V2H Lo
REG E6	40231	U	1000	Sys A2H Hi
REG E7	40232	U	1000	Sys A2H Lo

Read Input Registers (function 04) Point List

MODBUS Address	PLC Address	Register Contents	Engineering Units Range	Scaled Range
REG 00	30001	Instantaneous Watts, Phase A, Del	0 – 10600 W	0 - 32767
REG 01	30002	Instantaneous Watts, Phase A, Rec	0 – 10600 W	0 - 32767
REG 02	30003	Instantaneous Watts, Phase B, Del	0 – 10600 W	0 - 32767
REG 03	30004	Instantaneous Watts, Phase B, Rec	0 – 10600 W	0 - 32767
REG 04	30005	Instantaneous Watts, Phase C, Del	0 – 10600 W	0 - 32767
REG 05	30006	Instantaneous Watts, Phase C, Rec	0 – 10600 W	0 - 32767
REG 06	30007	Instantaneous Watts, Poly, Del	0 – 31800 W	0 - 32767
REG 07	30008	Instantaneous Watts, Poly, Rec	0 – 31800 W	0 - 32767
REG 08	30009	Instantaneous VARs, Phase A, Del	0 – 10600 VAR	0 - 32767
REG 09	30010	Instantaneous VARs, Phase A, Rec	0 – 10600 VAR	0 - 32767
REG 0A	30011	Instantaneous VARs, Phase B, Del	0 – 10600 VAR	0 - 32767
REG 0B	30012	Instantaneous VARs, Phase B, Rec	0 – 10600 VAR	0 - 32767
REG 0C	30013	Instantaneous VARs, Phase C, Del	0 – 10600 VAR	0 - 32767
REG 0D	30014	Instantaneous VARs, Phase C, Rec	0 – 10600 VAR	0 - 32767
REG 0E	30015	Instantaneous VARs, Poly, Del	0 – 31800 VAR	0 - 32767
REG 0F	30016	Instantaneous VARs, Poly, Rec	0 – 31800 VAR	0 - 32767
REG 10	30017	Instantaneous VA, Phase A, Del	0 – 10600 VA	0 - 32767
REG 11	30018	Instantaneous VA, Phase A, Rec	0 – 10600 VA	0 - 32767
REG 12	30019	Instantaneous VA, Phase B, Del	0 – 10600 VA	0 - 32767
REG 13	30020	Instantaneous VA, Phase B, Rec	0 – 10600 VA	0 - 32767
REG 14	30021	Instantaneous VA, Phase C, Del	0 – 10600 VA	0 - 32767
REG 15	30022	Instantaneous VA, Phase C, Rec	0 – 10600 VA	0 - 32767
REG 16	30023	Instantaneous VA, Poly, Del	0 – 31800 VA	0 - 32767
REG 17	30024	Instantaneous VA, Poly, Rec	0 – 31800 VA	0 - 32767
REG 18	30025	Instantaneous Amps, Phase A	0 –20 A	0 - 32767
REG 19	30026	Instantaneous Amps, Phase B	0 –20 A	0 - 32767
REG 1A	30027	Instantaneous Amps, Phase C	0 –20 A	0 - 32767
REG 1B	30028	Instantaneous Amps, Neutral	0 –20 A	0 - 32767
REG 1C	30029	Instantaneous Volts, Phase A	0 – 530 V	0 - 32767
REG 1D	30030	Instantaneous Volts, Phase B	0 – 530 V	0 - 32767
REG 1E	30031	Instantaneous Volts, Phase C	0 – 530 V	0 - 32767
REG 1F	30032	Frequency	0 – 100 Hz	0 - 32767
REG 20	30033	Instantaneous PF, Phase A, Del	0 – 1.00	0 - 32767
REG 21	30034	Instantaneous PF, Phase A, Rec	0 – 1.00	0 - 32767
REG 22	30035	Instantaneous PF, Phase B, Del	0 – 1.00	0 - 32767
REG 23	30036	Instantaneous PF, Phase B, Rec	0 – 1.00	0 - 32767
REG 24	30037	Instantaneous PF, Phase C, Del	0 – 1.00	0 - 32767
REG 25	30038	Instantaneous PF, Phase C, Rec	0 – 1.00	0 - 32767
REG 26	30039	Instantaneous PF, Poly, Del	0 – 1.00	0 - 32767
REG 27	30040	Instantaneous PF, Poly, Rec	0 – 1.00	0 - 32767
REG 28	30041	Volts THD, Phase A	0 – 100 %	0 - 32767
REG 29	30042	Volts THD, Phase B	0 – 100 %	0 - 32767
REG 2A	30043	Volts THD, Phase C	0 – 100 %	0 - 32767
REG 2B	30044	Amps THD, Phase A	0 – 100 %	0 - 32767
REG 2C	30045	Amps THD, Phase B	0 – 100 %	0 - 32767
REG 2D	30046	Amps THD, Phase C	0 – 100 %	0 - 32767

MODBUS Address	PLC Address	Register Contents	Engineering Units Range	Scaled Range
REG 2E	30047	$Volts^2$ Phase A	0 – 280900 V^2	0 - 32767
REG 2F	30048	$Volts^2$ Phase B	0 – 280900 V^2	0 - 32767
REG 30	30049	$Volts^2$ Phase C	0 – 280900 V^2	0 - 32767
REG 31	30050	$Amps^2$ Phase A	0 – 400 A^2	0 - 32767
REG 32	30051	$Amps^2$ Phase B	0 – 400 A^2	0 - 32767
REG 33	30052	$Amps^2$ Phase C	0 – 400 A^2	0 - 32767
REG 34	30053	$Amps^2$ Poly	0 – 1200 A^2	0 - 32767
REG 35	30054	Instantaneous Watts, Phase A, Bidirectional	-10600 to +10600W	-32768 to +32767
REG 36	30055	Instantaneous Watts, Phase B, Bidirectional	-10600 to +10600 W	-32768 to +32767
REG 37	30056	Instantaneous Watts, Phase C, Bidirectional	-10600 to +10600 W	-32768 to +32767
REG 38	30057	Instantaneous Watts, Polyphase, Bidirectional	-31800 to +31800 W	-32768 to +32767
REG 39	30058	Instantaneous VARs, Phase A, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
REG 3A	30059	Instantaneous VARs, Phase B, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
REG 3B	30060	Instantaneous VARs, Phase C, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
REG 3C	30061	Instantaneous VARs, Polyphase, Bidirectional	-31800 to +31800 VAR	-32768 to +32767
REG 3D	30062	Instantaneous Uncompensated Watts, Phase A, Del	0 – 10600 W	0 - 32767
REG 3E	30063	Instantaneous Uncompensated Watts, Phase A, Rec	0 – 10600 W	0 - 32767
REG 3F	30064	Instantaneous Uncompensated Watts, Phase B, Del	0 – 10600 W	0 - 32767
REG 40	30065	Instantaneous Uncompensated Watts, Phase B, Rec	0 – 10600 W	0 - 32767
REG 41	30066	Instantaneous Uncompensated Watts, Phase C, Del	0 – 10600 W	0 - 32767
REG 42	30067	Instantaneous Uncompensated Watts, Phase C, Rec	0 – 10600 W	0 - 32767
REG 43	30068	Instantaneous Uncompensated Watts, Poly, Del	0 – 31800 W	0 - 32767
REG 44	30069	Instantaneous Uncompensated Watts, Poly, Rec	0 – 31800 W	0 - 32767
REG 45	30070	Instantaneous Uncompensated VARs, Phase A, Del	0 – 10600 VAR	0 - 32767
REG 46	30071	Instantaneous Uncompensated VARs, Phase A, Rec	0 – 10600 VAR	0 - 32767
REG 47	30072	Instantaneous Uncompensated VARs, Phase B, Del	0 – 10600 VAR	0 - 32767
REG 48	30073	Instantaneous Uncompensated VARs, Phase B, Rec	0 – 10600 VAR	0 - 32767
REG 49	30074	Instantaneous Uncompensated VARs, Phase C, Del	0 – 10600 VAR	0 - 32767
REG 4A	30075	Instantaneous Uncompensated VARs, Phase C, Rec	0 – 10600 VAR	0 - 32767

MODBUS Address	PLC Address	Register Contents	Engineering Units Range	Scaled Range
REG 4B	30076	Instantaneous Uncompensated VARs, Poly, Del	0 – 31800 VAR	0 - 32767
REG 4C	30077	Instantaneous Uncompensated VARs, Poly, Rec	0 – 31800 VAR	0 - 32767
REG 4D	30078	Instantaneous Uncompensated VA, Phase A, Del	0 – 10600 VA	0 - 32767
REG 4E	30079	Instantaneous Uncompensated VA, Phase A, Rec	0 – 10600 VA	0 - 32767
REG 4F	30080	Instantaneous Uncompensated VA, Phase B, Del	0 – 10600 VA	0 - 32767
REG 50	30081	Instantaneous Uncompensated VA, Phase B, Rec	0 – 10600 VA	0 - 32767
REG 51	30082	Instantaneous Uncompensated VA, Phase C, Del	0 – 10600 VA	0 - 32767
REG 52	30083	Instantaneous Uncompensated VA, Phase C, Rec	0 – 10600 VA	0 - 32767
REG 53	30084	Instantaneous Uncompensated VA, Poly, Del	0 – 31800 VA	0 - 32767
REG 54	30085	Instantaneous Uncompensated VA, Poly, Rec	0 – 31800 VA	0 - 32767
REG 55	30086	Instantaneous Uncompensated PF, Phase A, Del	0 – 1.00	0 - 32767
REG 56	30087	Instantaneous Uncompensated PF, Phase A, Rec	0 – 1.00	0 - 32767
REG 57	30088	Instantaneous Uncompensated PF, Phase B, Del	0 – 1.00	0 - 32767
REG 58	30089	Instantaneous Uncompensated PF, Phase B, Rec	0 – 1.00	0 - 32767
REG 59	30090	Instantaneous Uncompensated PF, Phase C, Del	0 – 1.00	0 - 32767
REG 5A	30091	Instantaneous Uncompensated PF, Phase C, Rec	0 – 1.00	0 - 32767
REG 5B	30092	Instantaneous Uncompensated PF, Poly, Del	0 – 1.00	0 - 32767
REG 5C	30093	Instantaneous Uncompensated PF, Poly, Rec	0 – 1.00	0 - 32767
REG 5D	30094	Instantaneous Uncompensated Watts, Phase A, Bidirectional	-10600 to +10600W	-32768 to +32767
REG 5E	30095	Instantaneous Uncompensated Watts, Phase B, Bidirectional	-10600 to +10600 W	-32768 to +32767
REG 5F	30096	Instantaneous Uncompensated Watts, Phase C, Bidirectional	-10600 to +10600 W	-32768 to +32767
REG 60	30097	Instantaneous Uncompensated Watts, Polyphase, Bidirectional	-31800 to +31800 W	-32768 to +32767
REG 61	30098	Instantaneous Uncompensated VARs, Phase A, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
REG 62	30099	Instantaneous Uncompensated VARs, Phase B, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
REG 63	30100	Instantaneous Uncompensated VARs, Phase C, Bidirectional	-10600 to +10600 VAR	-32768 to +32767
REG 64	30101	Instantaneous Uncompensated VARs, Polyphase, Bidirectional	-31800 to +31800 VAR	-32768 to +32767

Extended Holding Registers (function 03)

JEMStar contains a number of Holding Registers that facilitate its use in energy monitoring and management systems and to provide limited access to Load Profile data. This section describes those registers and their interpretation. They are read using Function Code 03, the same as the basic Holding Registers.

MODBUS Register	JEMStar Parameter	Units	Format	Number of Registers
	Instantaneous			
1000	Amps, phase A	Primary milli-amps	Long	2
1002	Amps, phase B	Primary milli-amps	Long	2
1004	Amps, phase C	Primary milli-amps	Long	2
1006	Amps, phase N	Primary milli-amps	Long	2
1008	Amps polyphase	Primary milli-amps	Long	2
1010	Volts, L-L, phase A-B	Primary milli-amps	Long	2
1012	Volts, L-L, phase B-C	Primary milli-volts	Long	2
1014	Volts, L-L, phase C-A	Primary milli-volts	Long	2
1016	Volts, L-L, polyphase	Primary milli-volts	Long	2
1018	Volts, L-N, phase A-N	Primary milli-volts	Long	2
1020	Volts, L-N, phase B-N	Primary milli-volts	Long	2
1022	Volts, L-N, phase C-N	Primary milli-volts	Long	2
1024	Volts, L-N, polyphase	Primary milli-volts	Long	2
1026	Frequency	HZ.hundredths	Int	1
1027	PF Delivered, phase A	PF.milli	Int	1
1028	PF Delivered, phase B	PF.milli	Int	1
1029	PF Delivered, phase C	PF.milli	Int	1
1030	PF Delivered, polyphase	PF.milli	Int	1
1031	PF Received, phase A	PF.milli	Int	1
1032	PF Received, phase B	PF.milli	Int	1
1033	PF Received, phase C	PF.milli	Int	1
1034	PF Received, polyphase	PF.milli	Int	1
1035	THD, Amps, phase A	percent. milli	Long	2
1037	THD, Amps, phase B	percent. milli	Long	2
1039	THD, Amps, phase C	percent. milli	Long	2
1041	THD, Volts, phase A-N	percent. milli	Long	2
1043	THD, Volts, phase B-N	percent. milli	Long	2
1045	THD, Volts, phase C-N	percent. milli	Long	2
1047	THD, Volts, phase A-B	percent. milli	Long	2

MODBUS Register	JEMStar Parameter	Units	Format	Number of Registers
1049	THD, Volts, phase B-C	percent. milli	Long	2
1051	THD, Volts, phase C-A	percent. milli	Long	2
1053	W Delivered, phase A	Primary xW.milli	Long	2
1055	W Delivered, phase B	Primary xW.milli	Long	2
1057	W Delivered, phase C	Primary xW.milli	Long	2
1059	W Delivered, polyphase	Primary xW.milli	Long	2
1061	Real/Apparent Power UOM to Kilo conversion factor	power of ten	Int	1
1062	VAR Delivered, phase A	Pri xVAR. milli	Long	2
1064	VAR Delivered, phase B	Pri xVAR. milli	Long	2
1066	VAR Delivered, phase C	Pri xVAR. milli	Long	2
1068	VAR Delivered, polyphase	Pri xVAR. milli	Long	2
1070	Reactive/Q Power UOM to Kilo Conversion Factor	power of ten	Int	1
1071	VA Delivered, phase A	Pri xVA. milli	Long	2
1073	VA Delivered, phase B	Pri xVA. milli	Long	2
1075	VA Delivered, phase C	Pri xVA. milli	Long	2
1077	VA Delivered, polyphase	Pri xVA. milli	Long	2
1079	Real/Apparent Power UOM to Kilo conversion factor	power of ten	Int	1
1080	W Received, phase A	Primary xW.milli	Long	2
1082	W Received, phase B	Primary xW.milli	Long	2
1084	W Received, phase C	Primary xW.milli	Long	2
1086	W Received, polyphase	Primary xW.milli	Long	2
1088	Real/Apparent Power UOM to Kilo conversion factor	power of ten	Int	1
1089	VAR Received, phase A	Pri xVAR. milli	Long	2
1091	VAR Received, phase B	Pri xVAR. milli	Long	2
1093	VAR Received, phase C	Pri xVAR. milli	Long	2
1095	VAR Received, polyphase	Pri xVAR. milli	Long	2
1097	Reactive/Q Power UOM to Kilo Conversion Factor	power of ten	Int	1
1098	VA Received, phase A	Pri xVA. milli	Long	2
1100	VA Received, phase B	Pri xVA. milli	Long	2
1102	VA Received, phase C	Pri xVA. milli	Long	2
1104	VA Received, polyphase	Pri xVA. milli	Long	2
1106	Real/Apparent Power UOM to Kilo conversion factor	power of ten	Int	1
1107	Watts, bi-directional, phase A	Primary xW.milli	Long	2
1109	Watts, bi-directional, phase B	Primary xW.milli	Long	2

MODBUS Register	JEMStar Parameter	Units	Format	Number of Registers
1111	Watts, bi-directional, phase C	Primary xW.milli	Long	2
1113	Watts, polyphase, bi-directional	Primary xW.milli	Long	2
1115	Real/Apparent Power UOM to Kilo conversion factor	power of ten	Int	1
1116	VARs, bi-directional, phase A	Pri xVAR. milli	Long	2
1118	VARs, bi-directional, phase B	Pri xVAR. milli	Long	2
1120	VARs, bi-directional, phase C	Pri xVAR. milli	Long	2
1122	VAR polyphase, bi-directional	Pri xVAR. milli	Long	2
1124	Reactive/Q Power UOM to Kilo Conversion Factor	power of ten	Int	1
	Average Power Factors			
1200	PF Delivered, phase A	pf.milli	Int	1
1201	PF Delivered, phase B	pf.milli	Int	1
1202	PF Delivered, phase C	pf.milli	Int	1
1203	PF Delivered, polyphase	pf.milli	Int	1
1204	PF Received, polyphase	pf.milli	Int	1
	Consumption			
1205	Wh Delivered	pri xWh.milli	Mod 10 x 3	3
1208	Wh Received	pri xWh.milli	Mod 10 x 3	3
1211	Real/Apparent Energy UOM to Kilo conversion factor	power of ten	Int	1
1212	VARh Delivered	pri xVARh.milli	Mod 10 x 3	3
1215	VARh Received	pri xVARh.milli	Mod 10 x 3	3
1218	Reactive/Q Energy UOM to Kilo Conversion Factor	power of ten	Int	1
1219	VAh Delivered	pri xVAh.milli	Mod 10 x 3	3
1222	VAh Received	pri xVAh.milli	Mod 10 x 3	3
1225	Real/Apparent Energy UOM to Kilo conversion factor	power of ten	Int	1
1226	Qh Delivered	pri xQh.milli	Mod 10 x 3	3
1229	Qh Received	pri xQh.milli	Mod 10 x 3	3
1232	Reactive/Q Energy UOM to Kilo Conversion Factor	power of ten	Int	1
1233	Amphours	pri Ah.milli-UOM	Mod 10 x 3	3
1236	Amp^2hours	pri kAh.milli-UOM	Mod 10 x 3	3
1239	$Amps/Amp^2$ UOM to Kilo conversion factor	power of ten	Int	1
1240	$Volt^2hours$	pri kAh.milli-UOM	Mod 10 x 3	3
1243	$Volts^2$ UOM to Kilo conversion factor	power of ten	Int	1
	Demand			
1244	Demand - W Delivered	Primary xW.milli	Long	2

MODBUS Register	JEMStar Parameter	Units	Format	Number of Registers
1246	Peak Demand - W Delivered	Primary xW.milli	Long	2
1248	Prev Billing Period Peak Demand - W Delivered	Primary xW.milli	Long	2
1250	Real/Apparent Power UOM to Kilo conversion factor	power of ten	Int	1
1251	Demand - VAR Delivered	Primary xVAR.milli	Long	2
1253	Peak Demand - VAR Delivered	Primary xVAR.milli	Long	2
1255	Prev Billing Period Peak Demand - VAR Delivered	Primary xVAR.milli	Long	2
1257	Reactive/Q Power UOM to Kilo Conversion Factor	power of ten	Int	1
1258	Demand - VA Delivered	Primary xVA.milli	Long	2
1260	Peak Demand - VA Delivered	Primary xVA.milli	Long	2
1262	Prev Billing Period Peak Demand - VA Delivered	Primary xVA.milli	Long	2
1264	Real/Apparent Power UOM to Kilo conversion factor	power of ten	Int	1
	Demand Prediction			
1265	Predicted Demand - W Delivered, polyphase	Primary xW.milli	Long	2
1267	Predicted Demand - VAR Delivered, polyphase	Primary xVAR.milli	Long	2
1269	Predicted Demand - VA Delivered, polyphase	Primary xVA.milli	Long	2
1271	Real/Apparent Power UOM to Kilo conversion factor	power of ten	Int	1
1272	Reactive/Q Power UOM to Kilo Conversion Factor	power of ten	Int	1
	Demand Current			
1273	Demand Current Phase A	Primary milli-amps	Long	2
1275	Demand Current Phase B	Primary milli-amps	Long	2
1277	Demand Current Phase C	Primary milli-amps	Long	2
1279	Demand Current Phase N	Primary milli-amps	Long	2
1281	Peak Demand Current Phase A	Primary milli-amps	Long	2
1283	Peak Demand Current Phase B	Primary milli-amps	Long	2
1285	Peak Demand Current Phase C	Primary milli-amps	Long	2
1287	Peak Demand Current Phase N	Primary milli-amps	Long	2
	Time of Peak Demand			
1289	W Delivered, polyphase		Time	3
1292	VAR Delivered, polyphase		Time	3
1295	VA Delivered, polyphase		Time	3

MODBUS Register	JEMStar Parameter	Units	Format	Number of Registers
1298	Demand Current Phase A		Time	3
1301	Demand Current Phase B		Time	3
1304	Demand Current Phase C		Time	3
1307	Demand Current Phase N		Time	3
1310	Prev Billing Period Peak W Delivered		Time	3
1313	Prev Billing Period Peak VAR Delivered		Time	3
1316	Prev Billing Period Peak VA Delivered		Time	3
	Coincident Power Factor			
1319	when W Delivered was peak last billing period	PF.milli	Int	1
1320	when VAR Delivered was peak last billing period	PF.milli	Int	1
1321	when VA Delivered was peak last billing period	PF.milli	Int	1
	Pulse Inputs			
1400	Input 1		Int	1
1401	Input 2		Int	1
	Scratchpad (WRITABLE)			
1600 - 1619	20 registers writable by system		Int	1 ea
	Configuration			
1700	Meter ID or Type (unique for each Model)		Int	1
1702 - 1704	Date / Time		Time	3
1705 - 1707	Register Firmware Version		Int	3
1708	Class		Int	1
1709	Health Status		Int	1
1710	VT Ratio (x:1)		Long	2
1712	CT Ratio (x:1)		Long	2
1714	W/ VA/ Wh/ VAh Primary Unit of Measure	power of ten	Int	1
1715	VAR/ Q/ VARh/ Qh Primary Unit of Measure	power of ten	Int	1
1716	Volt Primary Unit of Measure	power of ten	Int	1
1717	Amp Primary Unit of Measure	power of ten	Int	1
1718	Volt Primary Squared Unit of Measure	power of ten	Int	1
1719	Amp Primary Squared Unit of Measure	power of ten	Int	1
1720	Connection Type		Int	1
1721	Demand Method		Int	1
1722	Demand Interval		Int	1
1723	Demand Subinterval		Int	1
1724	Configured number of display items in Normal Display List (See MODBUS registers 1800 - 1999, 12000 - 12749)		Int	1
1725	Configured number of display items in Alternate Display List (See MODBUS registers 2000 - 2199, 13000 - 13749)		Int	1

MODBUS Register	JEMStar Parameter	Units	Format	Number of Registers
1726	Configured number of display items in Internal Display List (See MODBUS registers 14000 - 14749)		Int	1
1727	Configured number of Load Profile channels (See MODBUS registers 15000 - 15179)		Int	1
	Display Registers			
1800-1999	Normal Display List Registers (up to 50 entries)		Display	4 ea
2000 - 2199	Alternate Display List Registers (up to 50 entries)		Display	4 ea
	Load Profile			
2900 - 2919	Data Log Header		Int	22
2950 - 2985	Data Log Table of Contents (36 scratchpad registers writable by system)		Int	36
3000 - 10799	Load Profile data		LP Record	200 records
	Display Register and Load Profile Channel Descriptions			
12000 - 12749	Normal Display List Register Map / Index (50 entries)		Reg Desc	15 ea
13000 - 13749	Alternate Display List Register Map / Index (50 entries)		Reg Desc	15 ea
14000 - 14749	Internal Display List Register Map / Index (50 entries)		Reg Desc	15 ea
15000 - 15179	Load Profile Channel Map / Index (12 entries)		Reg Desc	15 ea

Scaling Factors

Note: These MODBUS registers are scaling factors expressed as powers of ten that, when multiplied by the appropriate power or energy registers, give readings in primary kilo-units (e.g. kilowatts, kilowatthours).

MODBUS Register(s)	Measurement Type
1061, 1079, 1088, 1106, 1115, 1211, 1225, 1250, 1264, 1271	Watt, Watthour, VA, VAhour
1070, 1097, 1124, 1218, 1232, 1257, 1272,	VAR, VARhour, Q, Qhour
1239	Amp, Amp^2, Amphour, Amp^2hour
1243	$Volt^2$, $Volt^2$hour

Special Data Formats

These Registers have special or unusual formatting:

- Pulse Input 1(MODBUS register 1400): Reads 0 if JEMStar Contact Input 1 is off, 1 if on.
- Pulse Input 2 (MODBUS register 1401): Reads 0 if JEMStar Contact Input 2 is off, 1 if on.
- Meter ID (MODBUS register 1700): and unique identification number assigned by Square-D. JEMStar returns 15220.
- Register Firmware Version (MODBUS registers 1705 - 1701): Three MODBUS registers, each containing 2 digits of the JEMStar Register Firmware version number. Display each register's contents as a 2-digit hexadecimal number, and separate the registers with periods. (E.g. "B3.00.12")
- Health Status (MODBUS register 1709): A series of bits giving the present health status of the JEMStar:

  (MSB)-> 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 <-(LSB)

Bit	Meaning
16	1 = Battery Warning. Cumulative time on battery exceeds 2 years.
15	1 = Configuration error - using default configuration
14	1 = Site Monitor alarm condition is present
13	1 = External status input is ON
12	1 = Threshold 1 alarm condition is present
11	1 = Threshold 2 alarm condition is present
10	1 = Threshold 3 alarm condition is present
9	1 = Threshold 4 alarm condition is present
8	1 = (reserved)
7	1 = (reserved)
6	1 = (reserved)
5	1 = (reserved)
4	1 = (reserved)
3	1 = Phase C voltage active
2	1 = Phase B voltage active
1	1 = Phase A voltage active

- VT Ratio (MODBUS registers 1710 - 1711): The meter's configured external Voltage Transformer ratio multiplied by 1000.
- CT Ratio (MODBUS registers 1712 - 1713): The meter's configured external Current Transformer ratio multiplied by 1000.
- W/ VA/ Wh/ VAh Primary Unit of Measure (MODBUS register 1714): A power of ten showing the configured Unit of Measure for Real and Apparent power and energy measurements:
  0 = units (watts, VA)
  3 = kilo units
  6 = mega units
  9 = giga units
- VAR/ Q/ VARh/ Qh Primary Unit of Measure (MODBUS register 1715): A power of ten showing the configured Unit of Measure for Reactive and Q power and energy measurements:
  0 = units (VAR, Q)
  3 = kilo units
  6 = mega units
  9 = giga units
- Volt Primary Unit of Measure (MODBUS register 1716): A power of ten showing the configured Unit of Measure for Volt measurements:
  0 = units (volts)
  3 = kilo units
  6 = mega units
- Amp Primary Unit of Measure (MODBUS register 1717): A power of ten showing the configured Unit of Measure for Amp measurements:
  0 = units (amps)
  3 = kilo units
  6 = mega units
- Volt Primary Squared Unit of Measure (MODBUS register 1718): A power of ten showing the configured Unit of Measure for Volts Squared measurements:
  0 = units (volts squared)
  3 = kilo units
  6 = mega units
- Amp Primary Squared Unit of Measure (MODBUS register 1719): A power of ten showing the configured Unit of Measure for Amp Squared measurements:

0 = units (amps squared)
3 = kilo units
6 = mega units

- Connection Type (MODBUS register 1720): The meter service connection type. A 3-wire Delta connection returns 30, while a 4-wire Wye returns 40.
- Demand Method (MODBUS register 1721): A bit field indicating the demand methods configured in the meter.
  (MSB)-> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 E S <-(LSB)
  Where: E is the External Demand Interval Sync Enabled bit (1 = external demand sync, 0 = internal sync).
  S is the Sliding Window Demand indicator (1 = sliding window, 0 = fixed window)
- Demand Interval (MODBUS register 1722): The JEMStar's demand interval length in minutes.
- Demand Subinterval (MODBUS register 1723): The JEMStar's demand subinterval length in minutes.
- Number of Normal Display Registers (MODBUS register 1724): The number of display registers (max. 50) currently configured in the Normal display list.
- Number of Alternate Display Registers (MODBUS register 1725): The number of display registers (max. 50) currently configured in the Alternate display list.
- Number of Internal Display Registers (MODBUS register 1726): The number of display registers (max. 50) currently configured in the Internal display list.
- Number of Load Profile Channels (MODBUS register 1727): The number of Load Profile pulse channels (max. 12) currently configured in the meter.

MODBUS Register Formats

These extended MODBUS holding registers come in a variety of formats. These formats are described here.

Int

The Int type is a signed 16-bit integer number. It is the basic MODBUS register.

Long

The Long is two MODBUS registers sent consecutively to form a 32-bit value. The first register contains the sign bit and the 15 most significant bits of the value. The second register contains the remaining 16 least significant bits.

Time

The Time format is three MODBUS registers sent consecutively to form a date-time group encoded thus:

	Upper 8 bits	Lower 8 bits
First register	Month (1 - 12)	Day (1 - 31)
Second register	Year (0 - 199)	Hour (0 - 23)
Third register	Minute (0 - 59)	Second (0 - 59)

Mod10 x 3

The Mod10 x 3 format is three MODBUS registers sent consecutively to form a 12-digit decimal value encoded thus:

First register:	4 least significant (of 12) digits of complete value, in binary (0 - 9999)
Second register:	4 middle (of 12) digits of complete value, in binary (0 - 9999)
Third register:	4 most significant (of 12) digits of complete value, in binary (0 - 9999)

Therefore, the complete value is (R3 * 10^8) + (R2 & 10^4) + R1. This format can accommodate values from 0 to 999,999,999,999 decimal.

Display

The Display format varies depending on the exact definition of a given display item by the user. JEMStar Displays can contain a numeric value expressed as a Long or a Mod x 3 format with a primary scaling factor, a Long format without scaling, or a Time format.
Each Display has a corresponding Register Description (see Reg Desc below) that contains, among other things, a "Format Type" field that explains how to interpret that Display's data.

LP Record

The Load Profile Record contains the Load Profile data for a single interval. This format consists of a time stamp (in the Time format described here) followed by 1 to 12 pulse channels depending on the meter's configuration. Each pulse channel is three MODBUS registers in the format R1 * R2 * 10^R3. The first register is a pulse count, the second register is a pulse weight (in, for example, Watthours per pulse), and the third register is a power of ten. The complete interval's accumulation for that channel is found by multiplying the first register by the second register, then multiplying the result by 10 raised to the power in the third register.

LP Header

The Load Profile Header is a data structure that describes the JEMStar's implementation of Load Profile for MODBUS retrieval:

Register Offset	Register Name	Register Description	Notes
0	Table of Contents	Beginning register of record which lists the register numbers that are being logged for this data log. (0 specifies that the data log is not being used)	This is a pointer to the block where the 1-12 channels are defined by listing the first register corresponding to the value logged in that register. JEMStar reads Register 2950
1	File Type	Specifies the file type, i.e., data log, waveform capture, etc. (Set to 1 for Data Log)	JEMStar reads 1
2	File Size	The file size in records, max = 32000	JEMStar reads 200
3	Record Size	Record size in registers, max 39 including date/time stamp. Table of contents will hold (Record Size - 3) registers	Calculated by JEMStar based on Recorder Contents
4	File Mode	0 = FIFO, 1 = Fill and Hold	Always 0 for the JEMStar
5	Record Entry Enable / Disable	Record entry enable (FFFF)/disable(0000) for data log files	JEMStar is FFFF by default
6	Entry Update Interval	Entry update interval (in minutes) for data log files synchronized to entry interval offset time	JEMStar's configured Load Profile interval length, in minutes.
7	Entry Interval Offset Time	Time (in minutes) past midnight to synchronize record entry update intervals to	Always 0 for JEMStar
8	Current # Records in File	Current number of records in the file	Managed by JEMStar. Maximum 200
9	Current first record sequence	Current first (oldest) record sequence number in the file	Managed by JEMStar. Ranges from 1 to 32000
10	Current last record sequence	Current last (newest) record sequence number in the file	Managed by JEMStar. Ranges from 1 to 32000
11	Date/Time of last file reset/clear	Date/Time of last file reset/clear in 3 register format	Date & Time at which JEMStar Load Profile was reinitialized (reconfigured).
14	Allocated File Size	File size allocated during last file resize, in records	(same as Offset 2)
15	Allocated Record Size	Record size (in registers) allocated during the last file resize, including the date/time stamp	(same as Offset 3)
16	File Status	Status of the file based on actual and allocated file size and record size	JEMStar always reads 0 (OK)
17	File Location	Starting register number for file	JEMStar always reads 3000
18	Cont. WFC Segment Delay	Continuous WFC segment limit may be set in range 1-5	N/A = -32768
19	Cont. WFC Trigger Delay	Number of Pre-Trigger Cycles to obtain when a continuous WFC occurs. Applicable only to the Cont. WFC File Only. Reserved for all others.	N/A = -32768
20	Oldest Record	Register number at start of oldest record in file.	Location of record corresponding to sequence number stored at Offset 9.
21	Newest Record	Register number at start of newest record in file.	Location of record corresponding to sequence number stored at Offset 10.

Reg Desc

Each JEMStar Display Register and Load Profile Channel has a corresponding "Register Description" (Reg Desc) that tells the host system how to interpret its data.
Every Register Description contains 15 MODBUS registers that fully describes the Display or Load Profile Channel. Four of these registers contain bit fields that detail the operation of the Display or Channel.

Offset	Name	Contents
0	Reg Type	Describes the Type (Numeric, Time, Status, ID, or Totalization) of Display Register or Load Profile channel
1	Quantity Type (Used only if Reg Type is Numeric or Totalization, otherwise contains zero)	Describes the measurement quantity of a Numeric or Totalization Display Register or Load Profile channel
2	Demand Quantity Type (Used only if Reg Type is Numeric Coincident Demand to indicate quantity of associated Peak demand. Otherwise contains zero)	If this Display Register is a Coincident Demand, this describes the measurement quantity of the Peak Demand associated with it.
3	Reg Format	This describes how the Display Register or Load Profile channel data is to be interpreted and formatted for display.
4	Reg ID Number	The Identification number assigned by the user to this Display Register, or the Load Profile Channel Number.
5 - 14	Text Description	20 bytes of text, padded with nulls, that the user assigned to be displayed with this Display Register. This will contain all nulls for Load Profile channels.

Reg Type

The Reg Type register contains a number of bit fields that describe the basic type of the Display Register or Load Profile channel.
Reg Type: (MSB)-> t t t a a a l l d d d n n n n n <-(LSB)
Where:
t t t is the Register Type:

- 0 = Numeric (Power) Display Register or Channel
- 1 = Time Display Register
- 2 = Status Display Register
- 3 = ID Display Register
- 4 = Unused Register
- 5 = Totalization Display Register or Channel

a a a is the Display Register or Channel Algorithm:

- 0 = Demand
- 1 = Consumption
- 2 = Average PF
- 3 = Peak Demand
- 4 = Instantaneous
- 5 = Thermal
- 6 = Peak Thermal
- 7 = Demand Prediction

l l is the Demand Algorithm, and is used only for Demand, Peak Demand, or Peak Thermal Registers or Channels:

For Demand Registers or Channels:

0 = Unused
1 = Past Interval Demand
2 = Present Interval Demand

For Peak Demand Registers:

0 = Peak Demand
1 = Time of Peak Demand
2 = Coincident Demand
3 = Date of Peak Demand

For Peak Thermal Registers:

0 = Peak Thermal
1 = Time of Peak Thermal
2 = Unused
3 = Date of Peak Thermal

d d d is the Display Update:

0 = Working (value updates at any time)
1 = Freeze (value updates on communications Freeze)
2 = Season (value updates on TOU Season Change)
3 = Billing Period Reset (value updates on BPR)
4 = Cumulative (Peak Demand value accumulates on BPR)
5 = Continuous Cumulative (Peak Demand value accumulates on BPR and Demand Interval)

n n n n n is a Selection Number that defines which Status, ID, or Time value, or Totalization channel, this Display Register contains:

For Time Registers:

0 = Present Time - present value of the meter clock
1 = Last BPR Time - time of the last Billing Period Reset
2 = Last Freeze Time - time of the last communications Freeze
3 = Last Season Time - time of last Time of Use season change
4 = Next DST Time - time of next Daylight Saving Time change
5 = Present Date - present value of the meter clock
6 = Last BPR Date - date of the last Billing Period Reset
7 = Last Freeze Date - date of the last Register Freeze
8 = Last Season Date - date of the last Time of Use season change
9 = Next DST Date - date of the next Daylight Saving Time change
10 = Test Time Remaining - time remaining in meter Test Mode
11 = Demand Time Remaining - time remaining in present Demand Interval
12 = Days On Battery - number of days meter has used backup battery power (i.e. cumulative outage time)

For Status Registers:

0 = Present Status - present System Status Word.
1 = Latched Status Word - "sticky" System Status Word. Shows conditions that have set a Status bit in the System Status Word but have since gone away.
2 = Last BPR Status - System Status Word at last Billing Period Reset
3 = Last Freeze Status - System Status Word at last communications Freeze
4 = Last Season Status - System Status Word at last Time of Use season change
5 = Register Firmware Version - JEMStar register firmware version (no numeric value)
6 = Metrology Firmware Version - JEMStar metrology firmware version (no numeric value)

7 = Blank - blank display (no numeric value)
8 = Segment Check - all display segments active (no numeric value)
9 = Phasor V - 2- or 3-phase voltage vector display (no numeric value)
10 = Phasor A - 2- or 3-phase current vector display (no numeric value)
11 = Phasor VaIa - Phase A voltage and current vector display (no numeric value)
12 = Phasor VbIb - Phase B voltage and current vector display (no numeric value)
13 = Phasor VcIc - Phase C voltage and current vector display (no numeric value)
14 = BPR Count - cumulative number of Billing Period Resets that have occurred
15 = Outage Count - cumulative number of power outages that have occurred

For ID Registers:

0 = Label 1 - User-defined label 1 (default "Meter Name")
1 = String 1
2 = Label 2 - User-defined label 1 (default "Administrator")
3 = String 2
4 = Label 3 - User-defined label 1 (default "Location")
5 = String 3
6 = Label 4 - User-defined label 1 (default "Configuration ID")
7 = String 4
8 = Label 5 - User-defined label 1 (default "Account Number")
9 = String 5 (Selector value 9)

For Totalization registers, the Selection Number contains the number of the Totalization Channel (1 - 12) that is being displayed.

Quantity Type

The Quantity Type register describes the basic quantity being measured by the Display Register or Load Profile channel. Quantity Type is valid only if the associated Reg Type indicates this is a Numeric or Totalization Register.
(MSB)-> q q q q e e e d d d r r r r c i <-(LSB)
Where:
q q q q is the base electrical Measurement Quantity:

0 = Watts (Watthours)
1 = VAR (VARhours)
2 = VA (VAhours)
3 = Amps (Amphours)
4 = Q (Qhours)
5 = PF
6 = Volts
7 = Frequency
8 = Volts THD
9 = Amps THD
10 = External Count (Load Profile only)
11 = External Status (Load Profile only)
12 = Amps Squared (Amp Squared hours)
13 = Volts Squared (Volt Squared hours)

e e e is the Element or Phase on which the measurement is taken:

0 = No element - Not applicable to any element or line phase. (Frequency only)
1 = Polyphase - Sum or net of all phases. (If Channel Quantity is Volts or Volts Squared, Polyphase means an average of all phases.)
2 = Phase A - Measured on Phase A.

3 = Phase B - Measured on Phase B.
4 = Phase C - Measured on Phase C.
5 = Neutral - Measured on Neutral line. (Amps only)
6 = Phase Average - Average of all phases. (Amps or Amps Squared only)

d d d is the Direction of the measured quantity
0 = No direction - Directionless quantities such as volts or amps.
1 = Delivered - Power flowing from the line side of the meter to the load.
2 = Received - Power flowing from the load side of the meter to the line.
3 = Quadrant 1 - Delivered watts, lagging VARs. (VARs only)
4 = Quadrant 2 - Received watts, leading VARs. (VARs only)
5 = Quadrant 3 - Received watts, lagging VARs. (VARs only)
6 = Quadrant 4 - Delivered watts, leading VARs. (VARs only)

r r r r is the Time of Use Rate during which the quantity is measured.
0 = Total - Register is always active.
1 = Rate A - Register measures only during TOU Rate A.
2 = Rate B - Register measures only during TOU Rate B.
3 = Rate C - Register measures only during TOU Rate C.
4 = Rate D - Register measures only during TOU Rate D.
5 = Rate E - Register measures only during TOU Rate E.
6 = Rate F - Register measures only during TOU Rate F.
7 = Rate G - Register measures only during TOU Rate G.
8 = Rate H - Register measures only during TOU Rate H.

c is the Compensation flag:
0 = Value has Transformer Loss Compensation applied (if applicable)
1 = Value is not compensated.

i is the Integrated Quantity flag:
0 = Quantity is instantaneous or average (i.e. Demand, Instantaneous, Thermal, etc.)
1 = Quantity is integrated (i.e. Consumption, Totalization)

Demand Quantity Type

The Demand Quantity Type register describes the basic quantity being measured by an associated Peak Demand Display Register. It uses the same bit assignments as Quantity Type described above. It is valid only if the associated Reg Type indicates this is a Coincident Demand Display Register.

Reg Format

The Reg Format register identifies the MODBUS data format used by the associated Display Register or Load Profile channel.
(MSB)-> 0 0 0 0 f f f f d d d d c c c c <-(LSB)
Where:
f f f f is the Register Format identifier:
0 = No value - Register or Channel contains no displayable information
1 = Int - Display contains a single MODBUS register, remaining 3 registers are not used. (Display Registers only)
2 = Long - Display contains a Long (2 MODBUS registers), remaining 2 registers are not used. (Display Registers only)
3 = Time - Display contains a Time (3 MODBUS registers), last register is not used. (Display Registers only)

4 = Long + scale - Display contains a Long (2 MODBUS registers), 1 unused register, and the last register is a Scale (power of 10). (Display Registers only)
5 = Mod x 3 + scale - Display contains a Mod x 3 (3 MODBUS registers) and the last register is a Scale (power of 10). (Display Registers only)
6 = Load Profile channel - Display contains one Value (1 MODBUS register), one Multiplier (1 MODBUS register), and a Scale (power of 10). (Load Profile channels occupy only 3 MODBUS registers.) (Load Profile channels only)

d d d d is the total number of digits of the value to be displayed. (Only for Numeric or Totalization Display Registers.)
c c c c is the number of decimal places of the value to be displayed, and is part of the total number of digits displayed. (Only for Numeric or Totalization Display Registers.)

Reg ID Number

The Identification number assigned by the user to this Display Register, or the Load Profile Channel Number. The decimal value of this number is displayed with the Display Register.

Text Description

20 bytes of text, padded with nulls, that the user assigned to be displayed with this Display Register. This will contain all nulls for Load Profile channels.

APPENDIX F
ANSI TABLES COMMUNICATION

INTRODUCTION

The utility metering industry – utility companies, equipment vendors, government and standards agencies – has created a standardized method of retrieving meter data. The ANSI Standard C12.19 - 1997 "Utility Industry End Device Data Tables" (or "ANSI Tables") describes a set of data tables that are used to represent all types of metering data. The specification defines the data structures used to represent data involved in the configuration, control, and reading of utility meters. This does not define any process or behavior – it is strictly intended for data structure (table) definitions. It is recommended that you review the Standard before operating the JEMStar meter with ANSI Tables Protocol. Note that the Standard does not require the entire set of Data Tables to be implemented.

TABLE ORGANIZATION

ANSI Data Tables are numbered and grouped into "Decades" that are associated with a particular metering function. For example, Decade 0 (Tables 00 - 09) describes the end device (meter) configuration, identification, and procedural capabilities. Decade 1 (Tables 10 - 19) describes data sources such as device inputs, units of measure, etc.
Individual tables are built from basic data types that are also defined in ANSI C12.19. These basic types include Boolean, integer, character, and floating-point representations of various sizes. Basic types are collected into arrays, and combinations of singles and arrays are collected into tables.

COMMUNICATION METHODS

Three related ANSI Standards define the protocols for transmitting ANSI Tables over various communication channels. The JEMStar meter is fully compliant with all communication types.

- ANSI C12.18-1996, "Protocol Specification for ANSI Type 2 Optical Port"
- ANSI C12.21-1999, "Protocol Specification for Telephone MODEM Communication"
- ANSI C12.22, "Protocol Specification for Interfacing to Data Communication Networks" (unapproved draft)

ANSI Type 2 Optical Port Protocol (C12.18)

ANSI C12.18 defines the physical structure and dynamic processes required to send and receive ANSI Data Tables via an optical communications interface. The Optical Port Protocol describes how to establish a connection with the meter, negotiate communication parameters, establish user identity and privileges, perform various functions, and send and receive data tables. Since the Optical Port cannot support multiple end devices on a single connection, it makes no provision for unique device addresses.

ANSI Telephone Modem Protocol (C12.21)

ANSI C12.21 defines the dynamic processes required to send and receive ANSI Data Tables via a dial-up modem connection. C12.21 does not define the process for establishing a modem connection – it picks up responsibility for communication after the modem connection is established.
The Telephone Modem Protocol describes how to negotiate communication parameters, establish user identity and privileges, perform various functions, and send and receive data tables. Since a single modem may serve multiple meters, the Telephone Modem Protocol provides for individual end device addressing on a multidrop connection.

ANSI Network Protocol (C12.22)

ANSI C12.22 defines the dynamic processes required to send and receive ANSI Data Tables via a network connection. C12.22 is not an approved standard, but is mentioned here for future reference. At this time, there is no JEMStar implementation specifically related to C12.22.

ANSI TABLES IMPLEMENTATION IN JEMSTAR

ANSI Tables protocol is available on all JEMStar serial communication interfaces, standard or optional. You can configure a serial interface either via JEMWare configuration software or though the meter front-panel menu system. ANSI Tables protocol can be operated on one or more of the meter's serial interfaces. Using ANSI Tables on one serial port does not interfere with the use of ANSI Tables (or a different protocol) on any other port.

Optical Port

If a JEMStar is configured for ANSI Tables on the Optical port, it will automatically use the C12.18 Optical Port protocol. For connecting an Optical Adapter to the meter, refer to the section titled "Communication Ports" in Chapter 2 of this manual.

Modem Port

If a JEMStar is configured for ANSI Tables on the Modem port, it will automatically use the C12.21 Telephone Modem protocol. For connection details, refer to the section titled "Communication Ports" in Chapter 2 of this manual.

Direct-connect (RS-232 or RS-485) Port

If a JEMStar is configured for ANSI Tables on an RS-232 or RS-485 port, it will automatically use the C12.21 Telephone Modem protocol. For connection details, refer to the section titled "Communication Ports" in Chapter 2 of this manual.

Supported Data Tables

Only the following Tables are supported in the JEMStar meter. Rows shaded in gray are either undefined by the ANSI C12.19 Standard, or not supported by JEMStar.

Decade 0

Decade 0 – Device Configuration, Identification, and Procedure Tables			
Table No.	**Title**	**Description**	**Read / Write**
00.	General config	General info on end device configuration, data formats	R
01.	Manufacturer ID	Manufacturer, HW and FW revision numbers	R
02.	Device Nameplate	Nameplate data (form, class, voltage, freq, etc.)	R
03.	ED_MODE Status	Present operating mode, present error / warning status	R
04.	Pending Status	Indicates pending status of tables in the meter	
05.	Device Identification	Device serial number	R
06.	Utility Information	Utility and installation identification	R
07.	Procedure Initiate	Activate device procedures (BPR, etc.) *	W
08.	Procedure Response	Results of previous Procedure Initiate (Table 07) write	R
09.	(undefined)		

*Supported Procedures in Table 07 (Procedure Initiate)

Procedure Number	**Procedure Name**	**Description**
3	Clear Data	Erase Registers & Load Profile, retain Configuration, try to retain Event Logs
6	Change End Device Mode	Enter or Exit Test Mode
7	Clear Standard Status Flags	Clear Health Check and other status flags
9	Remote Reset	Billing Period Reset (Self Read, Season Change, and new Season not supported in this procedure)
10	Set Date and/or Time	Set Time and Date
18	Log In	Establish a user session
19	Log Out	End a user session

Decade 1

Decade 1 – Data Source Tables			
Table No.	**Title**	**Description**	**Read / Write**
10.	Dimension Sources Limiting	Maximum dimensions and end device capabilities	
11.	Actual Sources Limiting	Actual parameters configured in device	R
12.	Unit of Measure	Units of Measure, calculation methods (VA, etc.)	R
13.	Demand Control	Demand interval, subinterval, and related info	R
14.	Data Control	Data source selections (?)	R?
15.	Constants	?	R?
16.	Source Definition	Available data sources selectable by other tables (such as Table 14)	
17.	(undefined)		
18.	(undefined)		
19.	(undefined)		

Decade 2

Decade 2 – Register Tables			
Table No.	**Title**	**Description**	**Read / Write**
20.	Dimension Register Limiting	Maximum dimensions of measured data registers	
21.	Actual Register	Actual function values for registers	R
22.	Data Selection	Grouped lists of source indices into Table 16.	
23.	Current Register Data	Current Register Data	R
24.	Previous Season Data	Register Data as of most recent Season Change	R
25.	Previous Demand Reset Data	Register Data as of most recent Demand Reset	R
26.	Self Read Data	Register Data as of most recent Self Read event	R
27.	Present Register Selection	Lists of source indices into Table 16.	
28.	Present Register Data	Present demand and values selected by Table 27	
29.	(undefined)		

Decade 3

Decade 3 – Local Display Tables			
Table No.	**Title**	**Description**	**Read / Write**
30.	Dimension Display Limiting	Maximum dimensional values for local display operation	
31.	Actual Display	Actual dimensional values for local display operation	R
32.	Display Source	Select source data for local display	R?
33.	Primary Display List	Configuration of Primary display list (data, timing, scroll, etc.)	
34.	Secondary Display List	Configuration of Secondary display list (data, timing, scroll, etc.)	
35.	(undefined)		
36.	(undefined)		
37.	(undefined)		
38.	(undefined)		
39.	(undefined)		

Decade 4

Decade 4 – Security Tables			
Table No.	**Title**	**Description**	**Read / Write**
40.	Dimension Security Limiting	Maximum number of passwords and security access levels in end device	
41.	Actual Security Limiting	Actual number of passwords and security access levels in end device	R
42.	Security	Passwords; Read, Write, and Execute permission flags	R?
43.	Default Access Control	Default table and procedure access permissions (for tables not included in Table 44)	R?
44.	Access Control	Table and procedure access permissions for tables not using default access control	R?
45.	Key	Authentication and / or encryption keys	R?
46.	(undefined)		
47.	(undefined)		
48.	(undefined)		
49.	(undefined)		

Decade 5

Decade 5 – Time and TOU Tables			
Table No.	**Title**	**Description**	**Read / Write**
50.	Dimension Limiting Time and Time of Use	Maximum capabilities for Date & Time and TOU control	
51.	Actual Time and TOU Limiting	Actual capabilities for Time & Date and TOU control	R
52.	Clock	Real time clock	R
53.	Time Offset	Time zone offset and DST information	R
54.	Calendar	Schedule definition table for TOU	
55.	Clock State	Real time clock information	R?
56.	Time Remaining	Predictive time quantities	
57.	(undefined)		
58.	(undefined)		
59.	(undefined)		

Decade 6

Decade 6 – Load Profile Tables			
Table No.	**Title**	**Description**	**Read / Write**
60.	Dimension Limiting Load Profile	Maximum capabilities of Load Profile	
61.	Actual Load Profile Limiting	Actual Load Profile capabilities	R
62.	Load Profile Control	Data sources and formats used In Load Profile	R
63.	Load Profile Status	Status of each Load Profile data set	R?
64.	Load Profile Data Set 1	Load Profile data information, set 1	R
65.	Load Profile Data Set 2	Load Profile data information, set 2	
66.	Load Profile Data Set 3	Load Profile data information, set 3	
67.	Load Profile Data Set 4	Load Profile data information, set 4	
68.	(undefined)		
69.	(undefined)		

Decade 7

Decade 7 – History and Event Logs			
Table No.	**Title**	**Description**	**Read / Write**
70.	Limiting Log Dimensions	Maximum size and capabilities of History and Event Logs	
71.	Actual Log Dimensions	Actual size and capabilities of History and Event Logs.	
72.	Event Identification	Events supported by end device	
73.	History Log Control	Defines History Log codes to be written to History Log.	
74.	History Log Data	The History Log contents	
75.	Event Log Control	Defines Event Log codes to be written to the Event Log.	
76.	Event Log Data	The Event Log contents	
77.	(undefined)		
78.	(undefined)		
79.	(undefined)		

Decade 8

Decade 8 – User Defined Tables			
Table No.	**Title**	**Description**	**Read / Write**
80.	Dimension Function Limiting	Maximum values and control parameters for user-defined tables.	
81.	Actual Function Limiting	Actual values and control parameters for user-defined tables.	
82.	List	Data elements used in the generation of user defined tables.	
83.	Selection	Selects data elements used in user-defined tables.	
84.	First User Defined	User defined table 1	
85.	Second User Defined	User defined table 2	
86.	Third User Defined	User defined table 3	
87.	Fourth User Defined	User defined table 4	
88.	Fifth User Defined	User defined table 5	
89.	Sixth User Defined	User defined table 6	

Decade 9

Decade 9 – Telephone Control			
Table No.	**Title**	**Description**	**Read / Write**
90.	Dimension Telephone Limiting	Maximum dimensions for telephone control data	
91.	Actual Telephone Limiting	Actual dimensions for telephone control data	
92.	Global Parameters	General parameters for call answer and originate	
93.	Originate Communication Parameters	Call originate parameters	
94.	Originate Schedule	Call out schedule	
95.	Answer Communication Parameters	Call answer parameters	
96.	Call Purpose	Reason for most recent call out	R
97.	Call status	Progress of most recent calls to each phone number	
98.	(undefined)		
99.	(undefined)		

GLOSSARY

Apparent Power
The product of the applied voltage and current in an ac circuit. Apparent power, or volt-amperes, is not the real power of the circuit because the power factor is not considered in the calculation. JEMStar calculates Apparent Power $= \sqrt{Watts^2 + VARs^2}$

ARO
At Rated Output

Average Power Factor
The ratio of kilowatt-hour pulses to computed equivalent kVAh pulses for the billing period.

Billing Period
The period of time (commonly a month) between readings of a meter, when those readings are used for billing a power customer. Also, the period of time between two consecutive demand resets.

Billing Period Reset (BPR)
A task commonly associated with the Billing Read is the Billing Period Reset. The Reset causes a "snapshot" of register readings to be copied to storage as well as clearing Peak Demand readings and updating Cumulative and Continuous Cumulative readings. You must break a seal to perform a Billing Period Reset on the front panel. The Reset is recorded in the Billing Period Reset event buffer.

Billing Read
A Billing Read is the task of reading billing information from the meter front panel. If the billing information is required to be available to anyone, it can be programmed into the Normal display list (See "Casual" Read).

Burden
Load imposed by a device on an input circuit, expressed in ohms or VA.

"Casual" Read
A "casual" read is the ability to see measurements on a sealed, functioning meter without breaking a seal or otherwise violating the meter's security. The type and amount of information available during a casual read can be selected by the meter setup programmer using JEMWare.
For example, any non-secure readings may be placed in the Normal display list. If nothing is to be displayed to unauthorized users, the programmer may place the Blank or Segment Check display items in the Normal list. Consult the JEMWare user's manual for full configuration details.

Class; Class Amps
The maximum current for which a meter is specified to operate within its accuracy rating.

Daily Schedule
The daily schedule is an array of times and rates, and it determines the moment at which a TOU period changes.

Demand

The average of some measurement over a defined period of time, traditionally calculated by accumulating the integrated measurement over the defined period (the "demand interval") and dividing by the time.

Demand Deferral
A period immediately following a power outage during which demands are not calculated. It is determined by the number of demand-interval closures following the power outage.

Demand Prediction
An optional feature that calculates and displays the Demand value expected at the end of the present demand interval *before* the interval is completed. Demand Predictions may be used to monitor a load in order to prevent setting a new Peak Demand.

Demand Reset
A scheduled or user-initiated event that causes maximum demands to be zeroed and certain other calculations to occur.

DNP
Distributed Network Protocol: a serial communication protocol used in instrument networking. See Appendix D.

Element
A voltage and current input pair to a meter or transducer, typically from the same phase. A half element takes advantage of mathematical relationships present in a three phase power system to eliminate the need for one voltage measurement.

Full Scale
A reference condition corresponding to the highest rated value of a given measurement. For watts, this condition occurs at the user's input voltage, class current rating, and unity power factor. For VARs, full scale is at the user's input voltage, class current, and zero power factor.

Health / Status Read
A Health and Status Read is concerned with evaluating the correct operation of the meter and its installation, not its billing data. Health and Status display items may be programmed into either Normal or Alternate display lists at the user's discretion.

Holiday
For TOU purposes, a holiday is a date contained in the holiday schedule.

Holiday Schedule
A holiday schedule is an array of dates (in seconds time format at midnight) within the TOU schedule that enables the meter to identify holidays.

Instantaneous Quantities
Instantaneous quantities are short-term average or RMS measurements of electrical characteristics in a circuit. Instantaneous quantities are suitable for developing Instantaneous Register, Thermal Demand, or analog outputs.

Integrated Quantities

Integrated quantities are power measurement quantities that are integrated over time, and which may be accumulated. Integrated quantities are used for developing Consumption, Fixed or Sliding Window Demand (Peak or Coincident), Load Profile, or pulse outputs.

Interval
A period over which a demand is calculated consisting of one or more subintervals.

IRLED
Infrared light-emitting diode, such as the optical port on the *JEMStar* meter.

KYZ
A meter output that indicates energy by toggling a Form-C contact output at a frequency proportional to power flow. Each transition represents some constant amount of energy (typically referred to as Ke, "energy constant") that has been consumed. *JEMStar* mimics this function by allowing the user to configure two solid-state contact outputs into a similar arrangement.

Leading Zero(es)
The main section of the meter's LCD readout can be configured (with JEMWare) to fill in unused display digits with either blanks or zeros. "Leading Zeroes" inserts "0" digits to the left of the most significant digit until all display positions are filled (there can be 6 or 8 digit positions, depending upon user-configuration).

LLC
Line Loss Compensation: the ability of an instrument to measure or calculate the power lost in an imperfect conductor and to use that figure to modify its power or energy readings.

Liquid Crystal Display (LCD)
Display area on the meter face that contains alpha-numeric characters for data readout.

Load Linearity
Specifies the maximum deviation of performance in percent registration over a range of current (load) assuming all other conditions at nominal reference conditions.

Load Profile
A record of energy consumption stored periodically (typically every 1 to 60 minutes) and sequentially. Each stored "interval" (one record) contains one or more "channels" (a single integrated quantity accumulated during the interval just ended).

(Load Profile) Periodic Special Event
The meter stores pulses accumulated since the time of the previous LP interval closure.

Load Profile Interval
An LP interval is the period between two consecutive LP interval closures.

Load Profile Record
An LP record is the data in a segment of load-profile memory where the accumulated pulses from a single LP interval are stored.

Loss Compensation
A generic term used to include both TLC and LLC.

Measurement Quantity
A single measurable characteristic of power flow in a circuit, or a commonly used combination of measurement quantities. E.g. Volts Phase A, Watthours Delivered Total.

MODBUS™
A standard serial communication protocol used by programmable controllers.

Null Modem
Cable that emulates a modem to enable the connection of two DTE (data terminal equipment) devices such as any two devices that would communicate with a modem (DCE) device.

Partial Load Profile Count
The total accumulated counts within an interval after the last special event or load- profile interval closure.

Past Interval Demand
The demand for the most recently ended demand interval.

Peak Demand
(a.k.a. Maximum Demand) The highest demand reading in a Billing Period.

Phase
The timing relationship between two signals of the same frequency, expressed as an angle. E.g. the delay between voltage and current waveforms in an AC circuit, or between voltage waveforms in different circuits.

One of (usually) three circuits in a polyphase power distribution system. Each phase may be treated as an individual power source that is synchronized to the other phases in the system.

Polyphase
The sum, average, or combination (as appropriate) of measurements from all phases input to a meter.

Power Factor (PF)
The ratio of the real power (watts) to the apparent power (volt-amperes). PF is equal to the cosine of the phase angle between voltage and current.

Present TOU Period
The one Time Of Use period that the meter determines to be active at the present time. This is determined by the present date and time of the meter and the TOU schedule.

Pulse
A state change in either direction of a binary metering signal.

Register
Used to refer to specific quantities to be displayed or retrieved.

Register Assembly
The term used to refer to the hardware implementation of the display or control of the I/O functions of the meter.

RMS
Root Mean Square: the equivalent DC value of a periodic (AC) signal. 5 amps RMS delivers the same amount of power to a given load as 5 amps DC.

Rolling Interval/Sliding Window
A demand measurement consisting of the summation of values calculated over multiple consecutive subintervals. A calculation is updated at the completion of each subinterval, but includes a defined number of previous subintervals.

Season
A season is a range of dates whose start date is contained in the season schedule in seconds time format.

Season Schedule
A season schedule is an array of dates within the TOU schedule that enables the meter to identify the seasons.

Seconds Time Format
A 32-bit number in units of seconds referenced from January 1, 1990.

Special Event
An event stored in load-profile data such as a register freeze, power fail, time set, etc.

Storage Register
A copy of a quantity which could be a displayable register and is saved when triggered by a demand reset.

Subinterval
The increment of time in which demand calculations are updated.

T_A
Test Amperes; equal to ½ Class Amps

THD
Total Harmonic Distortion: a measure of the amount of harmonic content in a periodic signal, expressed as a percentage. A pure sine wave at the fundamental frequency has 0% THD.

Thermal Demand
A measurement filtered through a time delay such that step changes in the measurement are reflected slowly in the output. Commonly used to simulate the effects of current heating on power distribution equipment.

Thermal Time Characteristic
The time required for a Thermal Demand Register to reflect 90% of a step change in input. Similar to the time characteristic of mechanical thermal demand meters.

Threshold Alarms
JEMStar can be configured to monitor any Register and (if the proper option module is installed) generate a contact closure output based on the register's value. *JEMStar* compares the selected Register against the setpoints once per second.

The user can configure these characteristics:

- The register to compare against the thresholds
- The upper threshold (set point)
- The lower threshold (reset point)

Time
Time indicates hours, minutes, and seconds.

TLC
Transformer Loss Compensation: the ability of an instrument to measure or calculate the power lost in an imperfect transformer and to use that figure to modify its power or energy readings.

Total Registers
Those *JEMStar* registers that are not TOU registers are called total registers. The total registers always are active.

TOU Period
A selected duration of time during which the consumption, demand, and other information are assigned to a set of Time Of Use registers.

TOU Rate Indicator Output
A display segment that indicates the present TOU rate in effect.

TOU Register
A TOU register is a register of the *JEMStar* meter that, for a designated TOU period, accumulates and may display amounts of electrical energy, demand, or other quantities measured or calculated.

TOU Schedule
The TOU schedule is a static, externally configured database within the meter. The data base contains information that allows the meter to determine the present TOU period based upon the real date and time of the meter.

VA
Volt Amperes or Volt Amps: the product of voltage and current in a circuit regardless of phase. Typically expressed in RMS units, this is also called "apparent" power. JEMStar calculates VA vectorially.

$VA = \sqrt{Watts^2 + VARs^2}$

VAh
VA hour: VA integrated over time to produce a measurement that may be accumulated.

VAR
Volt Amps Reactive: the product of voltage and current in a circuit, times the sine of the phase shift between the two. Typically expressed in RMS units. The unit of "reactive" or "imaginary" power.

VARh
VAR hour: VAR integrated over time to produce a measurement that may be accumulated.

W
Watt: the product of voltage and current in a circuit, times the cosine of the phase shift between the two. Typically expressed in RMS units. The unit of "real" power.

Wh
Watt-hour: W integrated over time to produce a measurement that may be accumulated.

PROCEDURES FOR FACTORY REPAIR AND RETURN

A. Obtain a Returned Material Authorization (RMA) number by calling the AMETEK Repair Department and giving the following information:

1. ***Model*** and ***Serial Number*** of the equipment.
2. Failure Symptom - **Be Specific**
3. Approximate date of installation.
4. The site name and address of the failed equipment.
5. Complete shipping information for the return of the equipment if other than the operating site.
6. Name and telephone number of person to contact if questions arise.

B. Enclose the information with the equipment and pack in a commercially accepted shipping container with sufficient packing material to insure that no shipping damage will occur. Mark the outside of the container with the RMA number.
Ship to the appropriate location:

Attention: Repair Department

AMETEK Power Instruments
255 North Union Street
Rochester, New York 14605 USA
Telephone: (888) 222-6282
Fax: (585) 238-4945

C. Your equipment will be tested, repaired, and inspected at the factory. Normal factory turn-around is ten working days or less (excluding shipping time).

WARRANTY — AMETEK warrants equipment of its own manufacture to be free from defects in material and workmanship, under normal conditions of use and service. AMETEK will replace any component found to be defective, upon its return, transportation charges prepaid, within five years of its original purchase. AMETEK will extend the same warranty protection on accessories that is extended to AMETEK by the original manufacturer. AMETEK assumes no responsibility, expressed or implied, beyond its obligation to replace any component involved. Such warranty is in lieu of all other warranties expressed or implied.