



JEMSTAR II

Digital Multifunction IEC 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.

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GENERAL INFORMATION

OVERVIEW

The JEMStar II Digital Power Meter is a multifunction electricity meter for use in revenue & billing, energy management and power quality applications. This manual is for the IEC version of the JEMStar II.

JEMStar II incorporates features common to modern electronic polyphase meters including:

- Real and reactive power and energy measurement
- Display of consumption, demand, and "instantaneous" registers
- Load Profile data collection and storage
- Multiple communication options for remote retrieval of registers and Load Profile data, as well as programming
- Time of Use metering
- Digital inputs and outputs
- Loss Compensation (Transformer and Line)
- Voltage and Current Transformer Gain Correction
- Field Diagnostics
- Power Quality monitoring
- Demand prediction
- Alarm outputs
- Wide Voltage range (55 – 300V)
- Self power or external aux power
- 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 II:

- **JEMWare II** Configuration software for setting up the meter's operation.

It is also used to read the meter's registers and load profile data, retrieve meter events and display site conditions via phasor diagram. The JEMWARE II Software can be used offline or online while connected to a meter.

- **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[™] 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.

Display Navigation & Menus

On power up, the JEMStar II meter displays the AMETEK Power Instruments welcome screen. After a predetermined time, it begins scrolling register displays.

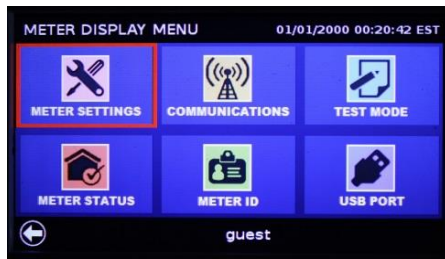
Display Scrolling:

During normal operation, the display scrolls the registers. The meter display can show from 1 to 4 registers per display screen. The scroll rate is selectable using the JEMWare II software.



Meter Display Menu:

Pressing the Left front arrow button will invoke the Meter Display Menu. The red perimeter around a menu item indicates it is selected. Meter Settings is the default starting location. To enter or select the menu item, press the Set button in the center of the navigation keys. To exit any menu, navigate to the Left arrow on the display and press Set. Or press the Read button.



Meter Settings:

To enter, press Set. Using this menu you can configure features such as: Date/Time, PT/CT, I/O and Register Presets.



Communications:

From the Meter Display Menu press the Right arrow once. And press Set. This will invoke the Communications menu where you can configure the ports.



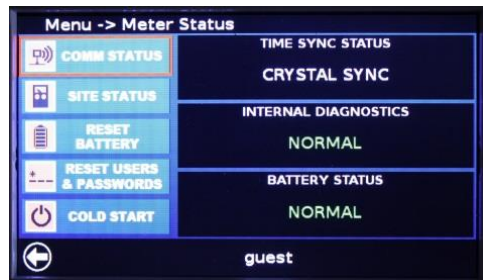
Test Mode:

From the Meter Display Menu press the Right arrow twice. Press Set. This will invoke the Test Mode menu where you can configure various tests.



Meter Status:

From the Meter Display Menu press the Down arrow once. Press Set. This will invoke the Meter Status menu where you can check the Comm and Site Status, check the battery state, reset users and passwords and do a cold start.



Meter ID:

From the Meter Display Menu, press the Down and Right arrow once each. Press Set. This will invoke the Meter ID menu where you can view the identification and firmware version.



Unlocking the Meter

Refer to the Meter Display Menu and Meter Settings menus.

Before you can change any configuration parameters, the meter must be unlocked.

This is accomplished from the configuration screen you wish to make a change to.

Log-in to the Meter:

To change a configuration item from the meter display menu, you need to log in to the meter with the correct username and password



TECHNICAL DESCRIPTION

JEMStar II 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
- Date & Time
- Cumulative Registers
- Continuous Cumulative Registers
- Firmware Version
- Health Status.

JEMStar II also has Time-Of-Use (TOU) capabilities, and most registers can be associated with a particular TOU rate.

The meter has an internal pulse recorder for storing load-profile data. The standard meter provides enough memory to store 16 channels of recorded data in 15-minute intervals for up to 365 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). [see Load Profile charts in the Advanced Features section for more detail.] 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 and Ethernet using JEMWare II or JEMRead™ software. Optionally, a custom Translation Interface Module (TIM) is available for the popular MV-90™ software supplied by Itron, Inc. The JEMStar II 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 optional communication board (RS-232, RS-485, Ethernet, internal modem). The meter has multiple levels of password protection with assignable privileges to accommodate read-only applications.

JEMStar II is software configurable using JEMWare II™. 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 II instruction manual 1079-699 for details on all the different parameters that can be programmed into the JEMStar II.

Event Recording

JEMStar II maintains records of certain events independent of the Load Profile features. JEMWare II or 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

All recorded events include the following information:

- Type of event description
- 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. **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. **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.
- **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 is recorded with the time at which it occurred.
- **Site Monitoring: Billing Period Reset:** Each Billing Period Reset event 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:** Each configuration event 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 500 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 as 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 II 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 II Model Number

You build a model number by selecting options from each selection.

JEMStar II Base Meter				Communication and I/O Options			Additional Options		Power Quality		
Meter Form	Enclosure	Frequency	Current Input	Communication Options		I/O Options		Comms, Power, Measurement			
05 = Form 5 3 phase, 3 wire Delta	I = IEC RK = 19" Rack	50 = 50Hz	02 = 1 Amp (0.001 to 2A)	0	None	0	None	0	= No Additional Options	0	= No Additional Options
		60 = 60Hz	10 = 5 Amp (0.002 to 10A)	1B	Dual Serial: RS-232/485	DIO	Internal D I/O	MID	= MID Certification		
09 = Form 9 3 phase, 4 wire Wye			20 = 10 Amp (0.002 to 20A)	2A	Single Ethernet Port	DIOP	Internal D I/O w/PS	Ethernet Options		Power Quality Options	
				3A	Dual Ethernet Port	You can select 1 each of Items: DIO or DIOP		WEB	= WEB server	PQ	PQ Ready
U = Universal Form 5/9 3 phase, 4 wire Wye 3 wire Delta				You can select 1 each of Items: 1,2,3 (Ex. 1B/2A/3A)		IEC Meters: 8 Channel Input/Output		IEC	= IEC 61850 Protocol	Meter can be upgraded in the field for a future PQ Option	
						7 channels selectable as inputs/outputs. 1 channel fixed as input only.		DLMS	= DLMS Protocol	PQ1	PQ Basic
								Measurement Recording Options		High Speed RMS	
								DLP	= Dual 16 ch Load Profile	PQ2	PQ Advanced
								ML	= Measurement Logging (8x50 channels)	Waveform capture, Harmonic Recording, Flicker (includes Measurement Logging)	
								IB	= IIRIG-B (19" Rack only)	PQ3	PQ Max
								EAP	= Ext Aux Power Power as primary with Self Power as backup (default is Self Power as primary and Ext Aux power as backup)	PQ Basic and PQ Advanced	

Typical Model Number

JSII-09I5010-1B/2A/3A-DIOP-DLMS-PQ

JS	JEMStar Meter
09	Form 9
I	IEC Meter
50	50 Hz
10	5 Amp Current Input (0.002-10A)
1B/2A/3A	Dual serial, single Ethernet, Analog Modem
DIOP	8 Channel I/O w/ power supply
DLMS	DLMS Protocol
PQ	PQ Ready

JEMStar II IEC Model Number			
JEMStar II Base Meter			
Meter Form	Enclosure	Frequency	Current Input
05 = Form 5 <i>3 phase, 3 wire Delta</i>	I = IEC	50 = 50Hz	02 = 1 Amp (0.001 to 2A)
	RK = 19" Rack	60 = 60Hz	10 = 5 Amp (0.002 to 10A)
09 = Form 9 <i>3 phase, 4 wire Wye</i>			20 = 10 Amp (0.002 to 20A)
U = Universal Form 5/9 <i>3 phase, 4 wire Wye 3 wire Delta</i>			

Communication and I/O Options			
Communication Options		I/O Options	
0	None	0	None
1B	Dual Serial: RS-232/485	DIO	Internal D I/O
2A	Single Ethernet Port	DIOP	Internal D I/O w/PS
2B	Dual Ethernet Port	You can select 1 each of Items: DIO or DIOP	
3A	Internal Analog Modem	IEC Meters: 8 Channel Input/Output 7 channels selectable as inputs/outputs. 1 channel fixed as input only.	
You can select 1 each of Items: 1,2,3 (Ex. 1B/2A/3A)			

Additional Options	Power Quality
Comms, Power, Measurement	
0 = No Additional Options	0 = No Additional Options
MID = MID Certification	
Ethernet Options	Power Quality Options
WEB = WEB server	PQ <u>PQ Ready</u> Meter can be upgraded in the field for a future PQ Option
IEC = IEC 61850 Protocol	
DLMS = DLMS Protocol	
NTP = NTP Time Sync	PQ1 <u>PQ Basic</u> High Speed RMS
Measurement Recording Options	
DLP = Dual 16 ch Load Profile	PQ2 <u>PQ Advanced</u> Waveform capture, Harmonic Recording, Flicker (includes Measurement Logging)
ML = Measurement Logging (8x50 channels)	
IB = IRIG-B (19" Rack only)	
EAP = Ext Aux Power as primary with Self Power as backup (default is Self Power as primary and Ext Aux power as backup)	PQ3 <u>PQ Max</u> PQ Basic and PQ Advanced

SPECIFICATIONS

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

Meter Forms

Form Number	Type
Form 5	2 Element [2PTs, 2CTs] (3 phase, 3 wire Delta)
Form 9	3 Element [3PTs, 3CTs] (3 Phase, 4 wire Wye)
U (Universal)	2 Element [2PTs, 2CTs] (3 phase, 3 wire Delta)
	3 Element [3PTs, 3CTs] (3 Phase, 4 wire Wye)

Current Classes

2 Amp	(.001 – 2A)	1 Amp Nominal, 2A max
10 Amp	(.002 – 10A)	5 Amp Nominal, 10A max
20 Amp	(.002 – 20A)	10 Amp Nominal, 20A max

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.

Instantaneous quantities

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

JEMStar II measures the following instantaneous quantities:

Uncompensated Quantities

JEMStar II 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.

Input Range Limits and Burdens

Current Inputs and Burden

Class 2

- Starting Current: 0.001 A
- Operating Range: 0.001 to 2A
- Maximum Overload with accuracy: 2.2A
- Maximum Continuous Overload without damage : 3A
- Burden: < 0.5VA @ 2A

Class 10, 20

- Starting Current: 0.002A
- Operating Range: 0.002 to 20A
- Maximum Overload with accuracy: 22A
- Maximum Continuous Overload without damage 30A
- Burden: < 0.5VA @ 10A
< 0.5VA @ 20A

Voltage Inputs and Burden

Operating Range	3 Phase: 45 to 300 Vac (L-N) 78–520 Vac (L-L)
Maximum Overload	550 Vac L-L
Burden	<5.0 VA @ 300V

Current Overload

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

Auxiliary Power and Burden

45–300VAC L-N or 90–300VDC externally powered via terminals
Maximum burden of 25VA.

Operating Frequency Range

45–55 Hz or 55–65 Hz

Clock

50/60 Hz

AC Line frequency can be used as time synchronization input

When the AC line sync is selected, it will be used as a backup time sync whenever there is no other external time sync connected.

Internal Crystal

The internal crystal will be used whenever there is no external time sync methods used.

Accuracy: 0.5 sec/day

NTP (option)

Internal clock can be synchronized by up to three NTP Servers. Must have Ethernet option in the meter.

Accuracy

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

V_{INPUT} = Nominal Input Voltage

I_{max} = I_{CLASS} = Meter Class Current (maximum current)

I_n = Rated current (Reference Current)

Full Scale = $I_{CLASS} \times V_{INPUT}$

Class 10 and 20:				
Watthours	Class 10 Input Current	Class 20 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
(per phase, polyphase total)	0.5 to 10 A	0.5 to 20 A	0.05 % RD (0.01% RD typ)	0.07 % RD (0.01% RD typ)
	0.1 to 0.5 A	0.1 to 0.5 A	0.15 % RD	0.2 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.2 % RD	0.35 % RD
VARhours	Class 10 Input Current	Class 20 Input Current	Accuracy (PF=0)	Accuracy (PF=0.5 lag)
(per phase, polyphase total)	0.2 to 10 A	0.2 to 20 A	0.1 % RD	0.15 % RD
	0.1 to 0.2 A	0.1 to 0.2 A	0.2 % RD	0.25 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.3 % RD	0.35 % RD
VAhours, Qhours	Class 10 Input Current	Class 20 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
(per phase, polyphase total)	0.2 to 10 A	0.2 to 20 A	0.1 % RD	0.15 % RD
	0.1 to 0.2 A	0.1 to 0.2 A	0.2 % RD	0.25 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.3 % RD	0.35 % RD
Volts²hours	Class 10 Input Current	Class 20 Input Current	Accuracy	
(per phase, polyphase total)	0 to 10 A	0 to 20 A	0.1 % RD	
AMP²hours	Class 10 Input Current	Class 20 Input Current	Accuracy	
(per phase, polyphase total)	0.3 to 10 A	0.3 to 20 A	0.5 % RD	
	0.1 to 0.3 A	0.1 to 0.3 A	2.0 % RD	
AMPhours	Class 10 Input Current	Class 20 Input Current	Accuracy	
(per phase, polyphase total)	0.3 to 10 A	0.3 to 20 A	0.1 % RD	
	0.1 to 0.3 A	0.1 to 0.3 A	0.2 % 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	0.1 % RD	0.12 % RD
	0.1 to 0.5 A	0.1 to 0.5 A	0.2 % RD	0.25 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.25 % RD	0.4 % RD
Instantaneous Vars (per phase, polyphase total)				
	Class 10 Input Current	Class 20 Input Current	Accuracy (PF=0)	Accuracy (PF=0.5 lag)
	0.2 to 10 A	0.2 to 20 A	0.15 % RD	0.2 % RD
	0.1 to 0.2 A	0.1 to 0.2 A	0.25 % RD	0.3 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.35 % RD	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)
	0.2 to 10 A	0.2 to 20 A	0.15 % RD	0.2 % RD
	0.1 to 0.2 A	0.1 to 0.2 A	0.25 % RD	0.3 % RD
	0.05 to 0.1 A	0.05 to 0.1 A	0.35 % RD	0.4 % RD

Instantaneous Amps (per phase, polyphase total)	Class 10 Input Current	Class 20 Input Current	Accuracy
	0 to 10 A	0 to 20 A	0.04 % RD + 0.025 % Iclass
	0.15 to 10 A	0.15 to 20 A	0.4 % RD

Instantaneous Amps² (per phase, polyphase total)	Class 10 Input Current	Class 20 Input Current	Accuracy
	0.3 to 10 A	0.3 to 20 A	0.5 % RD
	0.1 to 0.3 A	0.1 to 0.3 A	2.0 % RD

Class 2:			
Watthours (per phase, polyphase total)	Class 2 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
	0.1 to 2 A	0.1 % RD	0.2 % RD
	0.05 to 0.1 A	0.2 % RD	0.3 % RD
	0.015 to 0.05 A	0.4 % RD	0.6 % RD
Varhours (per phase, polyphase total)			
	Class 2 Input Current	Accuracy (PF=0)	Accuracy (PF=0.5 lag)
	0.1 to 2 A	0.15 % RD	0.2 % RD
	0.025 to 0.1 A	0.4 % RD	0.5 % RD
	0.01 to 0.025 A	0.8 % RD	0.9 % RD

VAhours, Qhours (per phase, polyphase total)	Class 2 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
	0.1 to 2 A	0.15 % RD	0.2 % RD
	0.025 to 0.1 A	0.4 % RD	0.5 % RD
	0.01 to 0.025 A	0.8 % RD	0.9 % RD
<hr/>			
Volts²hours (per phase, polyphase total)	Class 2 Input Current	Accuracy	
	0 to 2 A	0.1 % RD	
<hr/>			
AMP²hours (per phase, polyphase total)	Class 2 Input Current	Accuracy	
	0.03 to 2 A	0.5 % RD	
	0.01 to 0.03 A	2.0 % RD	
<hr/>			
AMPhours (per phase, polyphase total)	Class 2 Input Current	Accuracy	
	0.1 to 2 A	0.3 % RD	
	0.01 to 0.1 A	2.0 % RD	
<hr/>			
Instantaneous Watts (per phase, polyphase total)	Class 2 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
	0.1 to 2 A	0.15 % RD	0.25 % RD
	0.05 to 0.1 A	0.25 % RD	0.35 % RD
	0.015 to 0.05 A	0.45 % RD	0.65 % RD
<hr/>			
Instantaneous Vars (per phase, polyphase total)	Class 2 Input Current	Accuracy (PF=0)	Accuracy (PF=0.5 lag)
	0.1 to 2 A	0.2 % RD	0.25 % RD
	0.025 to 0.1 A	0.45 % RD	0.55 % RD
	0.01 to 0.025 A	0.85 % RD	0.95 % RD
<hr/>			
Instantaneous VA, Q (per phase, polyphase total)	Class 2 Input Current	Accuracy (PF=1)	Accuracy (PF=0.5 lag)
	0.1 to 2 A	0.2 % RD	0.25 % RD
	0.025 to 0.1 A	0.45 % RD	0.55 % RD
	0.01 to 0.025 A	0.85 % RD	0.95 % RD

Instantaneous Amps (per phase, polyphase total)	Class 2 Input Current	Accuracy
	0 to 2 A	0.04 % RD + 0.025 % Iclass
	0.025 to 2 A	0.4 % RD

Instantaneous Amps ² (per phase, polyphase total)	Class 2 Input Current	Accuracy
	0.03 to 2 A	0.5 % RD
	0.01 to 0.03 A	2.0 % RD

Class 2, 10, 20			
Instantaneous Volts (per phase, polyphase total)	Class 2	Class 10	Class 20
	0.04% RD	0.04% RD	0.04% RD
Instantaneous Volts ² : (per phase)	Class 2	Class 10	Class 20
	0.15 % RD	0.15 % RD	0.15 % RD

Frequency (phase A)	Class 2	Class 10	Class 20
	0.001 Hz	0.001 Hz	0.001 Hz
Instantaneous Power Factor (per phase)	Class 2	Class 10	Class 20
	0.002 % * (FS / VA)phase	0.002 % * (FS / VA)phase	0.002 % * (FS / VA)phase
Instantaneous Power Factor:	Class 2	Class 10	Class 20
Form 5 (system)	0.002 % * (2FS / VA)phase	0.002 % * (2FS / VA)phase	0.002 % * (2FS / VA)phase
Form 6, 8/9 (system)	0.002 % * (3FS / VA)phase	0.002 % * (3FS / VA)phase	0.002 % * (3FS / VA)phase
Volts THD: (system)	Class 2	Class 10	Class 20
	0.5 % RD	0.5 % RD	0.5 % RD
Amps THD: (system)	Class 2	Class 10	Class 20
	0.5 % RD	0.5 % RD	0.5 % RD

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 "compensated" in JEMWare II 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 0.05% 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 0.1%.

See the JEMWare II User Manual (document 1079-699) for details on how to select a register as "uncompensated."

Meter Power

Provided by 3 phase voltage inputs and Aux Power Supply (Primary/Backup Power Supply)

Default	3 Phase Voltage Inputs as Primary and automatic transfer to Aux Power
Option EAP	Aux Power Supply as Primary and voltage inputs as back-up

Note: Meter must be initially powered up with the primary power supply

Power Requirements:	
Voltage Inputs	45-300VAC L-N
Aux Power Input	55-300VAC L-N or 90-300VDC

Meter Power Burden:	25 VA maximum
Power Factor Influence:	Maximum additional error due to power factor influence is $\pm 0.002\%$ /P.F. for P.F. less than 0.5.

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:	0.5 seconds per day maximum error.

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

Test Outputs

Type	IR LED test pulse output provided through the optical port transmitter; emits bidirectional (delivered or received energy) Wh pulse when meter is in Normal mode, test pulse based on displayed register when in Test mode.
------	---

Digital Inputs/Outputs

8 Channels
 7 channels are user configurable for either an input or output; 1 channel fixed as Input only
 When configured as an input the channel shall have the following requirements:
 Form A
 Maximum voltage 40 VDC
 1 mS time accuracy
 Ability to capture 100 transitions per second
 * An optional isolated 24Vdc supply is available to be used for a contact input wetting voltage

When configured as an output the channel shall have the following requirements:

Selectable as Form A or KYZ

Maximum 200 Vdc, or 200 V peak AC @ 50mA contact rating

Ability to transmit 25 transitions per second

Registers

50 Normal, 50 Alternate and 50 Test Registers

Instantaneous

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 (Integrated Values)

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, Wh Net, Wh Absolute, VARh Del, VARh Rec, VARh Net, VARh Absolute, VAh Del, VAh Rec, VAh Net, VAh Absolute, VARh per quadrant, Ah, Qh Del, Qh Rec, V ² h, A ² h
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 any communication port

Average Power Factor

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)

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 any communication port

Peak Demand

Displayed Quantities

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 any communication port

Coincident Power Factor

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

Thermal Demand

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

Periodic Self-Read

Records Displayed Date and time of the Self Read
Health Status summary
Up to 16 Registering quantities (8 normal and 8 alternate register values)

Storage Up to the 96 most recent Self Read records

Configurable for: – Every Demand (Sub)Interval Closure
– hourly, daily, weekly, monthly
– Every Billing Period Reset

MID Registers (Meters with MID Option)

Displayed Quantities:
Polyphase Whr delivered, Whr Received, VARhr Delivered, VARhr Received

ID, Status

Items Meter status, Alarm display, communication status, last BPR status, last freeze status, last season status, meter ID strings, firmware versions, phasor display

Power Quality (with options PQ2, PQ3)

Items Flicker, Harmonics (THD), TDD, Crest Factor, Sequence
Measurements

Ext Input

Items Status Input, Pulse Counter

Status Word

Items System Bit, Trigger Bit

Time Of Use (TOU)

- 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

Totalization

Characteristics

- Special-purpose Consumption registers
- Displayed quantities, scaling, preset, and register retrieval are identical to Consumption registers.

Load Profile

16 Channels of Storage (additional 16 Channels available as an option)

Available Measurements:

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, A², V², A²h, V²h, Q, Qhr, , Status Word

- Up to 32 channels of storage (16 standard)
can store 365 days x 32 channels @ 15 minute intervals
- Programmable interval length (1, 2, 3, 4, 5, 6, 10, 12, 15, 30, and 60 minutes, daily, weekly, monthly); independent of Demand Interval

Meter Memory

1GB NAND Flash (Non Volatile), 2GB RAM (Volatile)

The JEMStar II uses a combination of non-volatile NAND Flash memory, RAM (volatile memory) and battery backed memory. The distribution of memory for various functions is described below:

- Meter Configuration - Stored in non-volatile memory the moment it's loaded into the meter
- Register Measurements - Stored in non-volatile memory every 10 minutes or directly after a Freeze command. Battery backed memory used to temporarily store measurements since the last write.

Load Profile Data -	Stored in non-volatile memory after an interval has completed. Battery backed memory used to temporarily store load profile data since the last interval write.
Event Logs -	Stored in non-volatile memory after an event occurs.
Power Quality Data -	Stored in non-volatile memory at the completion of every event.
Clock -	The meter's internal clock saves the time and date using battery backed memory. If power is removed from the meter and the battery is dead (or removed), the time will revert to midnight, January 1, 1970 upon power up.

Communication Ports

Optical (Port 1)

- Front panel mounted
- Mating Sensor can be attached with the meter cover installed (magnetic type), or cover removed (hanging type)
- Complies with IEC 62052-11
- JEM Binary Protocol, DLMS
- User configurable for 300 – 19200 baud
- Primarily used for calibration, verification and configuration

RS-232/485 (Port 3, 4) (optional)

Dual Serial Ports. Configurable as RS-232 or RS-485

RS-232

- Supports Tx, Rx, Gnd, and RTS signals
- Half duplex operation
- Configurable for 300 – 115,200 baud
- Mutually exclusive with RS-485 option (Ports 3,4)
- Configurable for JEM Binary, DLMS, Modbus, DNP, IEC 102
- Primarily used for direct connection to RTU, ext modem

RS-485

- Supports Tx, Rx, Gnd signals
- Configurable for 300 – 115,200 baud
- Mutually exclusive with RS-232 option
- Configurable for JEM Binary, DLMS, Modbus, DNP, IEC 102
- Recommended max. cable length: 4000 feet; actual length is dependent upon environment

Internal Modem (Port 5) (optional)

- 56k Analog Modem
- Configurable for JEM Binary protocol

Ethernet (Port 6, 7) (optional)

Single or Dual Ethernet Ports, each configured for:

- 12 simultaneous users
- 10 Base-T/100 Base-TX
- Fixed IP Address per Ethernet Port
- Configurable for :
 - JEM Binary (max 4 connections)
 - Modbus TCP/IP (max 2) Slave
 - DNP Protocol (max 5)
 - DLMS (max 1)
- IEC 61850 (max 1)
- NTP (time-sync)

- PQ DIF
- SNMP

Communication Protocols

Protocol	Port 1	Port 3	Port 4	Port 5	Port 6	Port 7
	Optical	RS-232/485	RS-232/485	Modem	Ethernet	Ethernet
JEM Binary	1	1	1	1	4	4
Modbus RTU		1	1	1		
Modbus TCP/IP					2	2
DNP		1	1	1	5	5
DLMS/COSEM	1	1	1		1	1
IEC 61850					1	1
NTP					1	1

Environmental

Temperature

- Operating
 - Continuous operating temperature: -30 to +70 °C
 - Short term (24 hour maximum operating temperature) per ANSI C12.20: +85 °C
 - Display operating range: -20 to +70 °C
 - Basic meter accuracy shall be derated by 50 ppm of Rated Output per degree C difference from nominal
- Storage
 - The storage temperature range shall be -30 to +85 °C

Humidity

- Continuous operating humidity: 95% at +40 °C

Insulation

- 2.5kV, 60Hz, 1 minute

Surge

- IEC 61000-4-5

EFT

- IEC 61000-4-4
 - 5/50 nS
 - 4kV on power inputs
 - 2kV on inputs/outputs

Damped Oscillatory

- IEC 61000-4-12
 - 2.5 kV common mode
 - 1.0 kV differential mode
 - 100 kHz and 1 MHz

RF Susceptibility

- IEC 61000-4-3
 - 10 V/m
 - 30 V/m

Emissions

- CISPR22, class A

ESD

- IEC 61000-4-2, 15kV

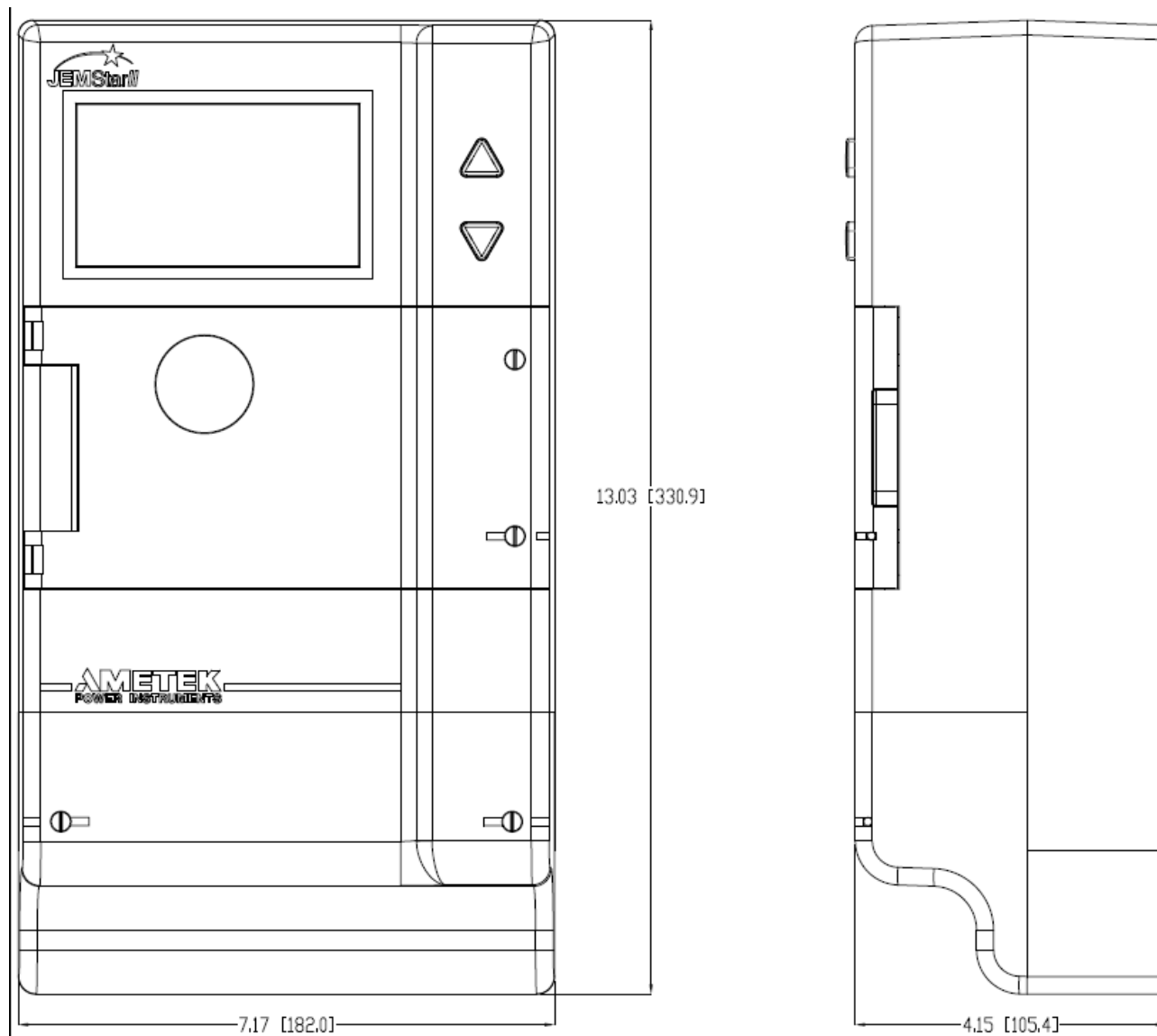
Agency Standards

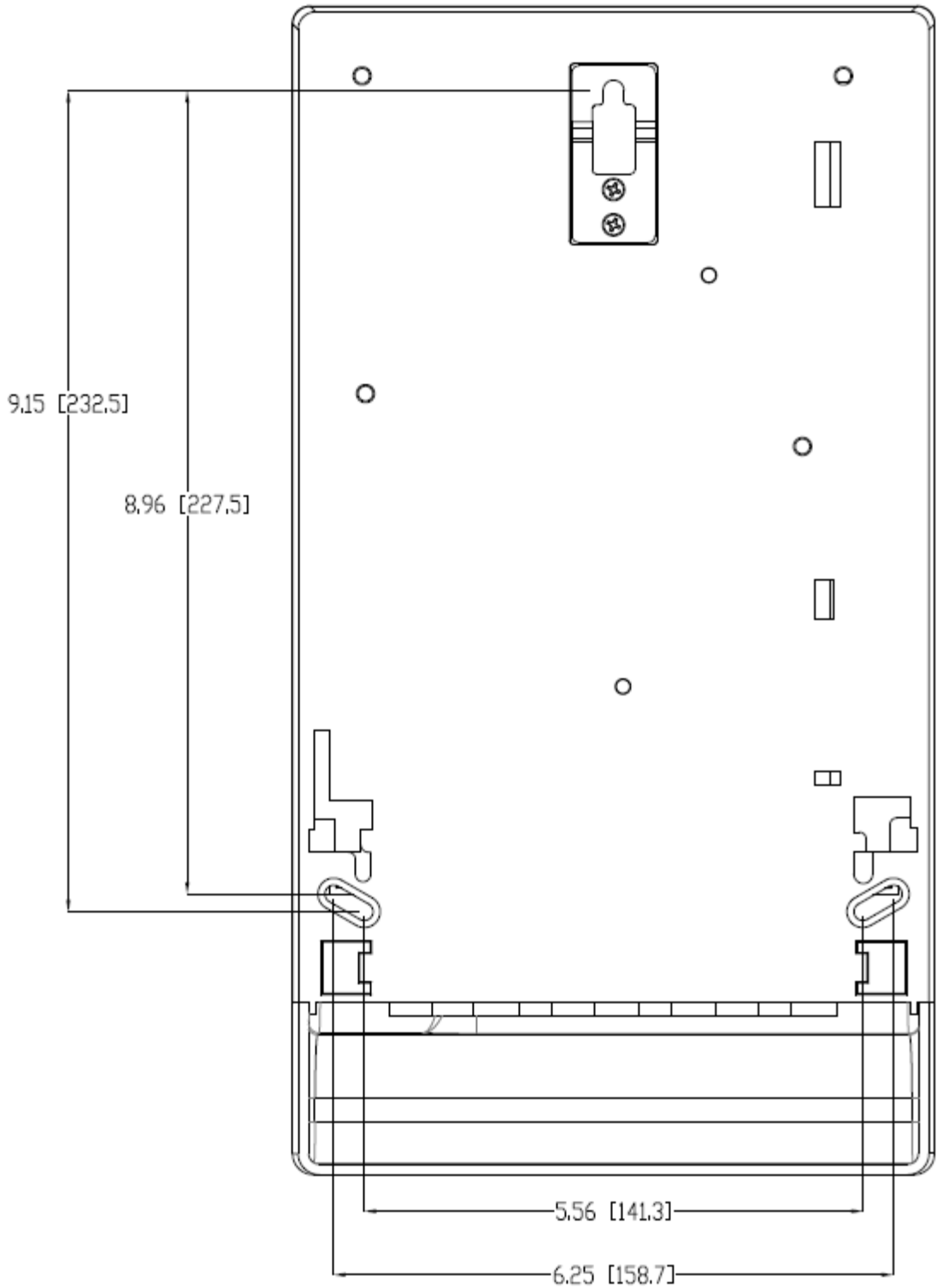
- * IEC 62052-11-2003 Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 11: Metering equipment
- * IEC 62053-22-2003 Electricity metering equipment (a.c.) - Particular Requirements - Part 22: Static meters for active energy (class 0,2 S)
- * IEC 62053-24-2014 Electricity metering equipment (a.c.) - Particular Requirements - Part 24: Static meters for reactive energy (class 0,5 S)

INSTALLATION

Size and Weight

- IEC: 5.5 pounds

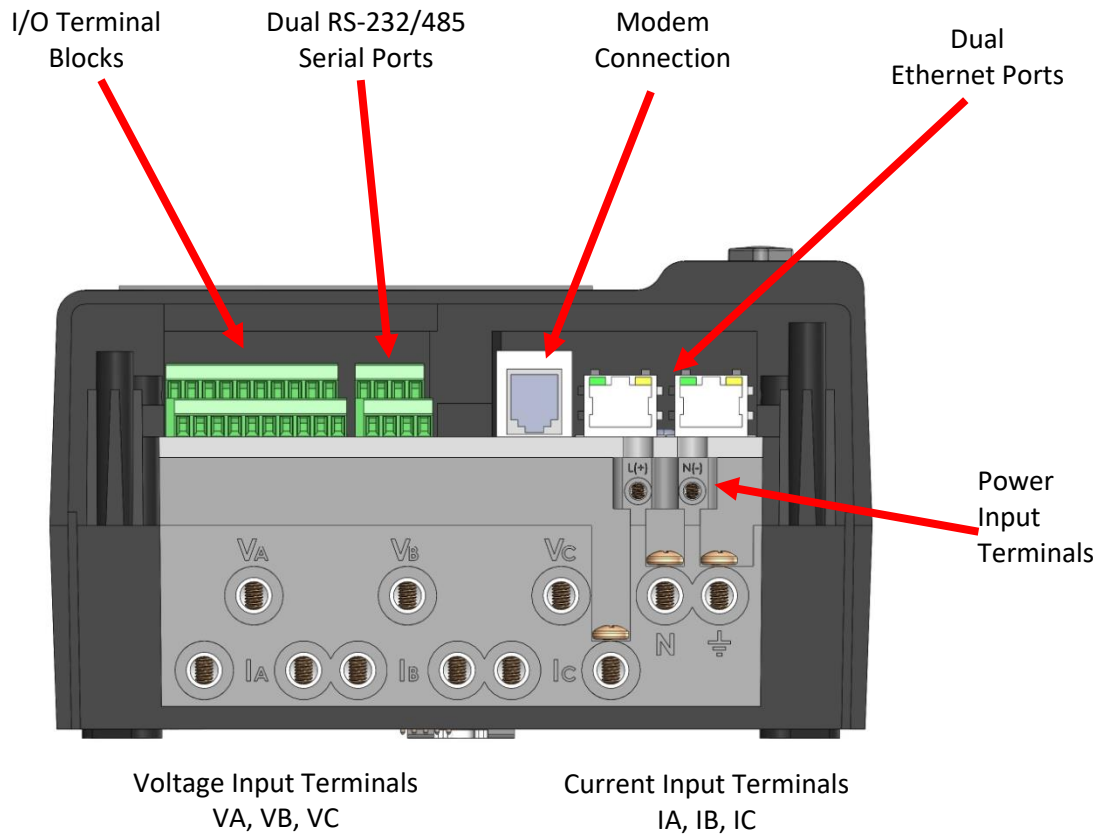




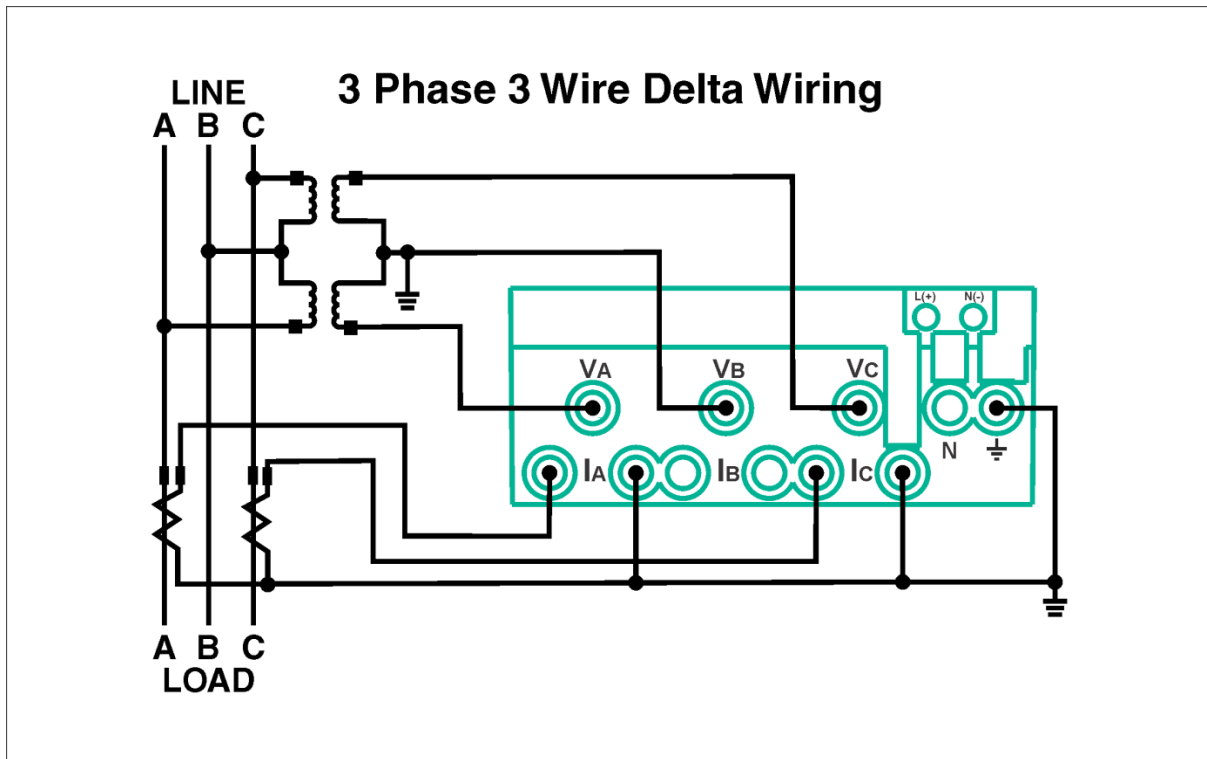
CURRENT AND VOLTAGE INPUT WIRING

Meter Forms

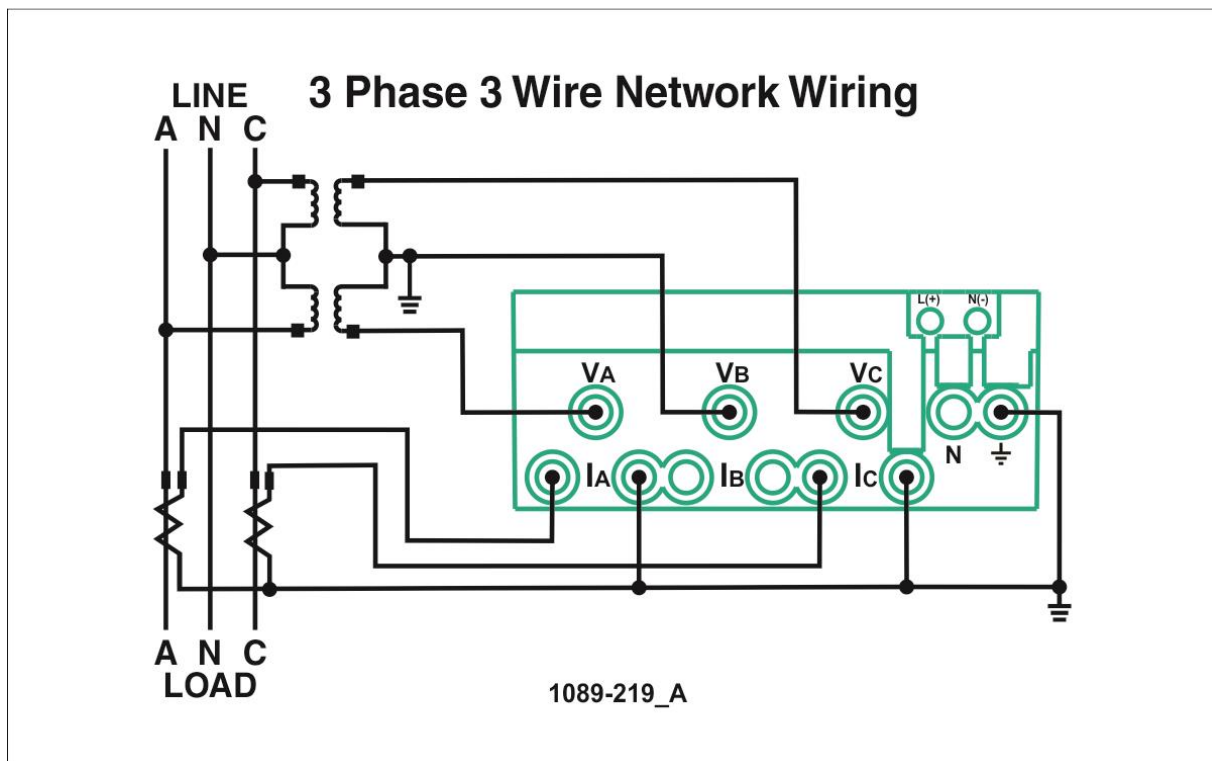
Form Number	Type
Form 5	2 Element [2PTs, 2CTs] (3 phase, 3 wire Delta)
	2 Element [2PTs, 2CTs] (3 phase, 3 wire Open Delta)
	2 Element [2PTs, 2CTs] (3 Phase, 3 wire Network)
	2 Element [2PTs, 2CTs] (3 phase, 3 wire Wye)
Form 9	3 Element [3PTs, 3CTs] (3 Phase, 4 wire Wye)
U (Universal)	2 Element [2PTs, 2CTs] (3 phase, 3 wire Delta)
	2 Element [2PTs, 2CTs] (3 phase, 3 wire Open Delta)
	2 Element [2PTs, 2CTs] (3 Phase, 3 wire Network)
	2 Element [2PTs, 2CTs] (3 phase, 3 wire Wye)
	3 Element [3PTs, 3CTs] (3 Phase, 4 wire Wye)



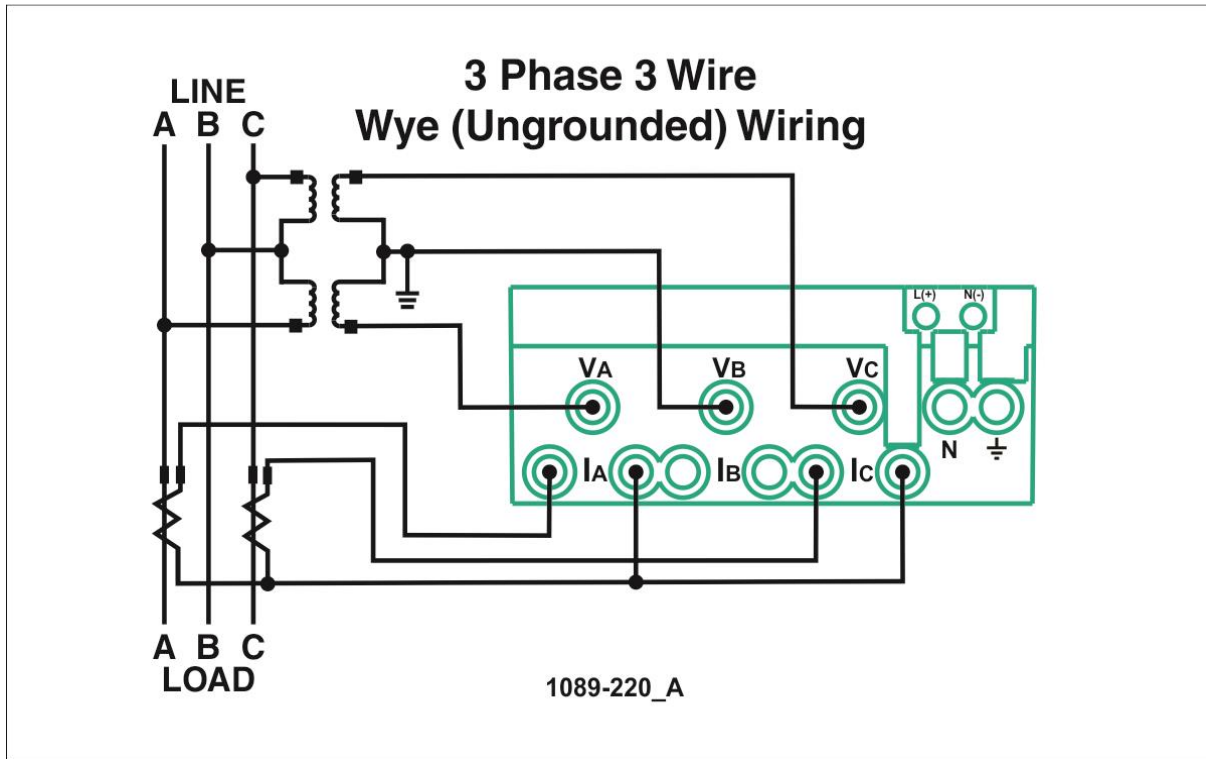
3 PHASE 3 WIRE DELTA WIRING (FORM 5)



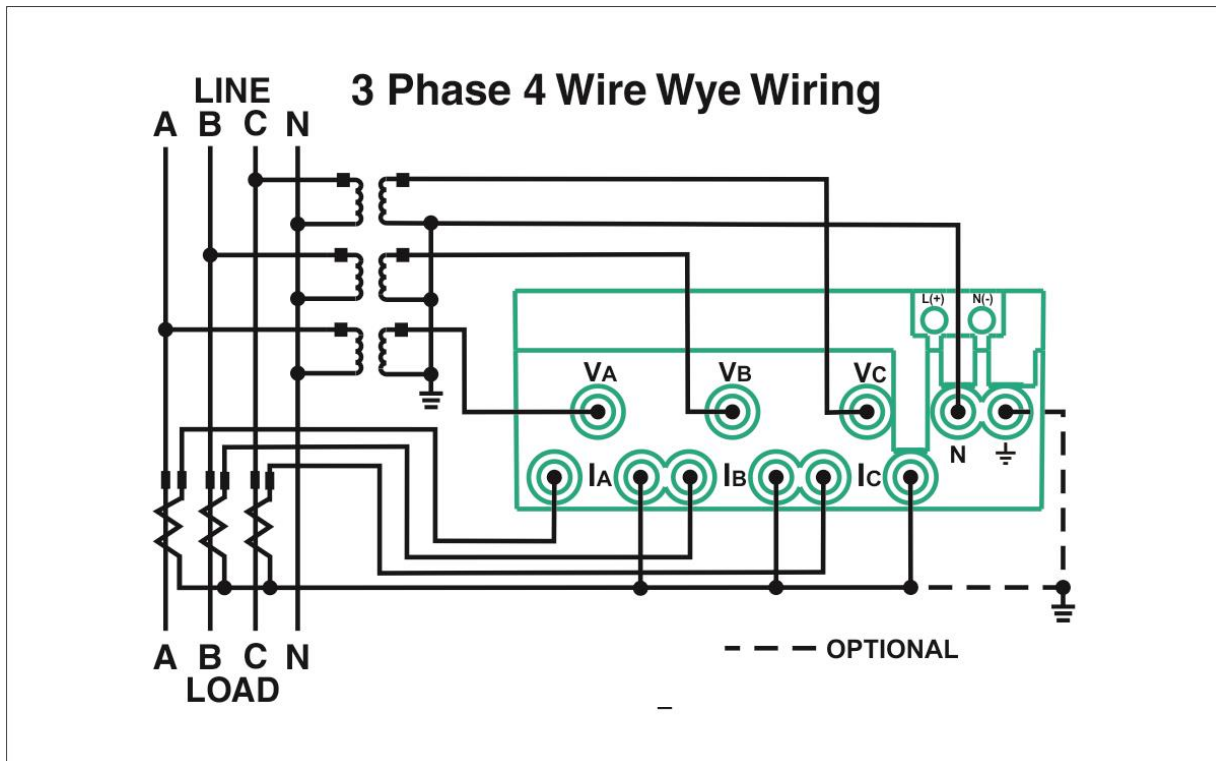
3 PHASE 3 WIRE NETWORK (FORM 5)



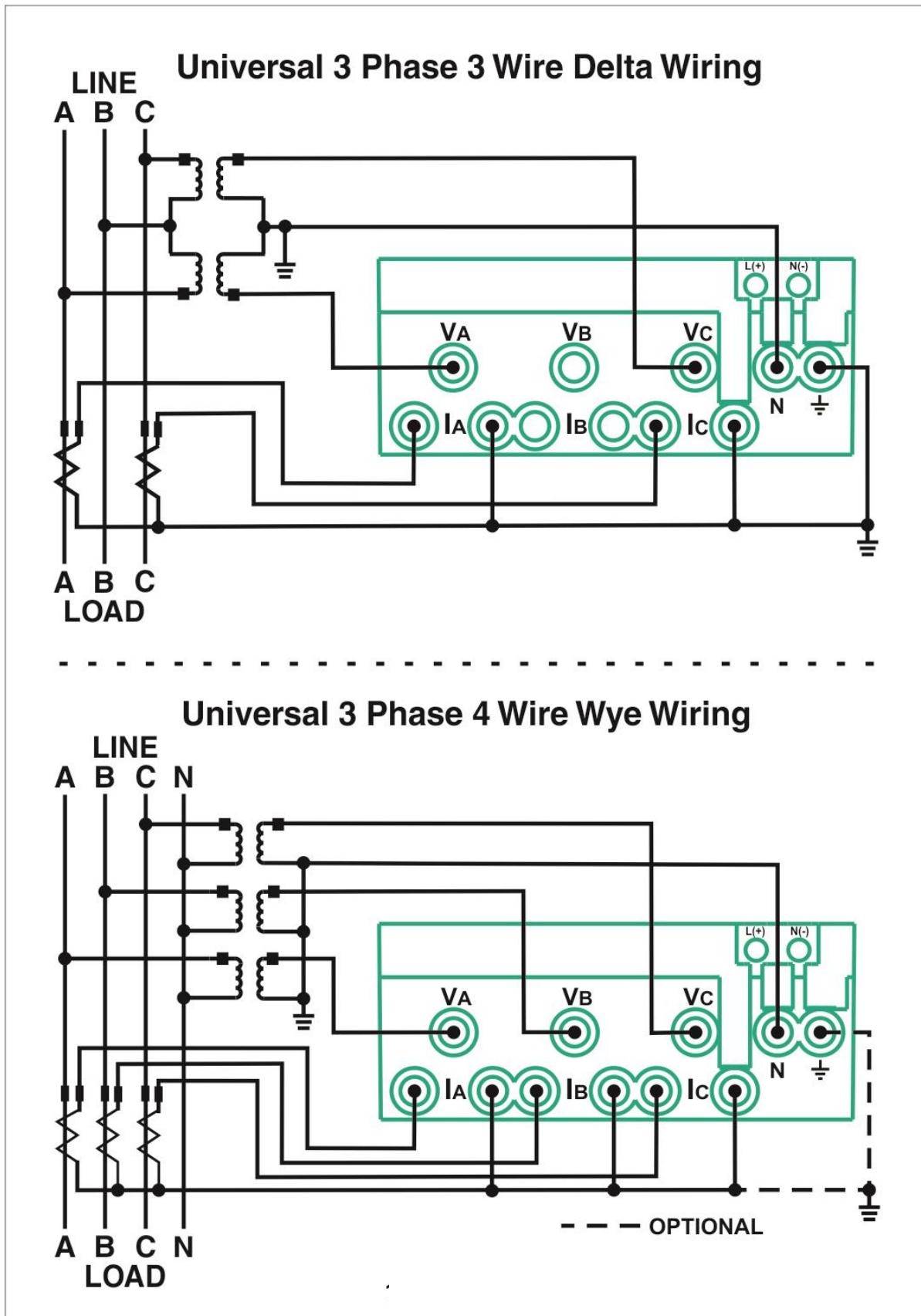
3 PHASE 3 WIRE WYE (FORM 5)

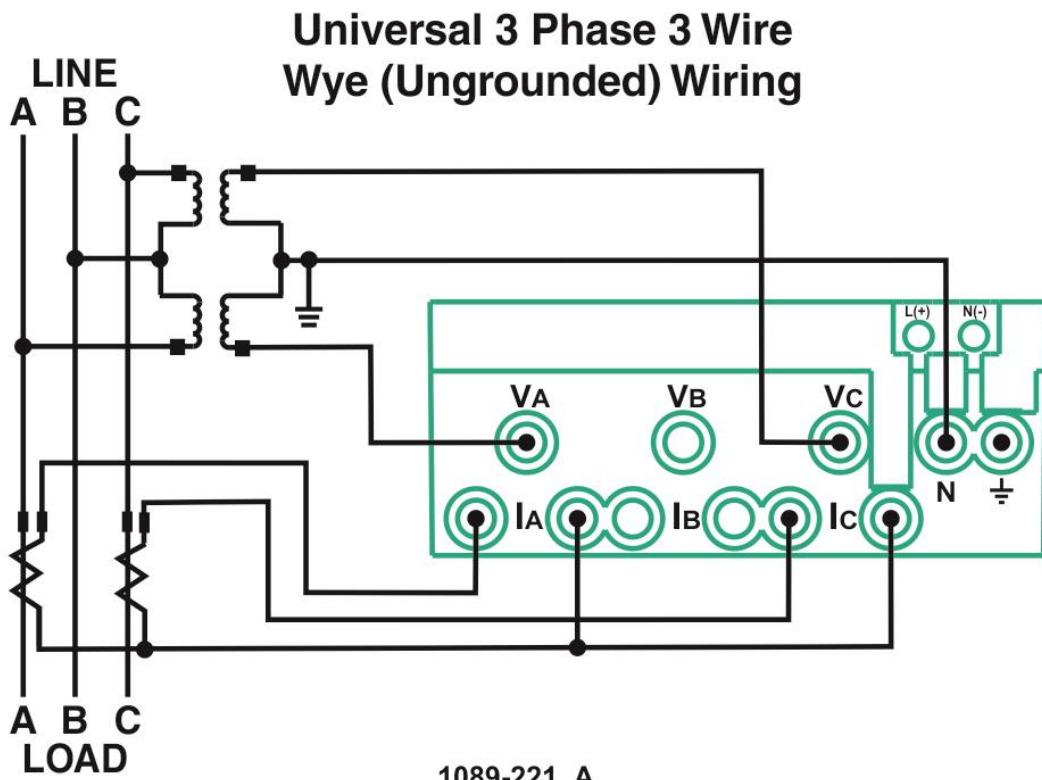
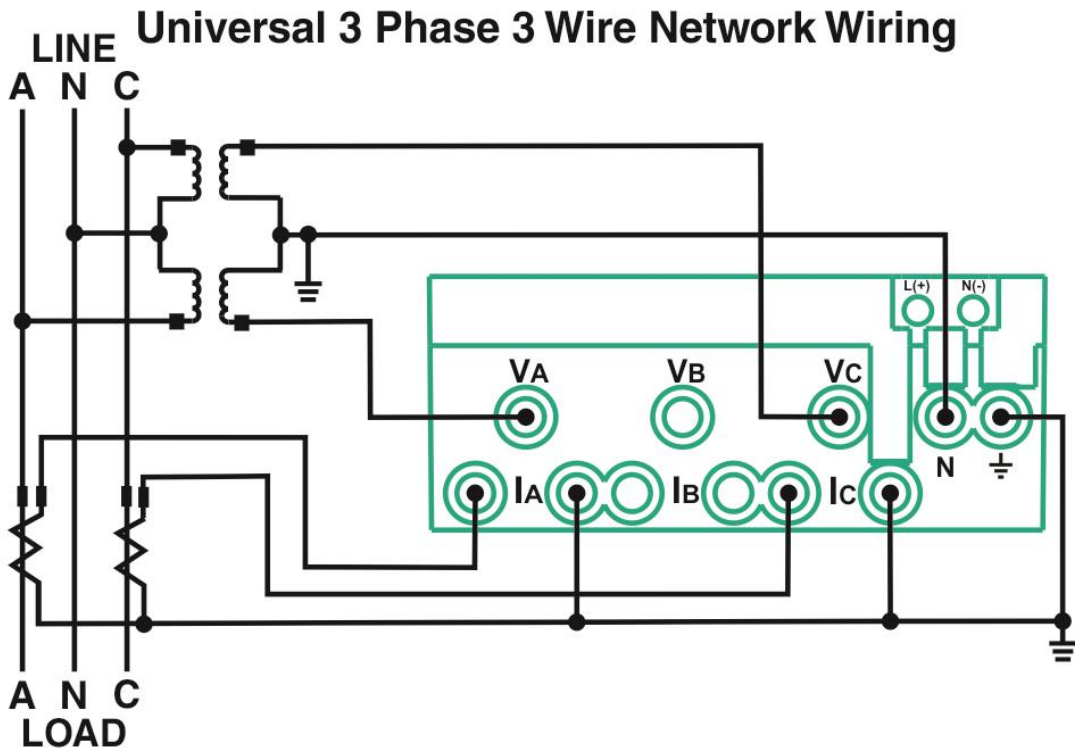


3 PHASE 4 WIRE WYE WIRING (FORM 9)



UNIVERSAL WIRING (OPTION U)





1089-221_A

EXTERNAL CONNECTIONS

JEMStar II uses clamp down style terminal blocks for current, voltage and power connections. I/O and serial communications use a dual row set of terminal blocks. Connectors are used for the phone line and Ethernet cables.

Grounding Recommendations

It is important to ensure that the JEMStar II meter is properly grounded. 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 45 – 300 volts while still meeting all operational specifications.

Refer to the Specifications section for input burden.

Current Inputs

The JEMStar II is configured at manufacture for one of the standard current Class ranges listed in the Specifications section. Each JEMStar II 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. Refer to the Specifications section for input burden.



METER POWER

The meter will operate from a Primary power source with automatic transfer to a Back-up source.

The meter power sources consist of:

- Self Powered via the Phase A, B & C voltage inputs. The power supply will operate from any phase (45-300 VAC L-N)
- External Aux Power (90-300VAC L-N, 90-300VDC)

The meter default is:

- Primary power Source from the voltage inputs
- Back-up power from the External Aux Power terminals

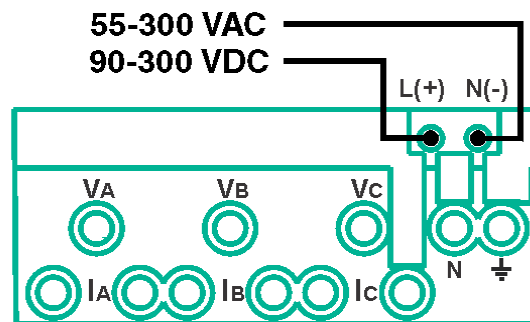
Option EAP will provide the opposite:

- Primary Power Source from the External Aux Terminals
- Back-up power from the voltage inputs

Note: The meter must be initially powered up from the primary power source before it will switch over to the back-up source. After switching to the back-up source, it will automatically return to the primary source when the power is restored.

The IEC meter is designed to obtain Auxiliary Power from a separate terminal block connection. The Auxiliary Power can be AC or DC as shown below.

Auxiliary Power Wiring



METER INPUTS AND OUTPUTS

Contact Inputs / Contact Outputs (DIO option)

JEMStar II can include an optional feature that includes 8 channels of digital inputs or outputs that are customer configurable using the JEMWare II software. Channels 1-7 can be configured as digital inputs or outputs and Channel 8 is fixed as an input. Channels 1 and 2 are provided as KYZ style outputs and channels 3-8 are Form A inputs or outputs.

Contact Inputs

JEMStar II Inputs can be configured to perform any one of the following functions:

- Pulse counter that is recorded as a channel in Load Profile.
- 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.
- Trigger Alarm: Used to trigger a power quality event.
- Record Load Profile: Can be used to record Load Profile only when the input is activated.

JEMStar II can provide an internal 24 Vdc wetting voltage for the contact inputs (Option DIOP). If option DIO is specified, 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 II will de-bounce both "make" and "break" transitions on each contact input for at least 20 milliseconds. The maximum detectable pulse rate is 100 *transitions* per second.

Contact Outputs

JEMStar II Outputs are configurable for either form A or KYZ (Channel #1 and 2 are equipped for KYZ).

Outputs can be configured to perform any one of the following functions:

- Energy pulse output: (Normally Open/Normally Closed or 1-shot) configurable for any consumption quantity
- End of Demand Interval Output: the output will close for one second when a demand (sub) interval closes.
- Triggered Alarm
The output will close for any selected trigger input
- Clock Pulse Output
Will Pulse based on internal clock. The timing of the pulses is configurable in JEMWARE.

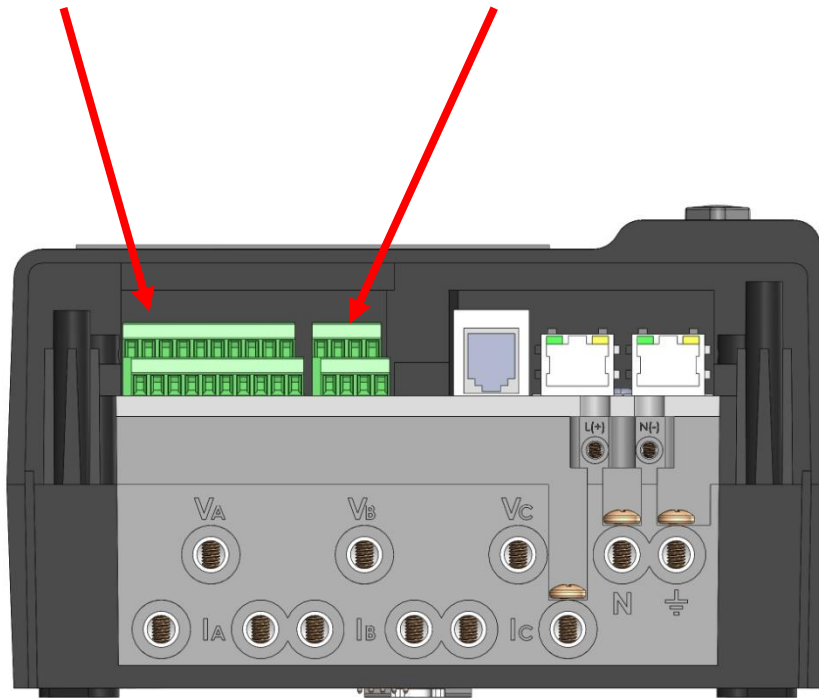
The JEMStar II contact closure outputs meet the following specifications:

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 output pulse duration is configurable from 20-200 msec. (default is 40msec) Maximum output rate is 25 transitions per second. A transition is defined as a single change of state, either open-to-close or close-to-open.

**I/O Terminal
Blocks**

**Dual RS-232/485
Serial Ports**

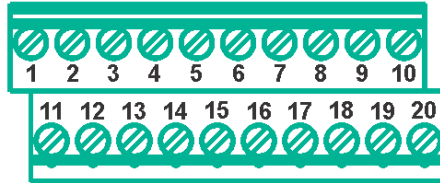


Digital I/O Wiring

A total of eight Digital I/O channels are available with the DIO Option. Channels 1-7 can be selected as a Digital Input or Digital Output using the JEMWARE Software. Channel 8 is always an input.

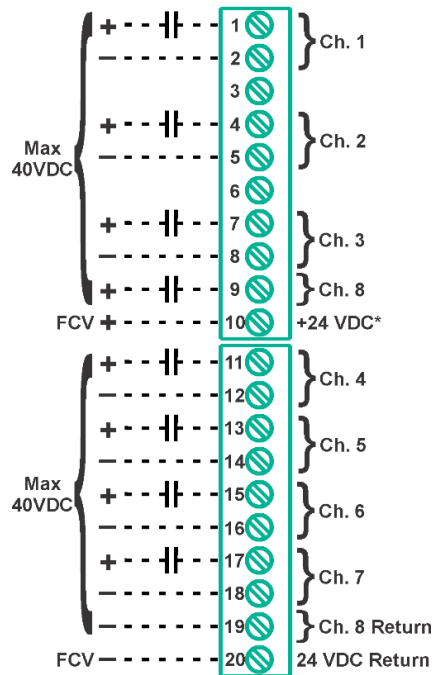
A 24VDC Isolated Power supply can be provided (Option DIOP) for powering the digital Inputs. Otherwise, you can use your own power source up to 40VDC.

Digital I/O Terminal Block

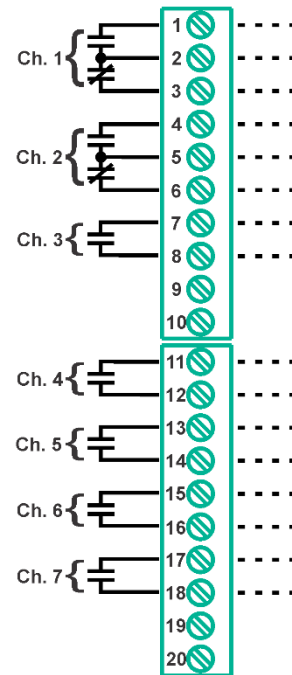


The wiring shown below illustrates where the inputs and outputs would be connected for each channel. For example: If the meter was configured in JEMWARE with Channels 1-6 as Outputs and Channel 7 & 8 as inputs, you would refer to the Digital Output Wiring figure for the Ch 1-6 and the Digital Input Wiring for channel 7&8.

Digital Input Wiring



Digital Output Wiring



* 24VDC FCV (Field Contact Voltage)
SUPPLIED WITH OPTION DIOP

Customer wiring shown dashed.

COMMUNICATION PORTS

The meter has 7 communication ports available, consisting of Optical, Serial, Modem and Ethernet selections. Each port can support one or more communication protocols. All communication ports operate simultaneously and independently.

Com Port #	Port Type
1	Optical
2	N/A
3	RS-232/485
4	RS-232/485
5	Modem (Analog or Cellular)
6	Ethernet 1
7	Ethernet 2
8	WIFI

Communication Options

The Communication ports are available in the following configurable options.

For each Port Type (Serial, Ethernet, Modem), you can select a single option. For example: Option 2A or 2B. The Optical Port is included with every meter.

Port Type	Model Number Option	Communication Ports	Port Numbers
Serial	1B	(1) RS-232/485	Port 3,4
Ethernet	2A	(1) Ethernet	Port 6
	2B	(2) Ethernet	Port 6,7
Modem	3A	56K Analog Modem	Port 5

Communication Port Protocol Assignments

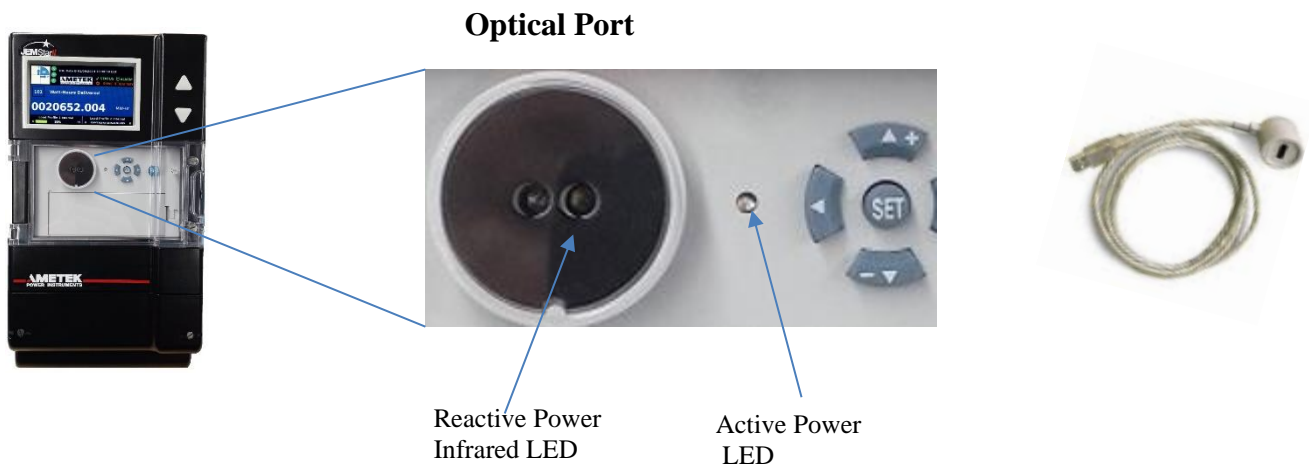
The communication ports support the following communication protocols. The quantity of simultaneous protocol sessions are shown for each port.

For Optical, Serial and Modem, only 1 protocol can be selected at a time per port. The Ethernet Port can support up to 12 simultaneous connections using the protocols shown.

Protocol	Port 1	Port 3	Port 4	Port 5	Port 6	Port 7
	Optical	RS-232/485	RS-232/485	Modem	Ethernet	Ethernet
JEM Binary	1	1	1	1	4	4
Modbus RTU		1	1	1		
Modbus TCP/IP					2	2
DNP		1	1	1	5	5
DLMS/COSEM	1	1	1		1	1
IEC 61850					1	1
NTP					1	1

Optical

JEMStar II uses a front panel mounted IEC 62052-11 Optical Port. 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 II Optical Port incorporates JEM Binary Protocol, and may be configured for 300, 1200, 2400, 9600 or 19200 baud communications.



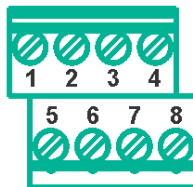
RS-232/RS-485

The JEMStar II can be optionally equipped with two serial ports. Ports 3 and 4 are software configurable for either RS-232 or RS-485. These ports are configurable for any valid communication address supported by the meter, and can be configured for 300, 1200, 2400, 9600, 19.2K, 38.4K or 115,200 bps communications. When configured for RS-232, the ports are operated in half-duplex mode using four signal wires: Common, Transmit Data (TX), Receive Data (RX), and Request To Send (RTS). For ports 3 and 4, the RS-232 option is mutually exclusive with the RS-485 option; that is, only one *or* the other can be configured.

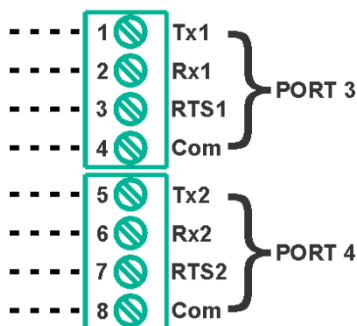
When configured for RS-485, the port operates in half-duplex mode (e.g.: the Transmit and Receive signals share the same wires). It is configurable for any valid communication address supported by the meter, and can be configured for 300, 1200, 2400, 9600, 19.2K, 38.4K or 115,200 bps communications. 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 configured.

Any RS-485 network requires 120 Ω terminating resistors at each end to operate properly. The JEMStar II RS-485 communication option has a built in terminating resistor that may be enabled using the JEMWare II software. See the section "Communication Repeater," later in this manual, for details on when and how to enable the terminating resistor.

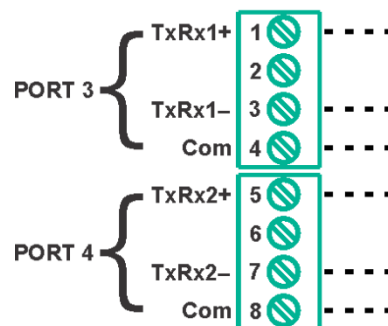
RS-232/485 Wiring



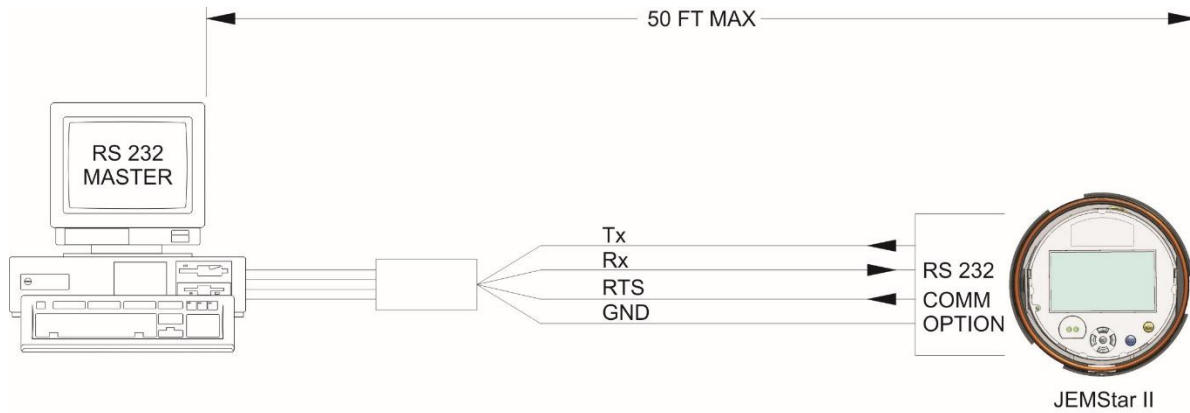
RS-232 Wiring



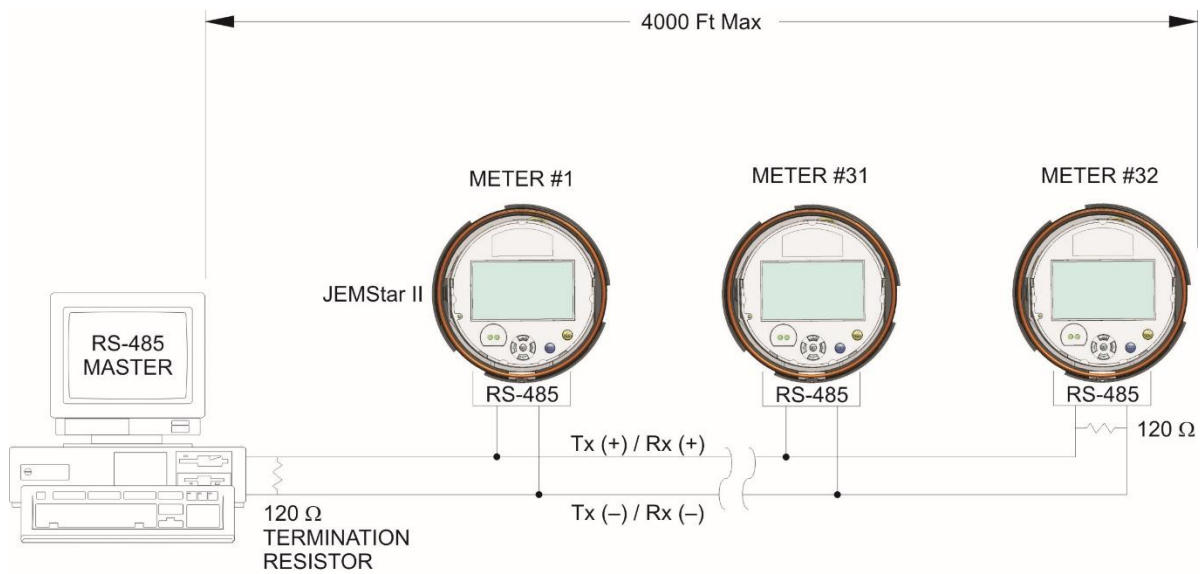
RS-485 Wiring



Selection of RS-232 or RS-485 is done with the JEMWARE Software.



RS-232 CONNECTION DIAGRAM



RS-485 CONNECTION DIAGRAM

The RS-485 protocol permits up to 32 transceiver pairs to share a party line. Because RS-485 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.

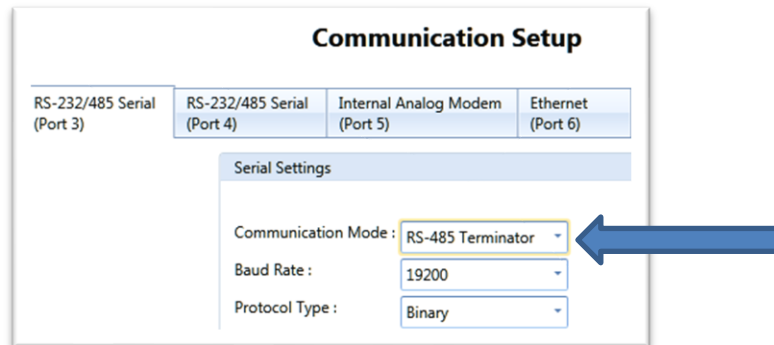
The signals labeled “TX(+)/RX(+)” and “TX(-)/RX(-)” are a half-duplex pair that carry Received Data to the meter and Transmitted Data to the master.

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 Ω resistor*. If the JEMStar II meters are the end devices, this is accomplished via the JEMWare II software or meter front panel. 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 II meters that are not at the ends of the RS-485 wiring should have their terminating resistors disabled via JEMWare II software or meter front panel.

The following shows how to enable the 120 Ω terminating resistor:

Termination in the JEMWare II software:

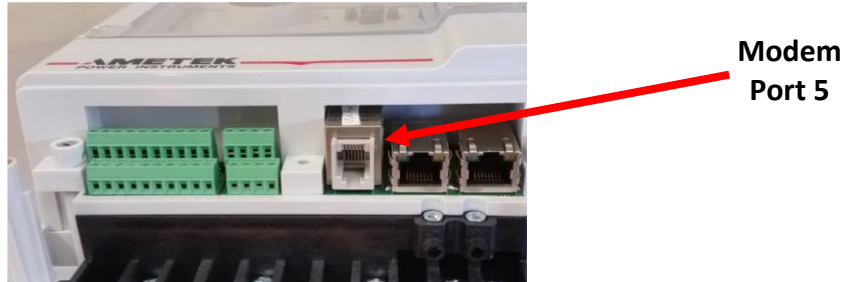
Using the drop-down menu select RS-485 Terminator for the end meter.



Modem

JEMStar II can be optionally equipped with an internal modem. The port is configurable via JEMWare II for any communication address supported by the meter, and can be set for 300 – 56K 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 are made using a standard four-wire RJ-11 phone jack.



Selecting Country Codes

The JEMWARE Software is used to set up the modem calling parameters including the initialization string used for the country code. Setting the modem’s country code is done by with the +GCI command. To change to one of the 64 available countries, issue the “AT+GCI=n” command where “n” is one of the two digit country codes. This command must be part of the Initialization string entered in the JEMWARE configuration Software.

Examples: **AT+GCI=00<CR>** Meaning: Change country code to Japan.

A list of some country codes is shown below.

Country	Code	Country	Code
Argentina	7	Luxembourg	69
Australia	9	Malaysia	6C
Austria	0A	Mexico	73
Belgium	0F	Morocco	77
Brazil	16	Netherlands	7B
Bulgaria	1B	New Zealand	7E
Canada	20	Norway	82
Chile	25	Pakistan	84
China	26	Philippines	89
Columbia	27	Poland	8A
Croatia	FA	Portugal	8B
Cyprus	2D	Romania	8E
Czech Republic	2E	Russia	B8
Denmark	31	South Africa	9F
Egypt	36	Saudi Arabia	98
Estonia	F9	Senegal	99
Finland	3C	Singapore	9C
France	3D	Slovakia	FB
Germany	42	Slovenia	FC
Greece	46	Spain	A0

Hong Kong	50	Sri Lanka	A1
Hungary	51	Sweden	A5
Iceland	52	Switzerland	A6
India	53	Taiwan	FE
Indonesia	54	Thailand	A9
Ireland	57	Tunisia	AD
Israel	58	Turkey	AE
Italy	59	United Kingdom	B4
Japan	00	UK Genesys	FD
Korea	61	United Arab Emirates	B3
Kuwait	62	Uruguay	B7
Lebanon	64	United States of America *Default	B5

Modem Certifications

The JEMStar II Modem is compliant for use as per FCC (Part 15 and 68) (Class A)

Part 68 User Information

- (1) This equipment complies with Part 68 of the FCC rules and the requirements adapted by the ACTA. The finished product containing this equipment displays a product identifier in the format [US: 3A4MM00BTM]. If requested, this information must be provided to the telephone company.
- (2) This equipment uses the USOC jacks: RJ11C
- (3) A plug and jack used to connect this equipment to the premises wiring and telephone network must comply with the applicable FCC Part 68 rules and requirements adopted by the ACTA. A compliant telephone cord and modular plug is provided with this product. This equipment is designed for connection to a compatible modular jack that is also compliant. See installation instructions for details.
- (4) The REN is used to determine the number of devices that may be connected to the telephone line. Excessive REN on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the REN should not exceed five (5.0). To be certain of the number of devices that may be connected to a line, as determined by the total REN, contact the local telephone company. The REN for this product is part of the product identifier that has the format: [US: 3A4MM00BTM]
The digits shown after MM are the REN without decimal point. (e.g., 00 is a REN of 0.0)
- (5) If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be

advised of your right to file a complaint with the FCC if you believe it is necessary. If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved. 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 in order for you to make the necessary modifications to maintain uninterrupted service.

- (6) The Telephone Consumer Protection Act of 1991 makes it unlawful for any person to use a computer or other electronic device, including fax machines, to send any message unless such message clearly contains in a margin at the top or bottom of each transmitted page or on the first page of transmission, the date and time it was sent and an identification of the business or other entity, or other individual sending the message and the telephone number of the machine or such business, other entity, or individual. (The telephone number provided may not be a 900 number or any other number for which charges exceed local or long-distance transmission charges.)

FCC Part 15

The JEMStar II, with modem installed, was tested to FCC Part 15 EMI/RFI emissions levels.

Operation of this device is subject to the following two conditions:

- This device must not cause harmful interference.
- This device must accept any interference received including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy. If not installed and used in accordance with the instructions, it can cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

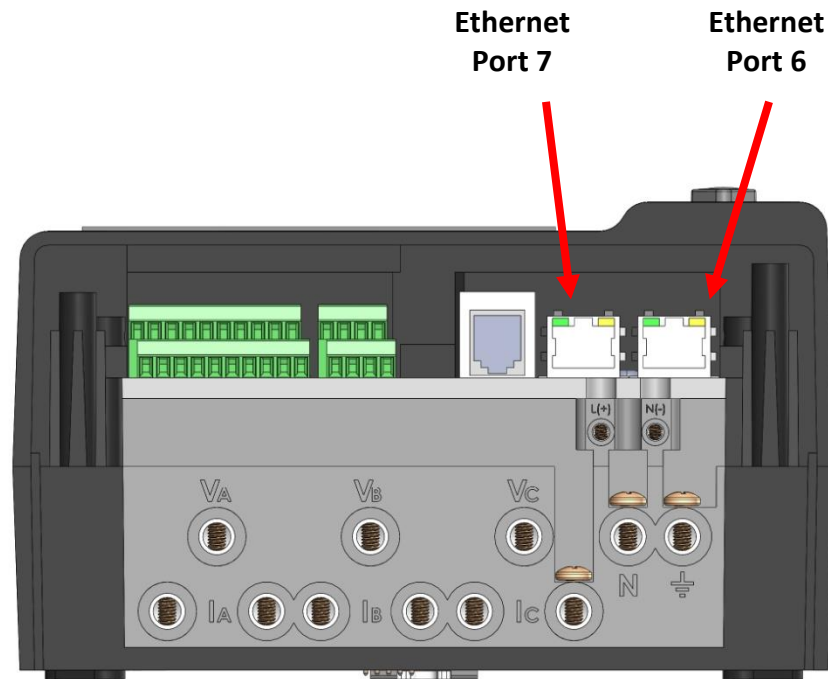
- 1 ~ If it can be done safely, try to reorient or relocate the receiving antenna.
- 2 ~ Increase the separation between the modem and the receiver.
- 3 ~ Connect the modem to an outlet on a different circuit from the receiver.
- 4 ~ Consult the dealer or an experienced radio/TV technician for help. 12

Ethernet Port

JEMStar II can be optionally equipped with a single or dual Ethernet port. The Ethernet port is configurable via JEMWare II for any IP address or it can obtain an IP address automatically using DHCP. The Ethernet port supports all JEMStar II protocols. (DLMS, IEC 61850, Modbus, DNP, JEM Binary) Up to twelve simultaneous connections are possible, permitting each user to access whatever metering information is necessary. Up to ten 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.

Ethernet connections are provided through a standard RJ-45 jack.

S-base and A-base meters are supplied with a network cable and RJ45 (male) connector on the rear of the meter. Switchboard meters have a RJ45 jack on the rear.



METER SEALING

Meters with the 'MID' option are equipped with a Manufacture seal.

All meters have provisions for an Installation Seal on the terminal cover and front cover, applied by the meter owner.

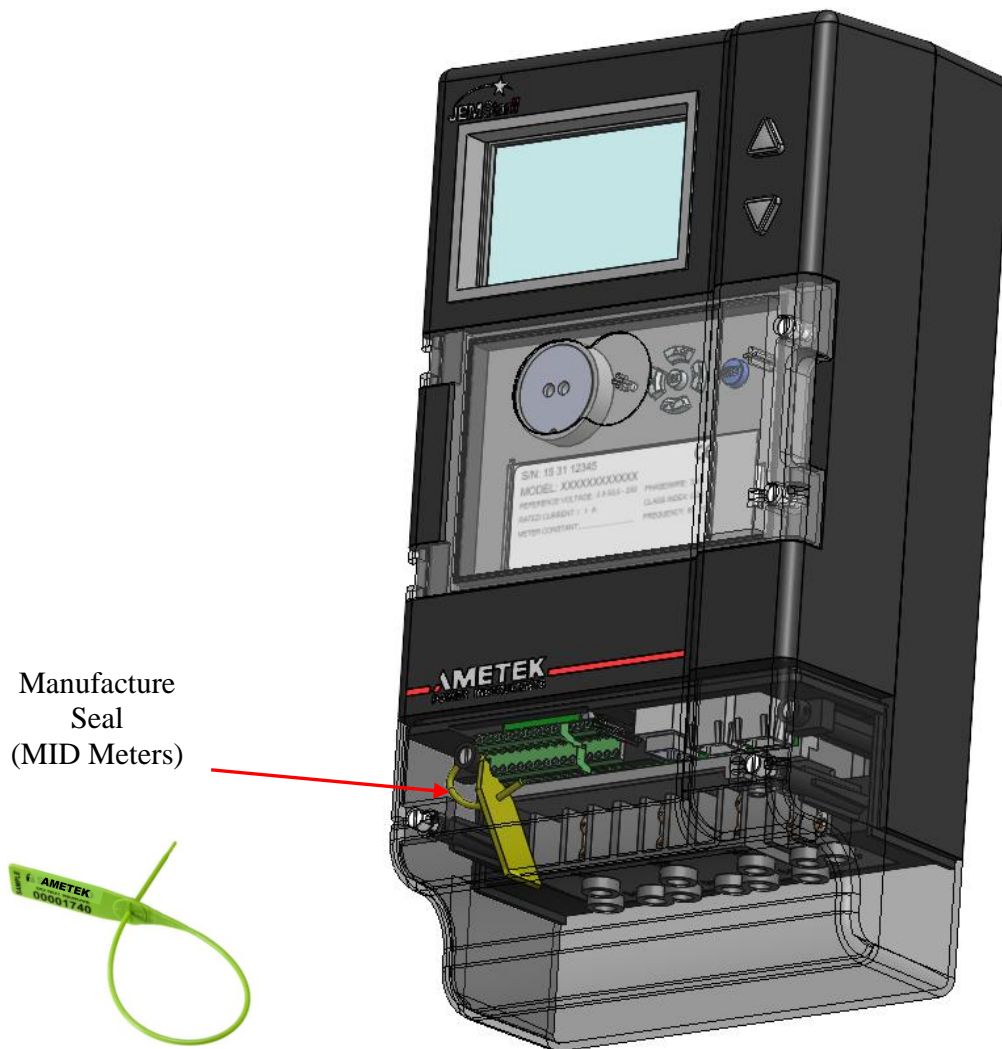
MANUFACTURE SEAL

The manufacture seal consists of a 'tamper proof' seal that prevents the opening of the internal meter components.

The seal is attached to the screw that is used to fasten the top of the meter enclosure to the meter base.

The screw can not be removed when the seal is applied.

The manufactures seal can only be applied by the Factory.



INSTALLATION SEALS

The Installation seals are applied by the meter owner after installation. One seal is used to secure the meter connection terminals and wiring and the other is used to secure the front cover which provides access to the display user menu and replaceable battery.

Terminal Cover Seal

The Terminal Cover should be sealed to prevent access to the wiring connections on the meter. There are two sealing screws provided on the meter cover (one at each side). The meter seal can be applied through the access hole in the terminal screws.

Front Cover Seal

The Front Cover shall be sealed to prevent access to the front display user menu buttons. There are two sealing screws provided on the meter cover (one at each side).

When the front cover is opened, it will provide access to the User Menu Display Screens, the Billing Reset button and for the internal battery replacement.

User Menu Display Screens can be used for:

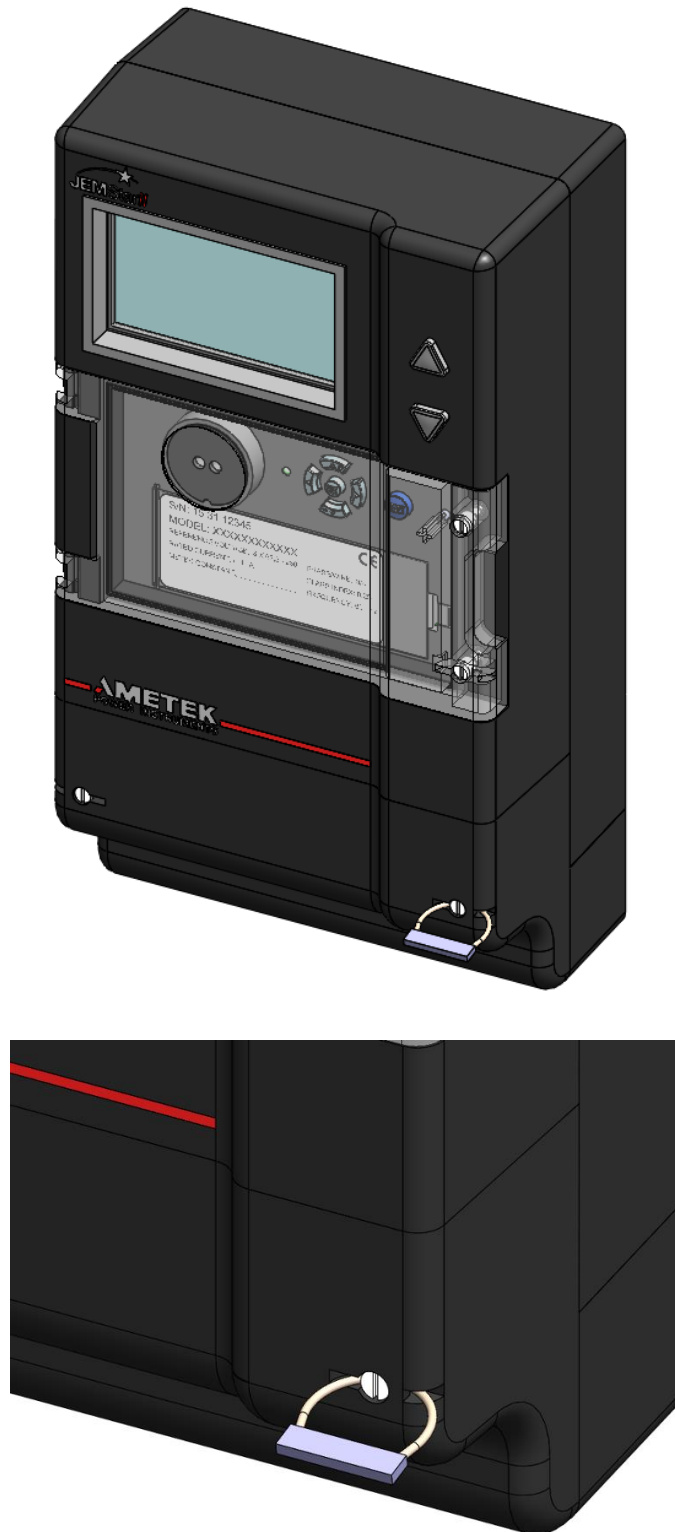
- Change meter time and date
- Display parts of the meter configuration
- Allow changes in the configuration when entering the correct username and password first
- Put the meter into the Test Mode for verifying the meter accuracy
- Resetting username and password to factory defaults (requires removal of power)
- Resetting entire meter configuration to factory defaults (requires username/password and removal of power)

The Billing Reset button will clear the Peak (Max) demand data stored and other billing data. The User Menu and Reset button can be disabled with the Security Keys as described in the manual Maintenance section.

Note: The Optical Port and Power Pulse LED can be used with the cover closed (or sealed).



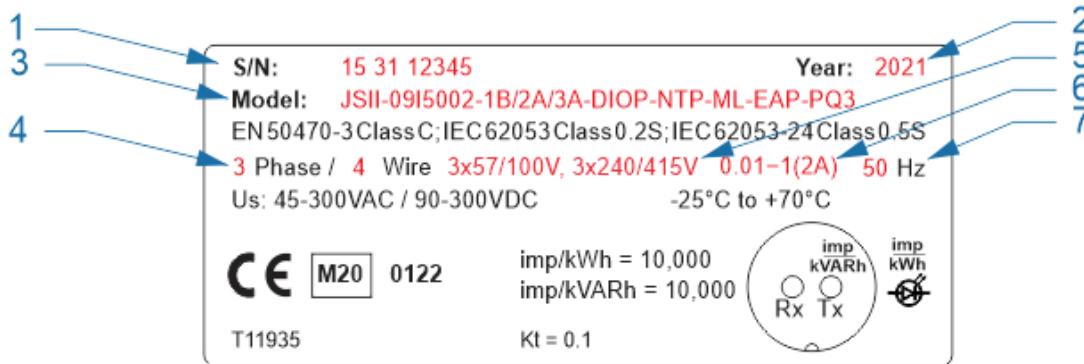
Meter shown with one of two meter seals attached to Terminal Cover
(typical for both sides of terminal cover and front cover)



OPERATION

METER NAMEPLATE

The meter's nameplate provides general information about the meter including the serial number, model number, manufacture year, wiring configuration (3-Wire or 4-Wire), voltage, class, current, frequency, and the metering constants.



1) S/N:

The Meter Serial Number format is: YY WW XXXXX

YY = Year

WW = Week of year

XXXXX = Unique number of production

For example, a Serial Number of: 14 32 23897, the meter was produced the 32nd week of 2014.

2) YEAR:

Year of manufacture

3) MODEL:

The Model Number indicates all of the options as described in the General Information section of this manual

4) PHASE/WIRE:

Form 5, 3 Wire Delta: 3 Phase/3 Wire

Form 9, 4 Wire Wye: 3 Phase/4 Wire

Form U, selectable for Form 5 or Form 9

5) REFERENCE VOLTAGE:

Form 5, 3 Wire Delta 2 X 57/100V, 2 X 240/415V

Form 9, 4 Wire Wye 3 X 57/100V, 3 X 240/415V

6) Current Input

Class 2 0.01-1(2)A

Class 10 0.05-5(10)A

- 7) **FREQUENCY:**
50 Hz
60Hz

- 8) **AUX POWER INPUT**
Us: 45-300VAC / 90-300VDC

- 9) **OPERATING TEMPERATURE**
-25°C to +70°C

- 10) **CE Mark, Year of Certification and Notifying Body**
CE M20 0122

- 11) **Meter Optical Pulse Outputs**
Imp/kWh 10,000 Imp/kVARh 10,000
(10 pulses per watthour)

- 12) **Meter Constant (Meter Test Pulse scaling)**
Kt = 0.1

- 13) **Current Input**
Class 2 0.001-1(2)A
Class 10 0.002-5(10)A

- 14) **FREQUENCY:**
50 Hz
60Hz

- 15) **AUX POWER INPUT**
Us: 45-300VAC / 90-300VDC

- 16) **OPERATING TEMPERATURE**
-30 to 70C

- 17) **CE Mark, Year of Certification and Notifying Body**
CE M20 0122

- 18) **Meter Optical Pulse Outputs**
Imp/kWh 10,000 Imp/kVARh 10,000
(10 pulses per watthour)

- 19) **Meter Constant (Meter Test Pulse scaling)**
Kt = 0.1

METER POWER UP SEQUENCE

When auxiliary power is first applied to the meter, it goes through a start up process as detailed below:

- Within 5 seconds of power applied, the meter will start measuring power. This includes register measurements and recording of load profile. Simultaneously, the KYZ energy pulses and LED Power Pulse will start operating. The primary meter functions for measuring and recording of power are fully operational at this time.
- The meter display will appear within 45 seconds; however, the meter measurements will be shown as 'Not Set'. This is normal operation as the display has not fully been loaded.
- After 2 ½ minutes from meter start-up, the meter will be fully operational with full access to all of the display measurements.

While the meter may appear to have a long start-up process as the display takes more time to load, the internal processes to measure and record power are fully functioning within 5 seconds.

METER CONFIGURATION

All of the parameters that determine the meter's operation can be set by using the JEMWare II configuration software. JEMWare II 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 II provides the ability to read the existing configuration from the meter and to read the time on the meter through serial communications. The JEMWare II Instruction Manual 1079-699 describes each parameter that can be programmed.

NOTE: You may use the latest version of JEMWare II to open a configuration file saved with a prior version, or to read the configuration from a JEMStar II 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 ensures confidence that the correct settings are in place and allows JEMWare II to insert appropriate default settings for features that may not have been present in the older version of JEMWare II.

Changing Meter Configurations

Certain features of the JEMStar II 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 II:

- Registers in the Normal, Alternate, Test display list
- Self Read registers

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

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

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/CT Ratio from the meter front panel)

Energy Pulses

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

- Energy pulse channel assignments

MID Meters

MID (Measurement Instruments Directive) is a set of requirements to protect legally relevant billing information.

Meters enabled for MID will have the MID option in the model code. These meters have the internal security jumpers installed preventing access to change the following screens:

- Configure Primary/PTCT Settings
- Configure Display Registers
- Configure Load Profile
- Configure Loss Compensation
- Configure TOU/DST settings
- Configure Input/Output Settings
- Configure Trigger Settings
- Configure Demand Settings
- Configure Transformer Correction
- Firmware/Option Upgrade
- Activate Test Mode

These items need to be configured at the factory before the meter is shipped.

Some items, such as the MID Registers and Load Profile Channels will be fixed in every meter.

MID Billing Registers

The following MID Registers will be included in every meter:

Normal Registers

- Whr Delivered, working
- Whr Received, working
- VARhr Delivered, working
- VARhr Received, working

Alternate Registers

- Whr Delivered, BPR
- Whr Received, BPR
- VARhr Delivered, BPR
- VARhr Received, BPR
- Billing Reset time and date

A *Working Register* will store the selected data in real time and update the displayed quantity on a continual basis. When a BPR (billing period reset) is performed, the contents of the working register are transferred to the BPR storage register. The working register continues to increment. The BPR register will only update at the next Billing Period Reset.

Note: Other registers can be configured in addition to the MID registers shown. Max 50

MID Load Profile Channels

The following MID Load Profile Channels will be included in every meter:

Load Profile Channels

- Whr Delivered
- Whr Received
- VARhr Delivered
- VARhr Received

Note: Other Load Profile channels can be configured in addition to the MID Load Profile Channels shown. A maximum of 16 channels is allowed per Load Profile Group.

Changing Meter Configurations (MID Meters)

Changes to the meter that result in a reset of the MID Registers or Load Profile are prohibited. MID meters have the internal security jumper installed which prevent access to the following configuration items:

- Configure Primary/PTCT Settings
- Configure Display Registers
- Configure Load Profile
- Configure Loss Compensation
- Configure TOU/DST settings
- Configure Input/Output Settings
- Configure Trigger Settings
- Configure Demand Settings
- Configure Transformer Correction
- Firmware/Option Upgrade
- Activate Test Mode

As a result, these items will be pre-configured at the factory prior to shipment.

The following commands will be allowed with the security key installed:

- Configure Meter Identification
- Configure Communication Settings
- Configure Protocol Settings
- Configure Display Settings
- Configure User Admin
- Change Password
- Set Time
- Freeze Registers
- Meter/Battery Status
- Read Triggered Alarms
- Read Display registers
- Read Load Profile
- Read Event/Diagnostic Logs
- Read Security Logs

MID meters will also have the second internal security jumper installed which prevents access to the Billing Reset pushbutton located under the meter front cover.

Access to the internal security jumpers is prevented by the manufacture seal.

DISPLAY FACEPLATE



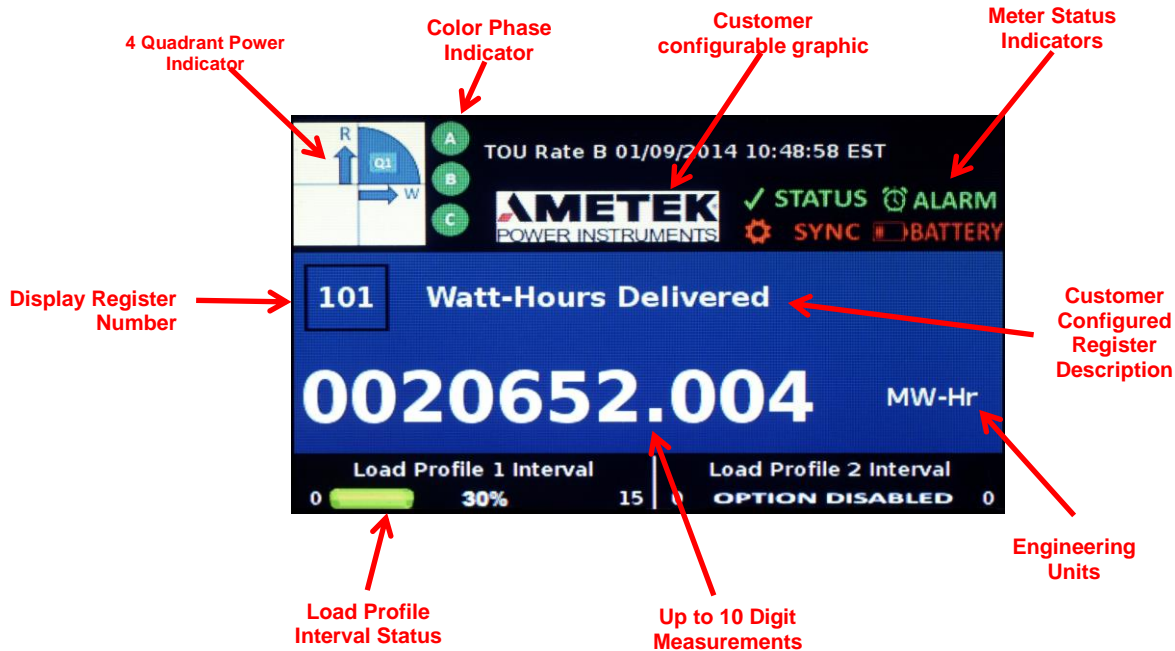
JEMStar II Front View

Optical Port
Navigation Keys
Scroll Buttons
Reset Key

Used for connecting an Optical Probe to read/write to the meter
Up/Down/Left/Right/Set keys used to navigate the user menu
Used to scroll through the register displays
Used to perform a billing reset, peak demand reset and min/max reset. This button can be sealed from the outside cover to prevent unauthorized access. In addition, you can prevent access through the Security Key on the Register board. Refer to the Maintenance section for further information.

METER DISPLAY

The JEMStar II Meter includes a color graphic display. The display is used to scroll the meter measurements (Display Registers), special displays (Phasor Display) and a user menu system that will show various meter configuration settings. The different display screens will automatically scroll from one meter display to another. The scroll rate and display screen contents are configurable in the JEMWARE Software. The main register display functions are shown below.



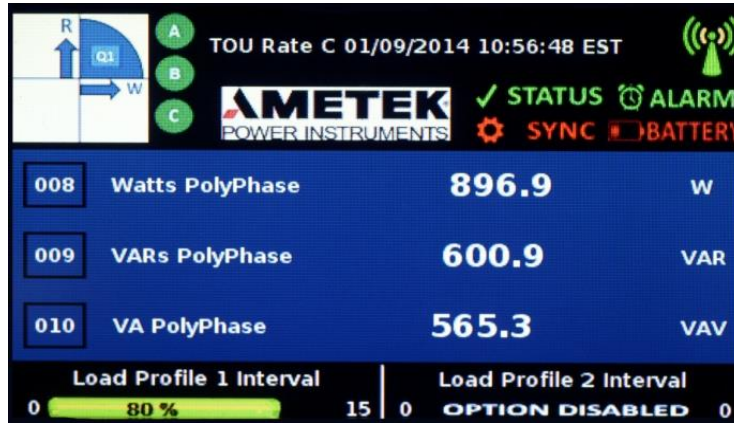
Single Register Display shown

Register Display Modes

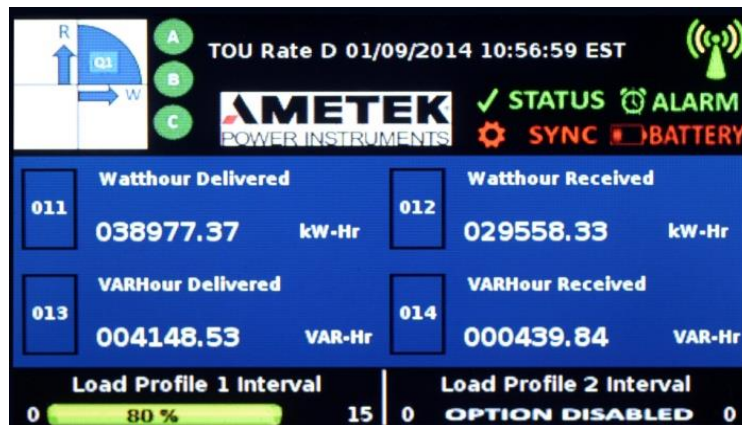
The meter can be configured to display a single register per screen or up to 4 registers per screen.



Dual Register Display



Triple Register Display



Quad Register Display

Navigating the Register Display

The meter registers can be grouped in three different display modes: Normal, Alternate, and Test. JEMStar II can display up to 50 Normal, 50 Alternate and 50 Test registers. Normal Registers are numbered 0-49, Alternate registers are numbered 100-149 and Test Registers are numbered 200-249. If display Scrolling is enabled (via JEMWare II), the display registers are sequentially displayed at a user-configurable rate. You can manually scroll through the registers by momentarily pressing the read button.

Alternate Mode registers are a second group of registers that could be used as a convenient method to group Billing Period quantities, site monitor displays, or any other user purpose. They are accessible to the meter reader by pressing and holding the READ button for at least five seconds. To return to Normal registers, press and hold the READ button again for five seconds.

Test Mode is used for testing the accuracy of the meter. Refer to the Test & Calibration section 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.

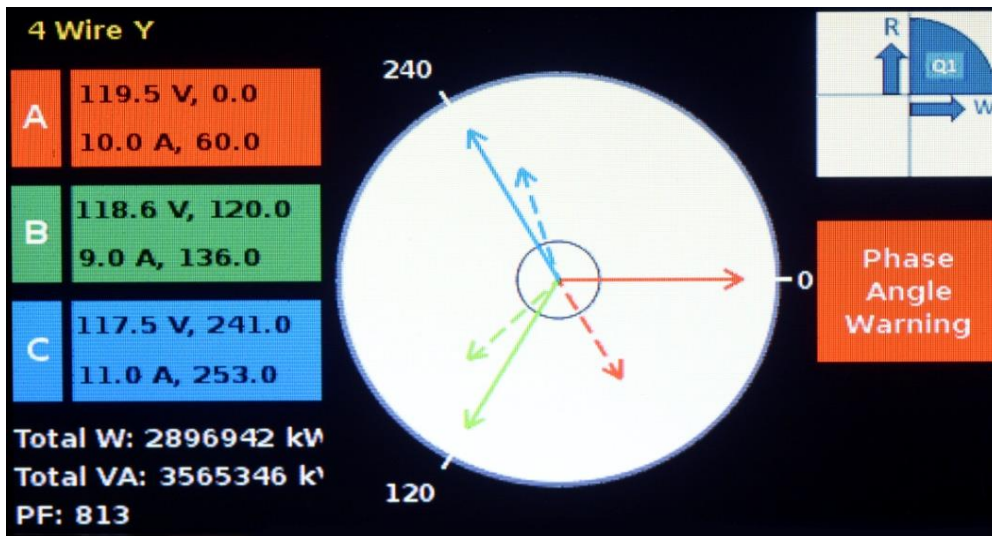
Special Displays

There are several custom displays that can be intermixed with the register displays including:

- Phasor Display
- Communication Status
- Alarm Display
- Graphical User Menu

Phasor Display

This display shows the current and voltage phase vectors graphically in real time. The display also shows the individual current and voltage magnitudes and phase angles. The solid line is for Voltage and the dashed line is for current.



Communication Status Display

The communication status display will provide the status of all communication ports and the protocols that are used with them. Any communication port not installed in the meter will be 'greyed' out. In the screenshot below, Serial 3, Ethernet 2 and WIFI are not installed. A matrix is provided to show the status of each installed port along with the protocol each port is configured for. The colors are described below:

- Light Blue** Indicates that the port and protocol have been configured and are ready for operation
- Green** Indicates that the port is currently being used (may be flashing)
- Yellow** Indicates that there may be a potential problem. For example, if the communication port is waiting for a poll from a master device, or the meter is waiting for a response from a device or receives an unrecognized response..
- Red** Indicates that the meter has detected a communication problem. For example; an Ethernet cable is unplugged, a port has timed out waiting for a response, no dial tone, etc

Communication Status		01/09/2014 10:52:59 EST						
Protocols	Optical	Serial1	Serial2	Serial3	Modem	Ethernet1	Ethernet2	WiFi
JEM Binary	Green	Light Blue	Light Blue	Grey	Yellow	Light Blue	Grey	Grey
Modbus	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Green	Light Blue	Light Blue
DNP	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Green	Light Blue	Light Blue
DLMS	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
ANSI	Light Blue	Red	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
IEC 61850	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
IEC 870-5-102	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
PMU	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
WEB	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue

Legend: Light Blue Ready, Green Active, Yellow Alert, Red Fault

Alarm Display

The Alarm Display will show the status of all alarms as configured in the JEMWARE Software. The Alarm Display will show the alarm trigger and time and date when it went into alarm.

Site Alarm Display		08/11/2014 10:56:56 EST		1 of 1	
Trigger	Trigger Description	Value	Date/Time		
4	4,Inst,VLN:A,>,120,0,119	120.573	10:36:28	11-Aug-2014	
5	5,Inst,VLN:B,>,120,0,119	120.572	10:36:28	11-Aug-2014	
6	6,Inst,VLN:C,>,120,0,119	120.574	10:36:28	11-Aug-2014	

Graphical User Menu

JEMStar II includes a graphical user menu to show the meter status, configuration details and perform functions such as configuring select items, putting the meter in Test Mode and presetting display registers. With the meter cover (or globe) removed, all configuration buttons are accessible to the user.

Note: The hardware Security Key in the Register board can be set up to disable access the user interface of the meter. Refer to the Maintenance section for a complete description of the Security Key features.

Activating the User Menu

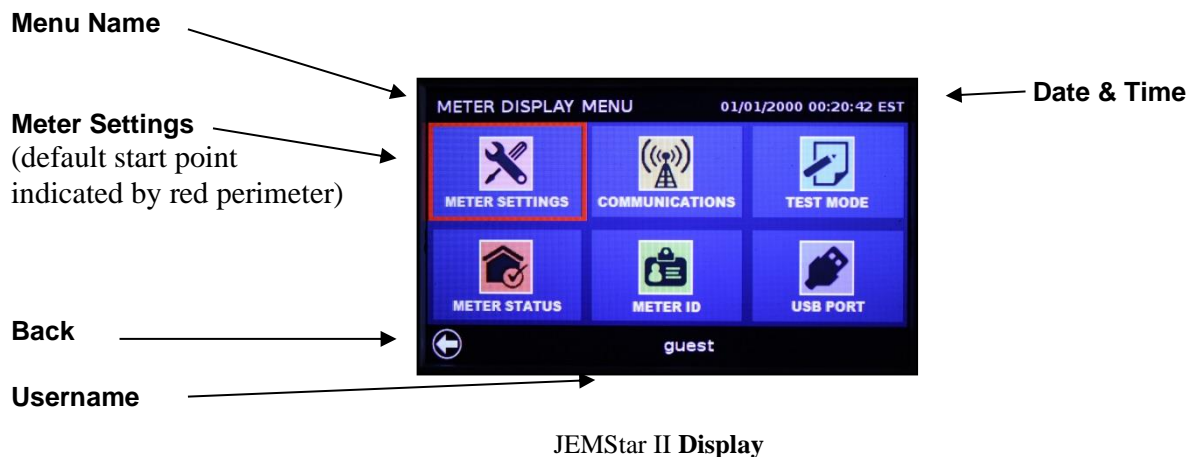
The User Menu is accessed after removing the meter cover. (this may require breaking a seal).

Press the left arrow button, and the display will immediately go to the Meter Display Menu.

Starting at the upper left corner, you will see Meter Settings highlighted. Highlighted areas (red perimeter) indicate the *selected* area. Using the UP and DOWN arrow buttons, you can scroll through the choices.

Use the right arrow button to move the cursor to the next menu item, Communications. In this manner, you can scroll up, down, left, or right, to place the selection 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.

Press SET to enter that menu. Once you have selected the desired menu feature, that menu will be displayed.



Menu Name

Each menu's title/name is displayed in the top left corner.

The Meter Display Menu is the main starting point for navigating all the menus.

Meter Settings

This is the default starting point, indicated by the red perimeter. Items included in this menu:

- Date & Time
- Analog I/O
- PT/CT
- Normal Preset Registers
- Digital I/O
- Alternate Preset Registers

Back

In the lower left corner is the Back navigation button. From any menu, moving the selection point to this icon will revert the display back to the previous menu.

Username

Your log-in status is indicated at the bottom of the display.

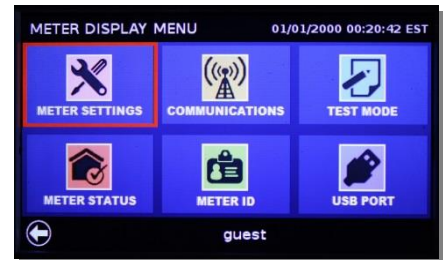
NAVIGATING THE DISPLAY USER MENUS

In standard operation, the JEMStar II display is used to show the measured electrical quantities and other monitored parameters. However, the display can easily be switched into the User Menu 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 shows all menu functions.

Meter Display Menu:

Pressing the Left front panel button will invoke the Meter Display Menu. The red perimeter around a menu item indicates it is selected. Meter Settings is the default starting location. To enter the menu item, press the Set button in the center of the navigation keys. To exit any menu, navigate to the Left arrow on the display and press Set. Or press the Read button.



Meter Settings:

To enter, press Set. Using this menu you can configure features such as: Date/Time, PT/CT, I/O and Register Presets.



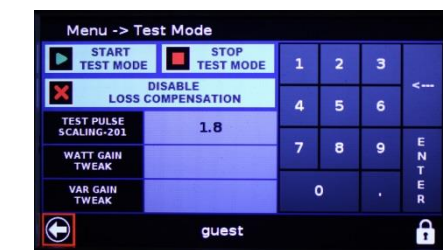
Communications:

From the Meter Display Menu press the Right arrow once. And press Set. This will invoke the Communications menu where you can configure the ports.



Test Mode:

From the Meter Display Menu press the Right arrow twice. Press Set. This will invoke the Test Mode menu where you can change the test pulse scaling, enable loss compensation and start Test Mode.



Meter Status:

From the Meter Display Menu press the Down arrow once. Press Set. This will invoke the Meter Status menu where you can check the Comm and Site Status, reset the battery status, reset users and passwords and do a cold start.



Meter ID:

From the Meter Display Menu, press the Down and Right arrow once each. Press Set. This will invoke the Meter ID menu where you can view the identification and firmware version.



Note: MID meters will not have access to any configuration changes from the User menu.

USING 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.

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 II settings can be configured using JEMWare II software. Please refer to the JEMWare II instruction manual 1079-699 to configure a meter via software.

JEMStar II 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.

Unlocking the Meter

Before you can edit configuration parameters, the meter must be unlocked with the correct username and password. Once this entered, the User Menu configuration items will remain unlocked for a predetermined amount of time as configured in the JEMWARE software. Whenever you are on a User Menu configuration screen that allows editing, you will see a lock icon in the lower right corner. Tab to this Lock Icon and press the Set key. This will bring up a Security Log-In screen. The Username field will have a red box to highlight this selection. Use the Up and Down arrow keys to scroll through the different Usernames configured for this meter. Once you arrive at the correct one, press the Set button. The Password field will now have a red box highlighting this selection. Use the Up,Down, Left and Right arrow keys to select the letters, numbers and symbols that make up the correct password for the specified username, pressing the Set key after each entry. When done entering the password, move to the Enter tab and press the Set Key. If done correctly, the Lock symbol will open up showing that the meter is unlocked for configuration edits. Also, the User Menu screens will display the current username that ou entered. If you need to exit from the password screen, press the Read button.



Note: Meters with the internal security jumpers installed can not be unlocked.

Meter Settings

This user menu will allow the viewing or editing of Date and Time, PT/CT Ratios, Digital and Analog I/O and Presetting Normal and Alternate Registers.



Time & Date:

The time and date can be set once the meter is unlocked. This will be evident when the lock is in the open position.

Press Set to enter the Set Time & Date menu shown here. Using the navigation keys, move around the fields to increase/decrease the numeric values. The time is displayed in the 24 hour format. Press SAVE once the time and date fields contain the desired value.



PT/CT Ratio

You can read and change the Power Transformer Ratio and the Current Transformer Ratio by going to the Meter Display Menu and selecting Meter Settings. Scroll right to PT/CT and press Set. Edit the existing setting by moving from field to field and using the arrow buttons to enter a new ratio and then pressing SET. Be sure to update the front panel label to correspond to the new ratio that you entered.



NOTE 1: Changing the meter's PT or CT Ratio will cause Load Profile pulse constants, Energy Pulse constants and Site Monitor thresholds 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 PT 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 PT and CT Ratios via JEMWare II configuration software to maintain your TLC settings.

Digital I/O

This is a view-only menu from the meter; all edits must be performed using JEMWare II software. If equipped with the DIO option, this screen will show whether the I/O channel is set up as an Input or Output, the function of the I/O and the current I/O state (ON or OFF)

CH	TYPE	FUNCTION	STATE
1	INPUT	INTERVAL SYNC, Scaling - None, TOU rate T, Form A	OFF
2	INPUT	INTERVAL SYNC, Scaling - None, TOU rate T, Form A	OFF
3	INPUT	INTERVAL SYNC, Scaling - None, TOU rate T, Form A	OFF
4	INPUT	INTERVAL SYNC, Scaling - None, TOU rate T, Form A	OFF
5	INPUT	INTERVAL SYNC, Scaling - None, TOU rate T, Form A	OFF
6	INPUT	INTERVAL SYNC, Scaling - None, TOU rate T, Form A	OFF

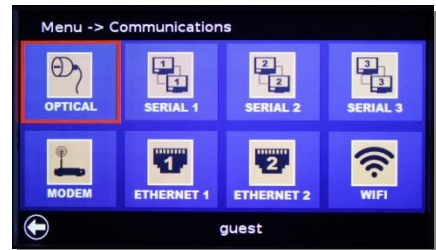
To view the input settings: from the Meter Settings menu press the right arrow twice and hit Set. Then select a Channel number that you want to view. The screen will display what each of the channels has been configured to monitor. To edit the configuration, you must use JEMWare II software.

Communication Settings

There are a few methods of interfacing with JEMStar II: Optical port, Serial data (RS-232/485), modem, Ethernet & WiFi. The display menu allows reading and editing of basic communications port parameters such as:

- Type: For Serial ports, select whether communications are via RS-232 or RS-485
- Protocol: Use the arrow buttons to select a communication protocol, such as; Binary, DNP, Modbus (RTU or ASCII), or ANSI Tables
- Baud: Use the arrow buttons to scroll through the available choices
- Address: A unique address assigned the each meter.
- IP Address: Select this for Ethernet options

Press the Left navigation key to invoke the Meter Display Menu. Press the right arrow once and hit Set. From this menu you can configure the desired communication parameters.



Test Mode

This display is used for putting the meter into Test Mode which is used for checking the accuracy of the meter. More details on testing the meter are in the next section called Test and Calibration



Meter 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 Meter Display Menu, scroll down once to Meter Status and press Set. This will display a screen that shows: Comm Status, Site Status, Reset Battery, Reset Users and Passwords, and Cold Start.

Comm Status

The Comm Status is a special display that provides the status of all communication ports. This screen can be configured as a standard Display Register in JEMWARE or displayed manually with the User menu. The function of this display is described in the previous Display section.

Site Status

The Site Status display shows various screens on the current site conditions, such as the Phasor Display, Harmonics (future), Alarm Summary, etc. These screens can also be configured as a standard Display register in JEMWARE or displayed manually with the User Menu. The function of these displays is described in the previous Display section.

Reset Battery The meter has a 10 year lithium ion battery to back up the time clock. If the battery needs replacement it will produce a Battery Warning indication. When the battery is replaced, you need to reset the Battery Monitor using the Reset Battery screen. Refer to the Maintenance section of the manual for battery replacement.

Reset Users & Passwords This selection resets all user names and passwords back to factory defaults. You will be warned of the pending removal of user configurations, which you must accept by selecting Yes. You will then be prompted to remove power from the meter within 15 seconds or it will ignore the request.

Cold Start A Cold Start returns the meter back to factory defaults. Refer to the Maintenance section of this manual for details on the Cold Start.

Meter Status Indicators

The Meter Status screen has indicators on the right side for the Time Sync Status, Internal Diagnostics and Battery Status. The function of these indicators is shown below.

Time Sync Status Indicates Crystal or Line sync.

Internal Diagnostics 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.

Battery Status Monitors the internal RAM battery and advises if OK.

Meter ID, Firmware Version

You can read the following information about how the meter is configured by going to the Meter Display Menu. Press down and right once. And press Set to enter the Meter ID menu.

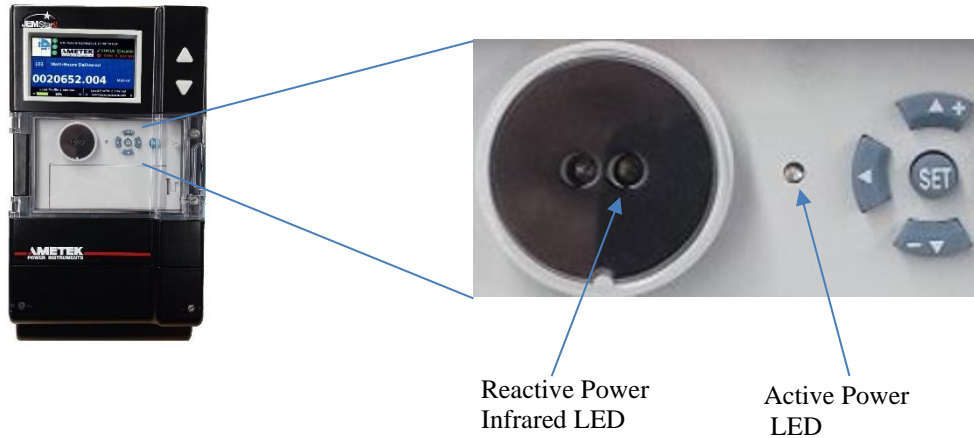
ID This is the meter identification that will appear in the register list.

Meter Set-up Available types are 4-Wire Wye, 4-Wire Delta, 3-Wire Delta, Network, Open Delta, 3-Wire Wye

Firmware Versions This is the version number of the firmware installed in the meter.

TEST & CALIBRATION

The meter can provide test pulses from the Optical Port and Active Power LED in Normal Mode or Test Mode. In Normal Mode, the meter operates normally, measuring and registering power in registers, Load Profile, etc. When the meter is put into Test Mode, it no longer registers power.

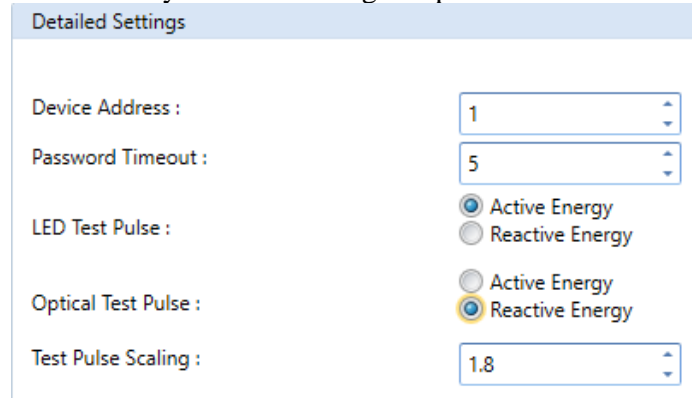


Normal Mode

Using JEMWARE Configuration Software, you can set up the Optical port to continuously output test pulses for either active or reactive power using your own scaling factors.(default is reactive power) In addition, the LED Power Pulse can be used for active or reactive power (default is active power). The test pulses will be scaled to whatever the secondary meter input is. For example, if the meter secondary is registering 1,800 watt-hours and the scaling is set for 1.8, you will get 1,000 pulses per hour. This allows you to check the meter accuracy without removing the meter cover and without putting the meter into Test Mode.

Notes: When the meter is first powered up, the meter begins registering power within a few seconds and the test pulses begin within 10 seconds. (The meter continues to start up during this process, eventually scrolling measurements on the display and enabling the communication options.)

When the Optical Port is used for serial communications, the test pulses will stop and serial communications will be established. Once the Optical Port communications are finished, the meter will automatically resume sending test pulses within a few minutes.



Test Mode

Test Mode is a special mode that stops the registration of power for testing purposes. When the testing is complete, you can return the meter to the normal operating mode. To put the meter into Test Mode, you need to access the meter user display to select the Test Mode activation screen.

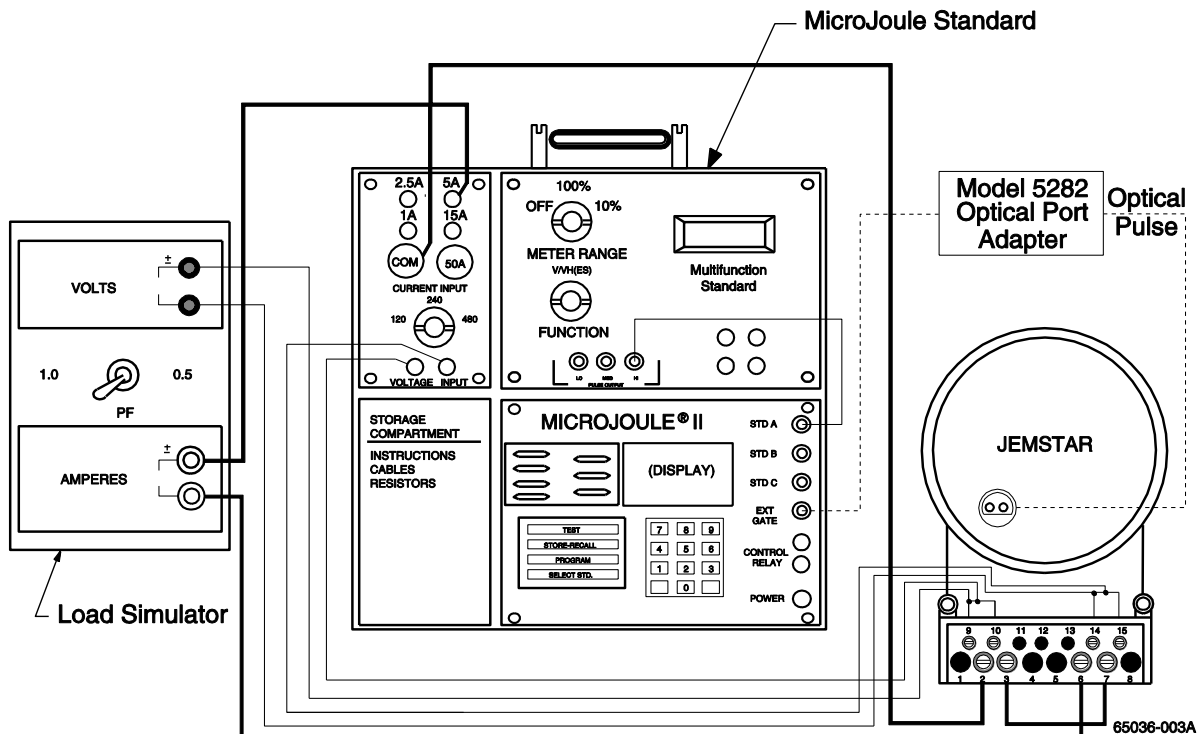


To enter the Test Mode, press the left key to invoke the Meter Display Menu:

Press the right arrow twice and hit Set. You must press the SET button to actually enter Test Mode. This action helps prevent accidentally entering into Test Mode and suspending registration. Use the navigation keys (+/Up or -/Down) to increase and/or decrease the values in the various fields.

The JEMStar II 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 KYZ digital pulse outputs are available even when the meter is in Test Mode, operating at their programmed K_e value.

The JEMStar II 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 II voltage elements in parallel and the current elements in series. Refer to the following example that shows how to connect a JEMStar II and a Watt Standard to an external load source.



TYPICAL CONNECTION DIAGRAM FOR JEMSTAR II 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.

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. Energy output pulses continue to operate as before.
6. DNP and Ethernet communication are suspended.

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.
5. DNP and Ethernet communication are re-enabled.

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 fields.

To turn Loss Compensation on or off:

1. Press the Up Arrow key as needed to reach Loss Compensation. Note: This is a default Test setting only, and has no affect over the actual meter configuration. The configuration setting as sent from JEMWare II 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 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 – 40 millisecond) burst of infrared light sent by the Optical Port transmitter.

Measurements that may be selected for output as a Test Pulse during Test Mode 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 test register may be output as a Test Pulse. The pulse weight (Kt) for each pulse is selectable by the user in JEMWARE via the Test Register setup or through the front panel user menu while in Test Mode.

MAINTENANCE

Damage to the instrument can be caused by Electrostatic Discharge (ESD). Appropriate precautions should be incorporated.

Any JEMStar II 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 electrostatic-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 II meter design, with its plug-together boards, requires few tools for maintenance.

Caution!

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

SERVICING

Serviceable Parts

The only serviceable parts are the meter clock battery and the security key jumpers. See the following sections for specific instructions for changing both.

The JEMStar II clock/RAM battery is designed to last 10 years under normal storage and usage conditions. If the battery needs replacement, or you would like more information on any JEMStar II components, call Ametek Power Instruments' Technical Support staff at 888-880-5361.

Clock Battery

The meter battery is primarily used for backing up the clock when power is removed. The long life cell should provide support for 10 years, and its life can be checked from the front panel display.

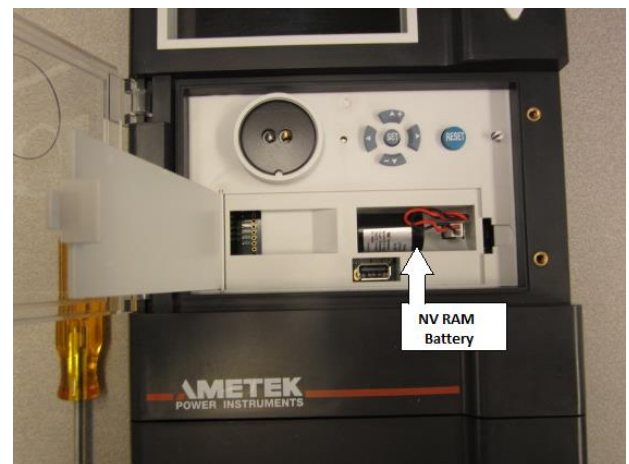
1. Press the Left key to invoke the Meter Display Menu.
2. Press the –/Down key once to highlight the Meter Status menu.
3. Press Set.

Battery Status is displayed on the bottom right.

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 time is not lost (the battery is not used as long as service power is connected).

➔ To replace the clock battery:

1. If you remove the battery while the meter is under power, you will preserve the current time and date
2. Open the clear front access door by unfastening the two captive screws on the right side of the front cover assembly. Unlatch and lift the battery compartment cover open.
3. The battery plugs into the top of the Register board. Unplug the two-pin connector and lift the battery out of its compartment.
4. Install a new, exact replacement battery, available from the factory. Specify part number 6005-254.



To reset the battery warning indicator:

1. From the front panel menu, press the Left key to invoke the Meter Display Menu.
2. Press the down key once to highlight the Meter Status menu and press Set.
3. Using the navigation keys, move down to Reset Battery. And press Set. The Date and Time may also need to be set if the meter was taken out of service while changing the battery.

Note: If you power up the meter with no battery or with a dead battery, the Register and Load Profile data will be erased and the configuration file will go back to the default. Also, the real-time clock will be reset to 1/1/2000.

Security Keys

JEMStar II 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 rear of the Register board.

One security key is used to disable all functions that could impact meteorological measurements. This includes configuration changes from the front panel keypad menus, plus the following commands when accessing the meter via remote communications using JEMWare II.

- Configure Primary/PTCT Settings
- Configure Display Registers
- Configure Load Profile
- Configure Loss Compensation
- Configure TOU/DST settings
- Configure Input/Output Settings
- Configure Trigger Settings
- Configure Demand Settings
- Configure Transformer Correction
- Firmware/Option Upgrade
- Activate Test Mode

The following commands will be allowed with the security key installed:

- Configure Meter Identification
- Configure Communication Settings
- Configure Protocol Settings
- Configure Display Settings
- Configure User Admin
- Change Password
- Set Time
- Freeze Registers
- Meter/Battery Status
- Read Triggered Alarms
- Read Display registers
- Read Load Profile
- Read Event/Diagnostic Logs
- Read Security Logs

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 removed, access is enabled. Install the jumpers to restrict access.

MID Meters will have both security keys installed. Non MID meters will have the security keys removed, but can be installed by the meter owner if desired.

If you want to install the key(s) after proper configuration in your meter shop, follow this procedure.

1. Remove power from the meter.
2. Remove the outer cover and inner display cover as described below.

Cover Removal (non MID meters)

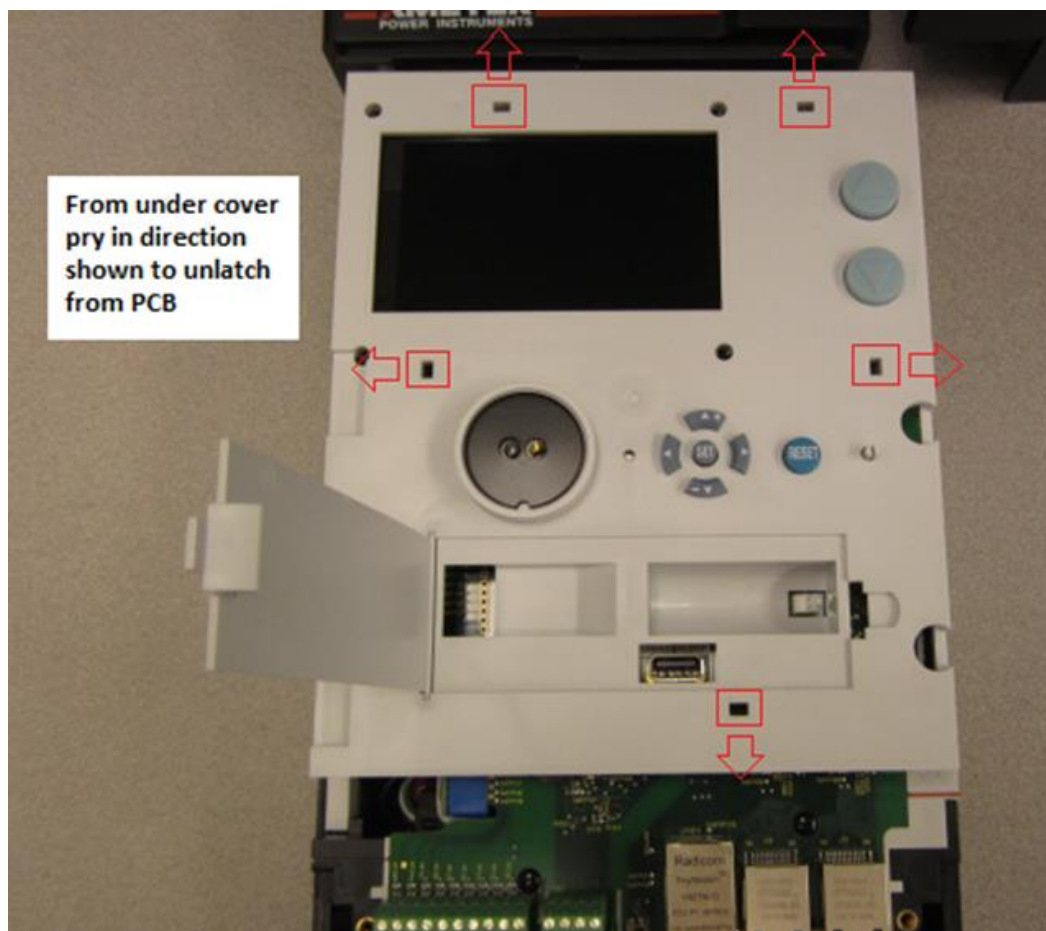
1. Removal of the entire front cover assembly is only necessary when changing or reconfiguring the *Security Keys* jumpers. This must be performed with the power completely removed from the meter.
2. Remove the terminal block cover by unfastening the two captive screws on each side of the meter.
3. Remove the front cover assembly by unfastening the two captive screws at the bottom of the cover. Lift the cover slightly while pulling forward from the bottom to remove this outer cover assembly.

Terminal Block Cover and Front Cover Removed



Internal Display Cover Removal

1. After removal of front cover, the internal display cover assembly must be removed in order to change *Security Key* jumpers. The internal cover retains the push buttons as well as the clock battery. The clock battery must be removed prior to removing the display cover. To do so, unlatch and open the battery cover door. Remove the battery from the 2 pin connector mounted to the Register board. Note that before or when the meter is put back into service, the meter clock will need to be set for the correct time and date.
2. The display cover assembly is retained by five plastic posts that are latched into the Register board. To remove the display cover gently pry the latch “fingers” outward while pulling upward on the display cover itself. When each cover latch is clear of the Register board, swing the entire assembly upward to the left of the meter. Take care not to pull on or stress the display cable located under the upper left side of the meter. The cover should be layed open to the left with the display cable remaining attached.



Display Cover Removed

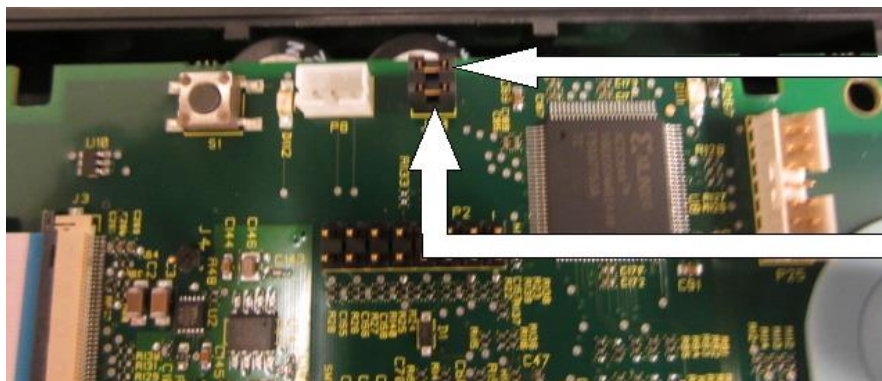


Security Jumpers

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 for replacement.

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.

After security keys (jumpers) are configured as desired, reassemble meter in reverse order of cover removal process. Reinstall the NV RAM battery before powering up the meter or putting into service. The meter time and date will need to be set after power up.



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

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

TOP OF METER WITH COVER REMOVED

FIRMWARE UPGRADES (NON MID METERS)

New meter firmware can be downloaded locally or remotely via the meter's communication ports. New firmware may be used to add optional features (like Power Quality), product enhancements, or program upgrades.

The firmware that can be upgraded on the meter consists of Register, Service and Metrology. When upgrading more than one version of firmware at one time, start with Service followed by Register and Metrology. The current versions of the firmware installed in the meter can be displayed on the User Menu, added to a Normal or Alternate register for scrolling on the display, or displayed on a WEB Browser when using that for a firmware upgrade.



It is recommended to use the Ethernet port for these upgrades due to the size of the firmware file. On meters that do not have the Ethernet Option provided, the meter will still contain a built-in Ethernet port to be used for this purpose.

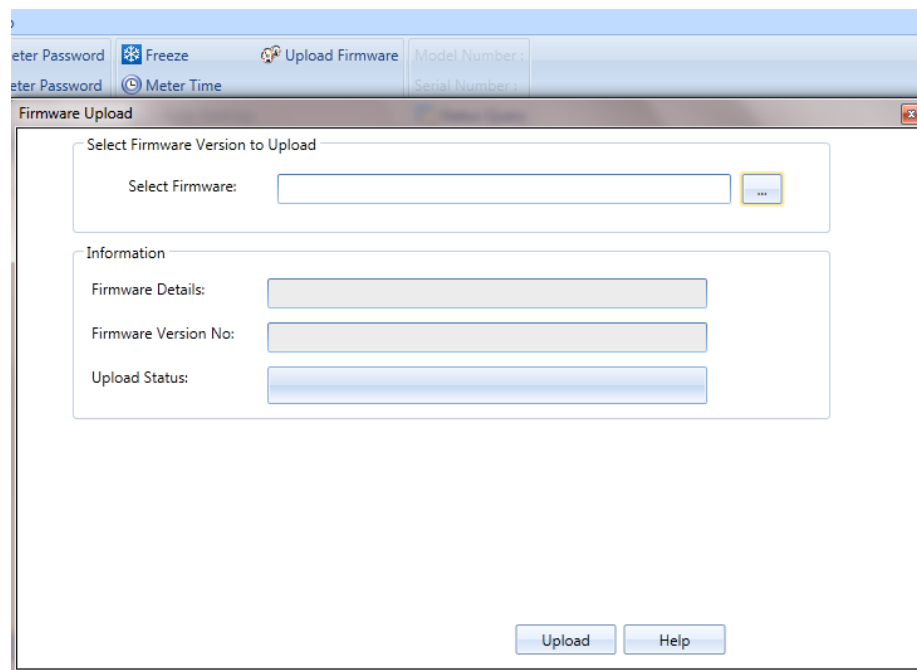
To perform a Firmware Upgrade, save the updated firmware file(s) you received from AMETEK to your computer. Connect your computer to the meter either locally or remotely via the Ethernet Port. Make sure the computer is set up to connect to the IP address assigned to the meter. The User Menu can be used to display the IP Address of the meter. The default setting from the factory is: 192.168.250.100

The upgrade can be performed through the JEMWARE II Software or through a standard WEB Browser.

Using JEMWARE for Firmware Upgrades

Connect the computer to the Meter. It is recommended to download the configuration file and meter data from the meter if you don't already have a copy of it. (Refer to the JEMWARE Software Manual for more details).

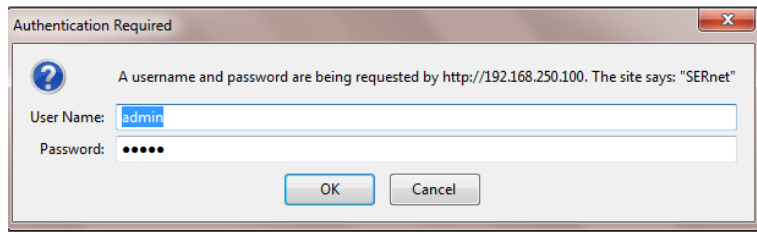
Select the button labeled 'Upload Firmware'. This will open up a box that will let you select the firmware file. Once selected, select the Upload button. When completed, perform a cold start on the meter.



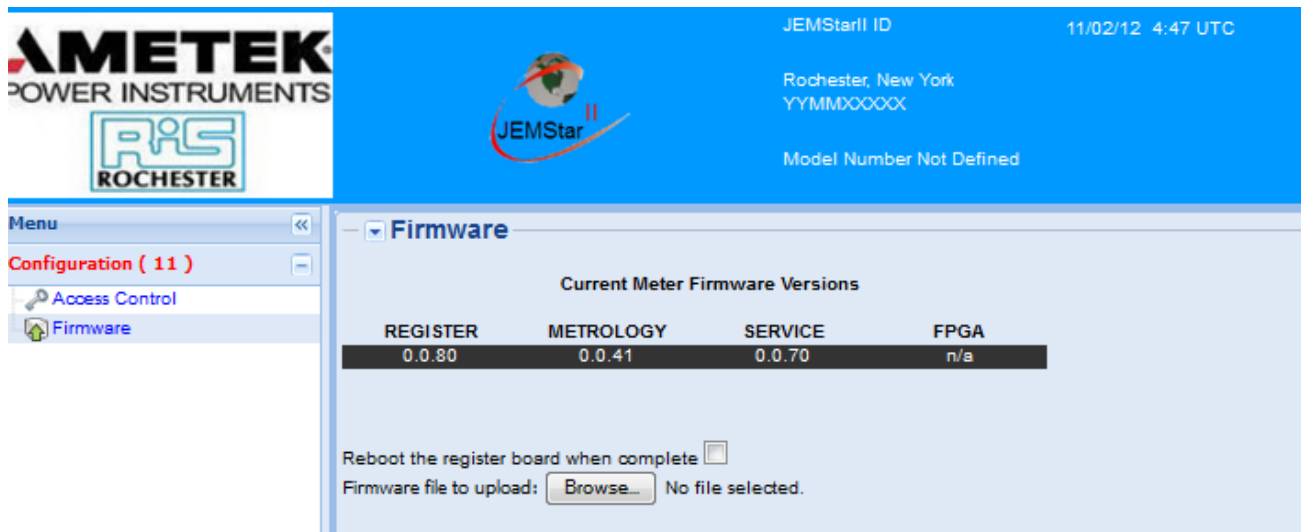
Using the WEB Browser for Firmware Upgrades

Connect the computer to the Meter's Ethernet Port. It is recommended to download the configuration file and meter data from the meter if you don't already have a copy of it. (Refer to the JEMWARE Software Manual for more details).

Using a standard web browser such as Internet Explorer, Mozilla Firefox, etc; enter the IP Address of the meter. (The factory default is 192.168.250.100) If successful, you will get a prompt for a Username and Password. The default is: User Name: admin Password: admin



Once the password is entered, you will get a browser window. Select the tab on the left for Firmware. This will open up a screen that will show you the current version of firmware. Select the Browse button to search your PC for the new firmware file. It is recommended to select the re-boot register board when complete. The browser screen will show you the status of the upgrade. When done, it will automatically disconnect from the web browser, so you will need to close out any warning messages that appear.



Tips for Upgrading Firmware:

1. Make a copy of the meter configuration and download data before upgrading firmware.
2. If upgrading multiple firmware versions, start with Service followed by Register and Metrology.
3. Select re-boot register when downloading firmware
4. Some upgrades may require a Cold Start after installing all firmware versions. AMETEK service will advise if this is required.
5. If you encounter issues after a firmware download, try disconnecting the battery, remove power and re-apply power. Plug in battery after the meter starts up. (This will reset the processors)

Note: MID meters must be returned to the factory for upgrading the firmware.

COLD START (NON MID METERS)

A Cold Start will bring the meter back to factory defaults. Sometimes this is needed when upgrading much older firmware to newer firmware. The AMETEK Service group will always advise if this is necessary in the update instructions. Other times, if configuration data gets corrupted, communications are locked up or you have internal issues that can't be resolved; a cold start can start you back to factory defaults.

A 'Warm Start' can also be tried first, which consists of removing power from the meter for a few seconds. If the issue isn't resolved, a Cold Start may be required.

Before performing a Cold Start, it is recommended to download/back-up all meter data and configuration details.

Note: A cold start erases all register and load profile data. The configuration parameters are reset to factory defaults (see Appendix A).

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

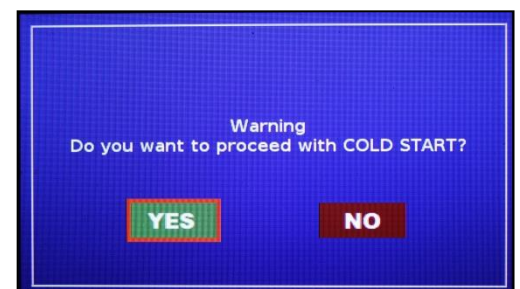
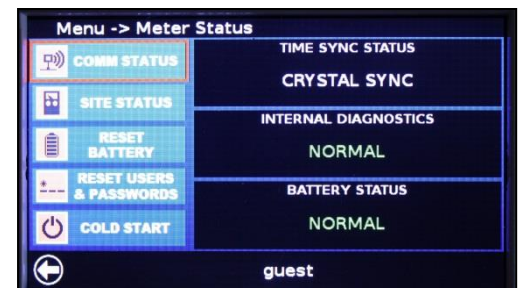
Performing a Cold Start

Pre-requisites:

- Requires the admin username and password
- Must un-seal the meter (remove terminal cover and front cover of IEC meter)
- Will require removal of power from the meter
- Must be performed at the meter

Instructions:

1. From the Meter Display User Menu, press the down button once and press Set. This takes you to the Meter Status menu.
 2. You will need to unlock the meter by moving to the 'lock' icon and press Set. This will bring up a keypad to select the admin username and password authorized to do this.
 3. Using the navigation keys, move down to Cold Start and press the Set button.
 4. Acknowledge the warning by selecting Yes.
 5. The meter will prompt you to power down the meter within 15 seconds
 6. The meter will take a little longer to start up. This is normal.
- After a Cold Start is performed, the meter should be reconfigured using *JEMWare II* configuration software to program the meter for your specific application.



Note: If you still encounter issues after a Cold Start, try disconnecting the battery, remove power and re-apply power. Plug in battery after the meter starts up.

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.

Note: 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.

SITE DIAGNOSTICS

JEMStar II can be configured to monitor its operating environment and report suspicious conditions. This monitoring occurs in two forms: Meter Health & Status and Phasor Display.

Meter Health and Status

The Meter Health and Status display provides the current status of the meter. There is a selection on the right top of the Meter Health and Status display for printing this page.

The screenshot shows the 'Meter Health and Status' window with the following data:

Trigger ID	Description	Value	Time\Date
1	1,Inst,VLL:A,<,100,0,105	1.475	11:16:30 06-Aug-2014
5	5,Inst,VLL:C,>,130,10,125	257.069	11:16:30 06-Aug-2014
6	6,Inst,PFV:P,<,0.7,10,0.75	0.000	15:52:25 07-Aug-2014

The following items are monitored in the Meter Health and Status display:

Meter Status:

This identifies the internal meter status. Green is normal. If red, you should be able to see additional detail by reading the Diagnostic Log from the meter. The meter status is also provided on the JEMStar Meter display.

Time Sync Status:

This is mainly used for external time sync options (IRIG-B and NTP). For IRIG-B, it will turn red when the IRIG-B time source is not detected. For NTP, it will display the status of the time server connected and will turn red when the signal is lost.

Battery Status:

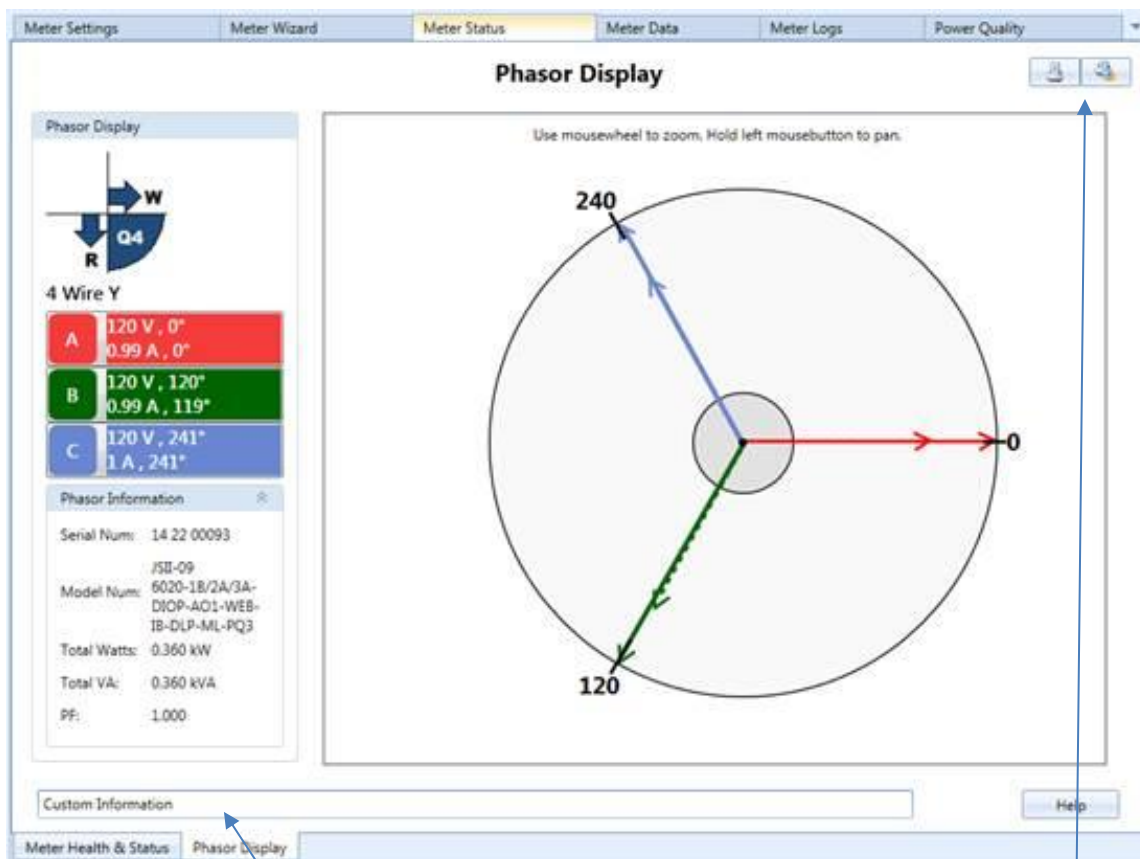
This indicates the status of the internal replaceable battery used to back up the time and date on the internal clock. Green indicates normal, yellow indicates that the battery should be replaced in 1-2 years and red indicates that you should replace the battery now. The same green/yellow/red indicator is provided on the meter display. The battery warning (red indicator) can be reset on the meter user menu display. Note: The internal battery is rated for 10 years under typical use. The battery monitor is conservative and assumes worse case where the battery is used almost continuously.

Triggered Alarms:

This is a display of all active alarms configured by a user trigger. The Alarm Log contains the history of all active alarms and previous alarms.

Phasor Display

The Phasor Display is available on the meter display and in JEMWARE Software as shown below. It provides quick verification of the site conditions and confirmation that it was wired correctly.



Phasor Display using JEMWare II

The Phasor display has a user field for entering custom information in case you wish to save or print this display. There is a selection on the right top of the phasor display for printing this page or saving it as a bitmap file.

ADVANCED FEATURES

LOAD PROFILE

JEMStar II can record up to 16 Load Profile channels as a standard feature, or up to 32 channels as an added option. All Load Profile configurations are performed using JEMWare II 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. Sometimes referred to as First In, First Out (FIFO). JEMStar II 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. The Load Profile Recording can be set up to record measurements in 16 bit (counts) with a scaling factor applied to the measurement (Km) or 32 bit values that can represent actual engineering values (no scaling required). When using 16 bit counts, each channel can store up to 16,383 counts per interval. When using 32 bit values, each channel can store measurements up to 1,073,741,824.

JEMStar II load profile storage will vary by the number of channels selected and the recording data interval. By configuring fewer channels and/or longer intervals, you can increase the number of days of storage.

Table 1 details the days available for the JEMStar II.

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

- Any consumption measurement
- Any instantaneous measurement (Note: instantaneous measurements are averaged over the interval time interval)
- Status Word
The Status Word consists of a System Bit and a Trigger Bit to monitor the status of the meter during that interval. (Refer to the next section on the Status Word)

- Pulse Inputs (the quantity of digital pulses are summed during an interval. The Digital I/O option must be included and configured to count input pulses)
- 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 Digital I/O option must be included and configured to count input pulses)

Table 1: Approximate Number of Days of Load Profile Storage (16-Channel)

Interval Length	Number of Load Profile Channels															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	128	101	83	70	61	54	48	44	40	37	34	32	30	28	26	25
2	256	201	166	141	122	108	97	88	80	74	69	64	60	56	53	50
3	383	301	248	211	183	162	145	132	120	111	103	96	90	84	79	75
4	509	400	330	280	244	216	193	175	160	148	137	127	119	112	106	100
5	635	499	411	350	304	269	241	219	200	184	170	159	149	140	132	125
6	759	597	492	418	364	322	289	261	239	220	204	190	178	167	158	149
10	1095	981	809	688	599	530	475	431	394	363	336	314	294	276	260	246
12	1095	1095	956	821	714	632	567	514	470	433	401	374	350	329	311	294
15	1095	1095	1095	1016	885	783	702	637	583	537	498	464	434	408	385	365
20	1095	1095	1095	1095	1095	1029	923	837	766	705	654	610	571	537	506	479
30	1095	1095	1095	1095	1095	1095	1095	1095	1095	1029	954	889	833	783	739	700
60	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095	1095

Event Recording in Load Profile

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

Power Fail

Indicates the meter has lost auxiliary power. If the meter does not have separate auxiliary power, Power Fail indicates the loss of all 3 phase inputs. The time of power failure & 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 II 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' JEMWARE II Software, *JEMRead* software or other third party software applications. Connection to the meter can be via the optical port, RS-232 / RS-485 serial port, Ethernet or a modem.

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 II 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 II can be used to configure any Load Profile channel to record when the TOU Rate Override contact input is ON.

Typical Load Profile Printout

Record No	Event Type	Start Time	End Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	Configuration	7/31/2014 16:23	7/31/2014 16:23	0	0	0	0	0	0	0	0	0	0	0	0	0	946	946	946
1	Normal	7/31/2014 16:23	7/31/2014 16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	949	949	949
2	Normal	7/31/2014 16:30	7/31/2014 16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	949	949	949
3	Freeze	7/31/2014 16:45	7/31/2014 17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	948	948	948
4	Normal	7/31/2014 17:00	7/31/2014 17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	950	950	950
5	Normal	7/31/2014 17:15	7/31/2014 17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	952	952	952
6	Normal	7/31/2014 17:30	7/31/2014 17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	951	951	951
7	Freeze	7/31/2014 17:45	7/31/2014 18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	947	947	947
8	Normal	7/31/2014 18:00	7/31/2014 18:15	0	0	0	0	0	0	0	0	0	0	0	0	0	950	950	950
9	Normal	7/31/2014 18:15	7/31/2014 18:30	0	0	0	0	0	0	0	0	0	0	0	0	0	951	951	951
10	Normal	7/31/2014 18:30	7/31/2014 18:45	0	0	0	0	0	0	0	0	0	0	0	0	0	953	952	952
11	Freeze	7/31/2014 18:45	7/31/2014 19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	952	952	952
12	Normal	7/31/2014 19:00	7/31/2014 19:15	0	0	0	0	0	0	0	0	0	0	0	0	0	953	953	953
13	Normal	7/31/2014 19:15	7/31/2014 19:30	0	0	0	0	0	0	0	0	0	0	0	0	0	954	954	954
14	Normal	7/31/2014 19:30	7/31/2014 19:45	0	0	0	0	0	0	0	0	0	0	0	0	0	955	955	955
15	Freeze	7/31/2014 19:45	7/31/2014 20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	957	957	957
16	Normal	7/31/2014 20:00	7/31/2014 20:15	0	0	0	0	0	0	0	0	0	0	0	0	0	957	957	957
17	Normal	7/31/2014 20:15	7/31/2014 20:30	0	0	0	0	0	0	0	0	0	0	0	0	0	955	955	955
18	Normal	7/31/2014 20:30	7/31/2014 20:45	0	0	0	0	0	0	0	0	0	0	0	0	0	952	952	952
19	Freeze	7/31/2014 20:45	7/31/2014 21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	949	949	949
20	Normal	7/31/2014 21:00	7/31/2014 21:15	0	0	0	0	0	0	0	0	0	0	0	0	0	951	951	951
21	Normal	7/31/2014 21:15	7/31/2014 21:30	0	0	0	0	0	0	0	0	0	0	0	0	0	953	953	953
22	Normal	7/31/2014 21:30	7/31/2014 21:45	0	0	0	0	0	0	0	0	0	0	0	0	0	955	955	955

STATUS WORD

The Status Word provides the current status of the meter. The Status Word can be configured as a Display Register and logged into Load Profile for each interval. The Status Word consists of two 16 Bit words: System Bit and Triggered Bit. Each individual bit provides the status of a particular item as listed below:

System Bit

This provides the current status of the meter with regards to internal diagnostics and external influences. The following items and their location within the 16 bit word are shown below:

Bit #	Status Indicator	Description
1	Battery Failure	Indicates that the internal battery needs replacing. Stays active until the battery reset is performed.
2	Auxiliary Power Loss	Future
3	General Failure	Indicates an internal error which could include a Service comm error, PQ Firmware CRC error, Metrology Firmware CRC error, Service Firmware CRC error, PQ Comm error, Metrology Comm error, CRC Error in Calibration Data, PQDIF Storage error, Config Update Request. (Note: all of these are reported separately in the Diagnostic Log)
4	Load Profile overflow	The Load Profile Counts have exceeded the maximum 16 bit storage range of
5	Pulse Output overflow	Pulse output rate has exceeded 10 pulses/sec
6	Loss of Time Sync	Indicates a loss of external time sync from NTP or IRIG-B
7	NTP Time Sync Drift	It shall go into alarm when the internal clock is more than the configurable tolerance Ts which is adjustable from 10ms to 10,000 msec. Default is 500msec
8	DST	Indicates when the meter is using Daylight Savings Time. DST time and dates are configured in JEMWARE.
9	Terminal / Service Cover Removed	Indicates that the terminal cover or service cover have been opened up.
10	Manual Time Change	The meter time was changed manually.
11	Configuration Change	The meter configuration was changed.
12	Firmware Changed	The meter firmware was changed.
13-16	Future	

Note: All of the above status indicators will stay active for the duration of the condition with a minimum duration equal to the current Load Profile Interval.

For example; if using a 15 minute Load Profile Interval, and the terminal cover was removed for 5 seconds, the 'Terminal Cover' bit would stay active during the 15 minute interval in which it occurred.

The system bit will be presented as a Hex word which can be converted into a 16 bit string with 1's or 0's representing the status of each item above. As shown below; a System Bit presented as: 00 21 hex (Binary: 0000 0000 0010 0001) would indicate a 'Battery Failure' and 'Loss of Time Sync'.

Example	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Bit Position	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Trigger Bit

This provides the current status of the meter with regards to alarm triggers that you can configure in JEMWARE. A typical example of various triggered alarm bits is shown below:

Bit	Status Indicator	Description
1	Loss of voltage V1	<0.4 x Vn
2	Loss of voltage V2	<0.4 x Vn
3	Loss of voltage V3	<0.4 x Vn
4	Overcurrent I1	>1.3 x In
5	Overcurrent I2	>1.3 x In
6	Overcurrent I3	>1.3 x In
7	Loss of Voltage V1 with Current	V1<0.4 x Vn & I1>0.05 x In
8	Loss of Voltage V2 with Current	V2<0.4 x Vn & I2>0.05 x In
9	Loss of Voltage V3 with Current	V3<0.4 x Vn & I2>0.05 x In
10	Phase Voltage Rotation Error	Angle between two phases < 90 and >150 degrees apart
11	Phase Current Rotation Error	Angle between two phases <60 and >180 degrees apart
12	Voltage Unbalance	>0.05 x Vn
13	Current Unbalance	>0.05 x In
14	External Fault 1	Via Digital Input
15	External Fault 2	Via Digital Input
16	Future	

V1 = Voltage Phase A
 I1 = Current Phase A
 Vn = Nominal Voltage

V2 = Voltage Phase B
 I2 = Current Phase B
 In = Nominal Current

V3 = Voltage Phase C
 I3 = Current Phase C

Some of the trigger bits can be a combination of alarm triggers as shown in Bits 6-8

Note: All of the above status indicators will stay active for the duration of the condition with a minimum duration equal to the current Load Profile Interval.

ID	Enabled	Trigger Measurement	Trigger On	Phase	Operator	Alarm	Trigger Delay	Reset	Reset Delay	Digital Output	Sag/Swell	High Speed RMS	Waveform Capture
1	<input checked="" type="checkbox"/>	Instantaneous	VoltsL-N	A	<	40	0	40.12	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Med
2	<input checked="" type="checkbox"/>	Instantaneous	VoltsL-N	B	<	40	0	40.12	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Med
3	<input checked="" type="checkbox"/>	Instantaneous	VoltsL-N	C	<	40	0	40.12	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Med
4	<input checked="" type="checkbox"/>	Instantaneous	AmpsRMS	A	>	1.3	0	1.2961	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
5	<input checked="" type="checkbox"/>	Instantaneous	AmpsRMS	B	>	1.3	0	1.2961	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
6	<input checked="" type="checkbox"/>	Instantaneous	AmpsRMS	C	>	1.3	0	1.2961	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
7	<input checked="" type="checkbox"/>	Instantaneous	AmpsRMS	A	>	0.05	0	0.04985	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
8	<input checked="" type="checkbox"/>	Instantaneous	AmpsRMS	B	>	0.05	0	0.04985	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
9	<input checked="" type="checkbox"/>	Instantaneous	AmpsRMS	C	>	0.05	0	0.04985	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
10	<input checked="" type="checkbox"/>	Instantaneous	Volts Imbal...	None	>	5	0	4.985	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
11	<input checked="" type="checkbox"/>	Instantaneous	Amps Imba...	None	>	5	0	4.985	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No

Assignment of triggers to trigger bit number

Trigger bit #7 is a combination of trigger #1 and #7

Typical JEMWARE Config for the Status Word.

Displaying the Status Word

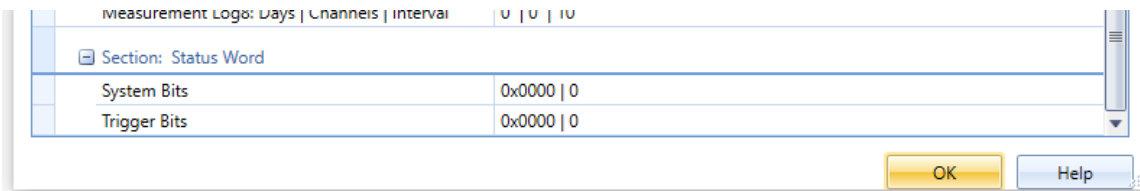
The Status Word can be presented when you connect to a meter in the Connection Status screen, as a display register, in load profile and in the communication protocols.

The value will be shown in Hex format which needs to be converted into Binary to determine the status of the 16 individual bit positions.

Some examples of this are shown below:

Meter Connection Status

When you connect to the meter, the Connection Status screen will indicate the current value for the Status Word System Bit and Trigger Bit, as shown below.



Display Register

If a display register is configured for the Status Word, the value will be shown when you read the register. Keep in mind that the current value for any register will be shown right after a meter freeze.

Category	Type	Description	Quantity	Phase	Direction	Value	Storage	Units
StatusWo...	TriggerBit	StatusWord,TBit	None	None	None	0x0070	None	None
StatusWo...	SystemBit	StatusWord,SBit	None	None	None	0x0400	None	None
Time	PresentTimean...	Time,PresTime&Date	None	None	None	05/14/2020 14:58:5		
Register	Instantaneous	C Phase Primary Volts	VoltsL-N	C	None	121.76		

Status Word
System BitsConfig Change;

Note: When you hold your mouse over the Status Word displayed in JEMWARE, it will indicate the individual bit status. As shown above, the mouse indicates that the System Bit result of 0x0400 is a configuration change.

The Trigger Bit Hex value of 0x0070 in binary is: 0000 0000 0111 0000. This reflects trigger bit numbers 5, 6 and 7 in alarm.

This is derived from the following Trigger Setup:

Trigger Setup

Advanced Trigger Configuration

Nominal % Calculations for Triggers

Nominal Voltage:
 PQ Voltage Measurement:

Threshold % Alarm Hysteresis % Reset

Sag:

Swell:

Interruption:

RVC:

Status Triggers

Bit	Enabled	Trigger/Combination
3	<input checked="" type="checkbox"/>	3
4	<input checked="" type="checkbox"/>	4
5	<input checked="" type="checkbox"/>	5
6	<input checked="" type="checkbox"/>	6
7	<input checked="" type="checkbox"/>	5 & 6

ID	Enabled	Trigger Measurement	Trigger On	Phase	Operator	Alarm	Trigger Delay	Reset	Reset Delay	Digital Output	Sag/Swell	High Speed RMS	Waveform Capture	Web
1	<input type="checkbox"/>	Instantaneous	VoltsL-N	Any	<	108	0	110.4	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	High	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>	Instantaneous	VoltsL-N	Any	>	132	0	129.6	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	High	<input type="checkbox"/>
3	<input checked="" type="checkbox"/>	VoltageInterr...	VoltsL-N	All	<	24	0	25.2	0	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
4	<input checked="" type="checkbox"/>	RapidVoltage...	VoltsL-N	Any	>	6	0	1.8	0	None	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
5	<input type="checkbox"/>	Instantaneous	VoltsTHD	A	>=	2	0	1.994	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No	<input type="checkbox"/>
6	<input type="checkbox"/>	Instantaneous	AmpsTHD	A	>=	1	0	0.997	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No	<input type="checkbox"/>

Load Profile

If a load profile channel is configured for the Status Word, it will show the current status for every interval. In the screenshot below, Load Profile Channel 5 is configured for the System Bit and Channel 6 is used for the Trigger Bit.

Record No	Event Type	Start Time	End Time	Channel: 1 Type: Consumption, Quantity: Whr, Phase: Polyphase, Direction: Delivered, Km Value: 1, TLC: 0, Interval Length: 5	Channel: 2 Type: Consumption, Quantity: Whr, Phase: Polyphase, Direction: Received, Km Value: 1, TLC: 0, Interval Length: 5	Channel: 3 Type: Consumption, Quantity: VARHr, Phase: Polyphase, Direction: Delivered, Km Value: 1, TLC: 0, Interval Length: 5	Channel: 4 Type: Consumption, Quantity: VARHr, Phase: Polyphase, Direction: Received, Km Value: 1, TLC: 0, Interval Length: 5	Channel: 5 Type: StatusWord, Quantity: SystemBit, Phase: None, Direction: None, Km Value: 0, TLC: 0, Interval Length: 5	Channel: 6 Type: StatusWord, Quantity: TriggerBit, Phase: None, Direction: None, Km Value: 0, TLC: 0, Interval Length: 5
0	Conf...	05/14/2020 15:28:4...	05/14/2020 15:28:4...	0.00	0.00	0.00	0.00	0x0400	0x0070

TriggerBit: Bit 5; Bit 6; Bit 7;

The Hex values displayed in Load Profile via JEMWARE will be identified by holding the mouse over them. As shown above, the trigger bit value in Hex 0x0070 is equal to trigger bits 5, 6 and 7.

POWER QUALITY

The JEMStar II can measure, capture and record power measurements related to power quality. The typical power quality issues include a variation of voltage above or below operating requirements and the presence of transients and harmonics. To capture these variations of the pure sine wave, there are several methods used including continuous recording of various power measurements and recording data after a pre-configured trigger. Once the data is collected, it needs to be analyzed so you can determine the type of issue, root cause and corrective action.

The JEMStar II meter has a variety of tools provided for your power quality applications:

- Sag/Swell/Outage Recording
- Waveform Capture
- High Speed RMS Recording
- Harmonic/Interharmonic Recording
- Flicker Measurement Recording
- Measurement Log (for saving recorded values)

Every JEMStar II meter includes the Sag/Swell/Outage Recording. When enabled, voltage sags and swells will record the time and date of the occurrence, number of cycles duration, phase that triggered the anomaly and the minimum/maximum/average current, voltage, power factor, THD and frequency during that event. For outages (interruptions), we record the start and end times/dates.

There are options available to enable the other power quality tools:

Option	Name	Description
PQ	PQ Ready	Meter can be upgraded in the field for a future PQ Option
PQ1	PQ Basic	High Speed RMS
PQ2	PQ Advanced	Waveform capture, Harmonic Recording, Flicker (includes Measurement Logging)
PQ3	PQ Max	PQ Basic and PQ Advanced (Option PQ1 and PQ2)

PQ Ready (Option PQ)

When meters are equipped with this option, they include all the hardware to support a future Power Quality Upgrade to option PQ1, PQ2 or PQ3. Once the specific option is purchased, the meter can be enabled with a software key provided by AMETEK. This option is useful when you may want a future PQ upgrade without having to change out the meter.

PQ Basic (Option PQ1)

This option provides the ability to record power quality anomalies with high speed RMS voltage and current measurements. The recording starts upon a pre-configured trigger which can be assigned to any instantaneous measurements.

With this option, the meter will record the following:

- Record RMS voltage, current and phase angle per phase
 - 100/120 Hz recording rate (2 measurements per cycle)
 - 0 to 0.5 second configurable pre-fault recording (recording prior to trigger)
 - 0 to 1.0 second configurable post-fault recording (recording after it returns to normal)
 - Maximum 60 second total recording time

PQ Advanced (Option PQ2)

This option provides the ability to record power quality anomalies with waveform capture, harmonic and flicker recording.

The waveform capture recording starts upon a pre-configured trigger which can be assigned to any instantaneous measurements. With this option, the meter will record the following:

- Voltage and current per phase
 - Three recording rates to choose from.
 - Low Resolution Recording
 - 900 Hz Recording rate (16 samples per cycle)
 - 0 to 30 cycle Pre-Fault/Post-Fault
 - 2 to 960 cycle Recording Time
 - Medium Resolution Recording
 - 7,680 Hz Recording rate (128 samples/cycle)
 - 0 to 10 cycle Pre-Fault/Post-Fault
 - 2 to 240 cycle Recording Time
 - High Resolution Recording
 - 30,720 Hz Recording rate (512 samples/cycle)
 - 0 to 5 cycle Pre-Fault/Post-Fault
 - 2 to 30 cycle Recording Time

Values shown for 60 Hz.

In addition to waveform capture, the PQ2 option provides the recording of harmonics and flicker. The measurements we can record include:

- Harmonics
 - Voltage and Current Magnitude per phase up to 64th
 - Voltage and Current Phase Angle per phase up to 64th
 - Voltage and Current THD to 128th
- Interharmonics
 - Voltage and Current Magnitude per phase up to 50th
- Flicker
 - Pst, Plt, Pinst

These measurements are recorded in the Measurement Log with selectable recording intervals from 150/180 cycles to 120 minutes. Refer to the next section on Measurement Log for more details.

PQ Max (Option PQ3)

This option combines options PQ1 and PQ2 together providing all features.

Power Quality Software

The JEMWARE Software used to configure the meter is also used to retrieve and display the power quality data. This software is included with every meter. Other third party software applications can be used to examine our power quality data saved in the PQDIF file format.

Power Quality Recording

The JEMStar II has several ways to measure and capture Power Quality data. There are options for short and long term recording and the data collected can range from low to high resolution. The JEMStar II can be used to collect all of the above simultaneously so that you can get a complete picture of the power quality event. The recording of power quality data can occur continuously or upon a trigger that you configure an alarm threshold with.

The methods used to record power quality data include a Measurement Log for trending, Sag/Swell Snapshot, High Speed RMS and Waveform Capture. The different modes are described below.

Measurement Log (option ML, PQ2, PQ3)

This is used for long term continuous trending of steady state values. Data can be recorded as minimum, maximum or average values. The recording rate can be configured from every 150/180 cycles to every 120 minutes. Typical measurements used for logging include voltage, current, harmonics, flicker, frequency, power factor and imbalance. This data can be used for analyzing power quality data from a high level. It's also useful for energy management studies and real time power analysis.

Sag/Swell/Outage Capture

This is a recording of voltage sags and swells upon a trigger. The recording is a snapshot of the event, recording min/max/avg values during the Sag or Swell. The measurements include volts, amps, THD, Power Factor and Frequency. This collection of data can provide a high-level overview of how the sag or swell occurred and what might have caused it. Outages (Interruptions) are logged with the time and date when you lose all three phases.

High Speed RMS (option PQ1, PQ3)

This is a recording of RMS voltages and current upon a trigger. The values are recorded every half cycle and can start prior to the trigger and end after the trigger returns to normal. The RMS values can simplify the analysis of sags and swells.

Waveform Capture (option PQ2, PQ3)

This is a recording of peak voltages and current upon a trigger. The values can be recorded at three different rates (16 samples/cycle, 128 samples/cycle or 512 samples/cycle). The recording can start prior to the trigger and end after the trigger returns to normal. The slower recording rates have lower resolution but with longer recording times. The faster recording rates have higher resolution but with a shorter recording time. The selection of recording rates is best matched with the type of power quality phenomena you wish to capture.

Power Quality Recording Modes

The JEMStar II Meter can record power quality data continuously or upon a trigger that you configure. For continuous recording, you select a measurement, recording interval duration and how the data is recorded. For triggered recording, you select a measurement, alarm threshold to start the recording and the type of recording methods.

Continuous Recording

The JEMStar II Meter uses the Measurement Log Option for continuously recording measurements over pre-selected time intervals.

Measurement Log

The Measurement Log is an option to record up to 400 channels, divided into eight groups of 50. While similar to Load Profile, the Measurement Log includes a wider choice of measurements and recording intervals and it does not record the various metering events like meter freeze, midnight event, billing reset, etc. The measurement log allocates its non-volatile memory using FIFO storage (first in, first out) and all measurements are stored in 32 bit format.

The Measurement Log is included with option PQ2 and PQ3 but can be included on its own without either Power Quality Option. (Note: You need the PQ options to record items like harmonics and flicker) Measurements can be recorded as individual phases or the total polyphase quantities. An example of a single channel for the measurement log would be: Phase A Voltage Minimum
To record the min/max/avg for all 3 Phase voltages would require 9 channels.

Measurements:

The available measurements include:

- **Metering**
Instantaneous: Volts, Amps, Watts, VA, VARs, PF, Freq, Q, Volts², Amps², Unbalance
Integrated: Whr, VARhr, VAhr, Qhr, Amphr, Amp²hr, Volt²hr
- **Harmonics**
Magnitude and Phase Angle of harmonics 2-64, THD, TDD, Crest Factor
- **Interharmonics**
Magnitude of inter harmonics 2-50
- **Flicker**
Short term, long term, instantaneous
- **Digital Inputs**
Contact Inputs
- **Fault**
Positive, Negative, Zero Sequence Components

Note: Harmonic, Interharmonic, Flicker and Fault measurements are only available with options PQ2 and PQ3. For a full list of measurements, refer to the back of the manual.

Measurement Calculation Methods:

The measurement calculation method is based on whether the meter is equipped with a Power Quality Option (PQ1, PQ2, PQ3). Meters with a Power Quality Option will follow calculation methods per standard IEC-61000-4-30. Meters without Power Quality will use the calculation methods used for metrology (registers, load profile, etc).

Meters with PQ Options (PQ1, PQ2, PQ3)

For Watts, VARs, VA, Power Factor and other related measurements, we use the values that are calculated by our metrology every half cycle.

For measurements like Volts, Amps, Unbalance, Harmonics, Sequence Components, etc, we use the IEC-61000-4-30 standard which provides a common measurement method for all devices. Measurements are calculated over a 200 msec interval: 10/12 cycles (10 cycles for 50 Hz and 12 cycles for 60 Hz).

For a measurement selected as Average, we take the 200 msec measurements and average them over the total recording interval. (Note: IEC-61000-4-30 defines these recording intervals as 150/180 cycles, 10 minutes and 2 hours. For other selectable intervals, we do similar)

For a measurement selected as minimum or maximum, we examine each 200 msec interval and record the minimum and maximum value over the total recording interval. For example, if the Recording Interval was selected as 10 minutes, we would look at the qty (3000) 200 msec intervals to determine what the minimum and maximum value were.

Meters without Power Quality enabled (includes option PQ: PQ Ready)

On meters with no power quality enabled, we calculate the measurement log values similar to how we calculate metrology for registers and load profile. For Watts, VARs, VA, Power Factor and other related measurements, we use the values that are calculated by our metrology every half cycle. For Volts and Amps RMS, we use the values that are calculated by our metrology every full cycle with updates every half cycle.

For a Volts or Amps measurement selected as Average, we take the one cycle calculations updated every half cycle and average them over the total recording interval. For example, if the recording interval is 10 minutes, we will average 72,000 calculations for 60 Hz.

For a Volts or Amps measurement selected as minimum or maximum, we examine each calculation based on a full cycle with updates every half cycle. We then look for the minimum value across all of these calculations until we reach the total recording interval.

Unbalance and THD Measurements

In addition to above, the calculations for Unbalance and THD vary whether your meter is equipped with the PQ Options.

On meters equipped with power quality enabled, unbalance is calculated using the ratio of Negative Sequence and Zero Sequence Ratios. $S2/S1$ and $S0/S1$

Percent THD is calculated per IEC61000-4-7, and includes harmonic content (up to and including the 128th harmonic).

On meters equipped with no power quality, unbalance is calculated using the ratio of the maximum deviation from average over the average. Percent THD is calculated using the Total RMS (over all harmonics) and the RMS over the Fundamental frequency. (typical for volts and amps)

Measurement Recording Methods:

For each of the above measurements, the measurement can be recorded as:

- **Minimum**
Lowest recorded value over the recording interval
- **Maximum**
Highest recorded value over the recording interval
- **Average**
Average value calculated over the recording interval
- **Total**
Total value recorded over the interval (used for integrated measurements)
- **Snapshot**
Value recorded at the end of that interval

For each measurement, you can select whether it is a primary or secondary value, engineering units for the value (units, kilo, mega, etc) and whether to include transformer compensation (if applicable).

Recording Interval

Up to 3 recording intervals can be configured as long as one of them is 10 minutes. The available recording intervals are:

- 150/180 Cycles (150 cycles for 50 Hz, 180 cycles for 60 Hz)
- 1 minute
- 2 Minutes
- 3 Minutes
- 4 Minutes
- 5 Minutes
- 10 Minutes
- 15 Minutes
- 20 Minutes
- 30 Minutes
- 60 Minutes
- 120 Minutes

Measurement Log Storage:

The Measurement Log is stored inside the meter in an Internal Log and in PQDIF Format (if selected)
The Internal Log has a maximum storage of 1,095 days.

The meter memory will support approximately 1,460,000 measurements per 50 channel log.

Example:

If using all 400 channels with a recording interval every 10 minutes, that's 144 x 400 channels per day = 57,600 measurements per day. With a maximum of 11,692,800 measurements, that equates to approximately 203 days.

If the Power Quality configuration in JEMWARE includes the measurement log in the PQDIF file, the measurements will be stored in a daily file starting at midnight and ending in 24 hours or in other intervals as configured in JEMWARE.

Measurement Log Display:

The Measurement Log can be retrieved via JEMWARE and downloaded into Excel and CSV formats. The Measurement Log can be displayed in JEMWARE as shown below.

Retrieval Settings

Log 1 **Log 2** Log 3 Log 4 Log 5 Log 6 Log 7 Log 8

Retrieval Selection

Days Date Range 2020-03-16 2020-03-16 Read All

Recording Status

Refresh Days: 8 Channel: 48 Interval: 10

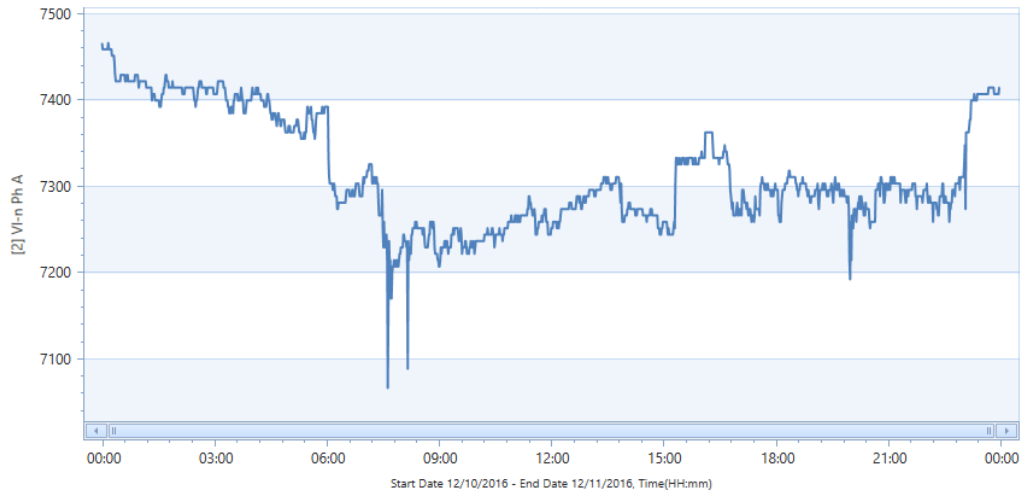
Record No	Start Time	End Time	Flagged Data	Channel : 1. Category : Metering. Quantity : VoltsL-N. Type : Instantaneous. Phase : A. Dir : None. Rec Type : Min. Scale : Primary. Units : Units. TLC : 0	Channel : 2. Category : Metering. Quantity : VoltsL-N. Type : Instantaneous. Phase : A. Dir : None. Rec Type : Max. Scale : Primary. Units : Units. TLC : 0	Channel : 3. Category : Metering. Quantity : VoltsL-N. Type : Instantaneous. Phase : A. Dir : None. Rec Type : Average. Scale : Primary. Units : Units. TLC : 0	Channel : 4. Category : Metering. Quantity : VoltsL-N. Type : Instantaneous. Phase : B. Dir : None. Rec Type : Min. Scale : Primary. Units : Units. TLC : 0	Channel : 5. Category : Metering. Quantity : VoltsL-N. Type : Instantaneous. Phase : B. Dir : None. Rec Type : Max. Scale : Primary. Units : Units. TLC : 0	Channel : 6. Category : Metering. Quantity : VoltsL-N. Type : Instantaneous. Phase : B. Dir : None. Rec Type : Average. Scale : Primary. Units : Units. TLC : 0
59	03/16/2020 09:40:00...	03/16/2020 09:50:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000
60	03/16/2020 09:50:00...	03/16/2020 10:00:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000
61	03/16/2020 10:00:00...	03/16/2020 10:10:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000
62	03/16/2020 10:10:00...	03/16/2020 10:20:00...	<input checked="" type="checkbox"/>	5606.1000	10134.6000	10133.1000	5555.4000	10129.0000	10127.5000
63	03/16/2020 10:20:00...	03/16/2020 10:30:00...	<input checked="" type="checkbox"/>	3148.8000	10134.6000	10131.3000	3145.9000	10129.0000	10125.7000
64	03/16/2020 10:30:00...	03/16/2020 10:40:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000
65	03/16/2020 10:40:00...	03/16/2020 10:50:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000
66	03/16/2020 10:50:00...	03/16/2020 11:00:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000
67	03/16/2020 11:00:00...	03/16/2020 11:10:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000
68	03/16/2020 11:10:00...	03/16/2020 11:20:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000
69	03/16/2020 11:20:00...	03/16/2020 11:30:00...	<input type="checkbox"/>	10134.6000	10134.6000	10134.6000	10129.0000	10129.0000	10128.9000

The measurement log has a column for flagged data to indicate that a voltage sag/swell or interruption occurred within that recording interval. This is used to highlight the data recorded during that event in case it falls outside of typical trend data.

When the measurement log is stored in PQDIF format, it can be displayed graphically in JEMWARE as shown below.

Observation	Quantity	Channel
[0] 12/10/2016 00:00:00	ID_QT_VALUELOG	[0] Pst Ph A [1] PIt Ph A [2] VI-n Ph A [3] VI-n Ph B [4] VI-n Ph C

Power Quality Test, ML Daily Record - 12/10/2016 00:00:00.000 AM, Source: MEASURE



Triggered Recording

For the triggered recording, you set an alarm threshold for a measurement (Volts, THD, Power Factor, etc) and then you select the type of recording method, such as Sag/Swell snapshot, High Speed RMS or Waveform Capture.

Up to 64 triggers can be created: each one with it's own triggering criteria and recording modes.

Trigger Measurements

Category	Measurements			
Instantaneous	Volts	Frequency	Watt	Volt ²
	Amps	Power Factor	VAR	Amp ²
	Volts THD %	Volts Imbalance	VA	
	Amps THD%	Amps Imbalance	Q	
Power Quality	Flicker	TDD	Volts THD Odd %	Volts THD Even%
	Volts THD %	TDD Odd	Amps THD Odd%	Amps THD Even%
	Amps THD%	TDD Even	Crest Factor	
Fault	Negative Sequence, Positive Sequence, Zero Sequence			
Transient	Transient voltage trigger			
Phase Loss	Dedicated trigger to detect a loss of phase			
Phase Rotation	Detects a phase rotation error based on thresholds			
Voltage Interruption	Used for recording power outages (3 phase voltage interruptions)			
RVC	Rapid Voltage Change Trigger (per IEC 61000-4-30)			
Digital Input	On/Off			

Trigger Operation

The measurements used for instantaneous triggers are calculated with a full cycle of sampled data updated every half cycle. The measurements are sampled at a fixed rate of 512 samples per cycle. Note: When PQ is enabled in the meter, some measurements; like Sequence Components and Harmonics are calculated over 10/12 cycle intervals.

Digital Input Triggers have a resolution of 100 msec which means the 'ON State' must be at least 100 msec in duration. Since there could be a 100 msec delay to start the capture, make sure you have adequate pre-trigger settings >100 msec so that you don't miss the start of the anomaly.

Trigger settings can be filtered by adding delays in milliseconds. Trigger delays extend the time before a trigger is activated to help reduce nuisance alarms. A setting of 0 indicates no delay. There is a separate setting for the trigger reset (Hysteresis). This setting determines the level when the trigger returns to normal. We also have a selectable delay for when the trigger resets beyond the threshold to prevent frequent re-triggering.

When a trigger is activated, it will turn the Alarm indicator on the meter to red and the trigger will be recorded in the Alarm Log which can be retrieved by JEMWARE. The Alarm Log indicates the trigger number, value of the trigger and time and date when it triggered. A separate log entry keeps track when the trigger returns to normal.

In addition to logging the alarm, you can select several items that can be activated by the triggered alarm such as:

- Digital Output (must have the DIO option)
- Sag/Swell Capture

- High Speed RMS Recording
- Waveform Capture Recording (low, medium, high resolution)

Note: Some or all of these selections are available depending on the measurement and options installed in the meter. For example, The Sag/Swell capture only applies to Voltage triggers; High Speed RMS and Waveform capture require the power quality options.

Voltage Sag/Swell Triggers:

Voltage Sag/Swell triggers can operate in accordance to IEC 61000-4-30 Class A.

The meter will only allow a single set of voltage triggers for Sag and Swell capture. The trigger setup needs to use a phase selection of ‘Any’ which provides a trigger from any one phase.

The top of the trigger screen provides a tool to set the voltage triggers for Sags and Swells using a % of nominal as opposed to specific magnitudes.

Once you adjust your settings, you select the ‘Apply to Sag/Swell Triggers’ button which will transfer the settings to your Voltage Sag/Swell triggers below.

Advanced Trigger Configuration

Nominal % Calculations for Triggers

Nominal Voltage:

PQ Voltage Measurement:

	Threshold %	Alarm	Hysteresis %	Reset
Sag	<input type="text" value="90"/>	<input type="text" value="108.00"/>	<input type="text" value="2.22"/>	<input type="text" value="110.4"/>
Swell	<input type="text" value="110"/>	<input type="text" value="132.00"/>	<input type="text" value="1.82"/>	<input type="text" value="129.6"/>
Interruption	<input type="text" value="50"/>	<input type="text" value="60.00"/>	<input type="text" value="2"/>	<input type="text" value="61.2"/>
RVC	<input type="text" value="5"/>	<input type="text" value="6.00"/>	<input type="text" value="50"/>	<input type="text" value="3"/>

Status Triggers

Bit	Enabled	Trigger/Combination
<input checked="" type="checkbox"/>	<input type="checkbox"/>	

	ID	Enabled	Trigger Measurement	Trigger On	Phase	Operator	Alarm	Trigger Delay	Reset	Reset Delay	Digital Output	Sag/Swell	High Speed RMS	Waveform Capture
	1	<input type="checkbox"/>	Instantaneous	VoltsL-N	Any	<	108	0	110.4	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Med
	2	<input type="checkbox"/>	Instantaneous	VoltsL-N	Any	>	132	0	129.6	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Med

All alarm values are in secondary units

Advanced Trigger Configuration

Nominal % Calculations for Triggers

Nominal Voltage:

	Threshold %	Alarm	Hysteresis %	Reset
Sag	<input type="text" value="90"/>	<input type="text" value="108.00"/>	<input type="text" value="2.22"/>	<input type="text" value="110.4"/>
Swell	<input type="text" value="110"/>	<input type="text" value="132.00"/>	<input type="text" value="1.82"/>	<input type="text" value="129.6"/>

Status Triggers

Bit	Enabled	Trigger/Combination
<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	<input checked="" type="checkbox"/>	4
	<input checked="" type="checkbox"/>	5
	<input checked="" type="checkbox"/>	6
	<input checked="" type="checkbox"/>	1 & 7
	<input checked="" type="checkbox"/>	2 & 8
	<input checked="" type="checkbox"/>	3 & 9

	ID	Enabled	Trigger Measurement	Trigger On	Phase	Operator	Alarm	Trigger Delay	Reset	Reset Delay	Digital Output	Sag/Swell	High Speed RMS	Waveform Capture
	1	<input type="checkbox"/>	Instantaneous	VoltsL-N	A	<	40	0	40.12	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Med
	2	<input type="checkbox"/>	Instantaneous	VoltsL-N	B	<	40	0	40.12	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Med
	3	<input type="checkbox"/>	Instantaneous	VoltsL-N	C	<	40	0	40.12	0	None	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Med
	4	<input type="checkbox"/>	Instantaneous	AmpsRMS	A	>	1.3	0	1.2961	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	5	<input type="checkbox"/>	Instantaneous	AmpsRMS	B	>	1.3	0	1.2961	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	6	<input type="checkbox"/>	Instantaneous	AmpsRMS	C	>	1.3	0	1.2961	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No

Note: You must have a voltage sag trigger pre-configured to make the ‘Apply’ button work. A voltage Sag/Swell trigger is the selection of Instantaneous Voltage

When selecting High Speed RMS and Waveform Capture, you need to configure how these recordings will operate in the Power Quality Setup.

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RVC (Rapid Voltage Change) Triggers:

Rapid Voltage Change triggers will operate in accordance to IEC 61000-4-30 Class A. They are used to record steady state changes in voltage that don't meet the criteria set for a Voltage Sag/Swell Trigger. The trigger threshold is based on comparing the previous cycle steady state RMS voltage to the current cycle.

They can be used to monitor motor starting, capacitor banks switching on/off, load switching or transformer tap-changer operations. In addition, they can occur from sudden load variations or by power output variations from distributed energy resources such as solar (clouds appear) or wind power systems (wind drops).

The meter will only allow a single set of voltage triggers for Rapid Voltage Change. The trigger setup needs to use a phase selection of 'Any' which provides a trigger from any one phase.

The top of the trigger screen provides a tool to set the voltage triggers for Rapid Voltage Change using a % of nominal as opposed to specific magnitudes.

Once you adjust your settings, you select the 'Rapid Voltage Change Triggers' button which will transfer the settings to your Rapid Voltage Change triggers below.

Voltage Interruption Triggers:

Voltage Interruption triggers will operate in accordance to IEC 61000-4-30 Class A. When the three voltage inputs all fall below a certain threshold, the time, date and duration of the interruption shall be recorded.

The meter will only allow a single set of voltage triggers for Voltage Interruption.

The top of the trigger screen provides a tool to set the voltage triggers for Voltage Interruption using a % of nominal as opposed to specific magnitudes.

Once you adjust your settings, you select the 'Voltage Interruption Triggers' button which will transfer the settings to your Voltage Interruption triggers below.

ID ▲	Enabled	Trigger Measurement	Trigger On	Phase	Operator	Alarm	Trigger Delay	Reset	Reset Delay
1	<input checked="" type="checkbox"/>	Instantaneous	VoltsL-N	Any	<	90	0	92	0
2	<input checked="" type="checkbox"/>	Instantaneous	VoltsL-N	Any	>	110	0	108	0
3	<input checked="" type="checkbox"/>	VoltageInterruption	VoltsL-N	All	<	20	0	20.4	0
4	<input checked="" type="checkbox"/>	RapidVoltageChange	VoltsL-N	Any	>	5	0	2.5	0

Screenshot of Sag/Swell, Voltage Interruption and Rapid Voltage Change triggers.

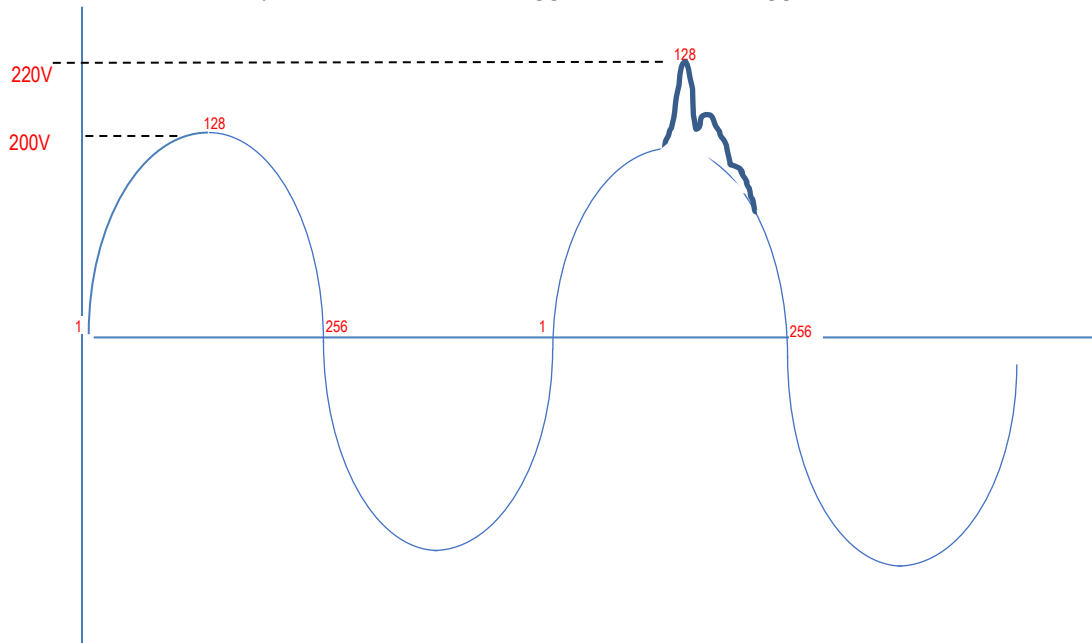
Voltage Transient Triggers:

The Transient Trigger compares one of the 256 samples in each half cycle to the previous half cycle. The user can select the amount of difference in volts from one sample to the sample in the previous cycle. A filter can be applied to select the number of consecutive samples that exceed the alarm threshold before a trigger occurs.

As shown below: We sample each waveform 512 times per cycle (256 per half cycle). In the second cycle shown, sample #128 is about 20V higher than the previous cycle. We set the trigger based on the voltage difference between measurements. To capture this transient, we would use a Transient Trigger setting of 20V or less. To eliminate any false triggers, we can set a filter for the number of samples that need to exceed this

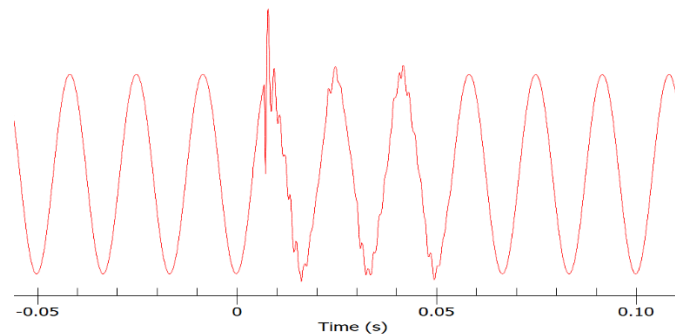
threshold. If we set the filter as 4, we are saying that samples 128, 129, 130 and 131 need to be above the threshold.

There is a 'Debounce' feature to prevent continuous triggering of anomalies. After a trigger occurs, you can select a number of half cycles after the meter triggers before a re-trigger occurs.



Typical Capacitor Switch Transient

Electric transmission and distribution utilities use capacitor banks to improve power factor, as well as lower system losses. Capacitor banks have to be switched in and out of the system to match with changes in the load profile. This switching operation often results in an oscillatory voltage transient that can be damaging to sensitive loads. The Transient Trigger will capture this.



Configuring the Transient Trigger:

When selecting 'Transient' for a trigger type, the following fields can be configured.

Trigger Measurement	Trigger On	Phase	Operator	Alarm	Trigger Delay	Reset	Digital Output	Sag/Swell	High Speed RMS	Waveform Capture
Transient	VoltsL-N	Any	>	10	3	120.00	None	<input type="checkbox"/>	<input type="checkbox"/>	High

Field	Description
Trigger On	This trigger is designed to capture voltage transients. Your selections are Volts L-N or L-L depending on your circuit connection
Phase	You can set up a trigger for a specific Phase (A,B,C) or use Any for all three phases. When selecting an individual phase, this will be recorded upon a trigger.
Operator	Transient Triggers are designed for an over voltage only
Alarm	This is the alarm threshold in volts (secondary) from one sample in the previous cycle to the current cycle. A setting of 10 is equal to a difference in 10 volts between one cycle and another. The Alarm setting can be from 1 to 913.
Trigger Delay	The Trigger delay is the number of consecutive samples in a half cycle that exceed the alarm threshold before triggering the unit. A setting of three indicates that 3 consecutive samples need to exceed the alarm threshold before initiating a trigger. The setting can range from 1 to 256.
Reset	This is used as a 'debounce' setting to prevent the unit from triggering multiple times on the same event. The value entered for 'Reset' is the number of half cycles after a trigger occurs that the meter will not retrigger. A setting of 120 indicates that the meter will not retrigger for 120 half cycles (60 cycles) after a trigger occurs. The setting can range from 1 to 432,000 half cycles.
Digital Output	After a trigger occurs, the user can have a digital output contact transfer. (one shot pulse)
Waveform Capture	After a trigger occurs, you can enable the waveform capture using any of the three resolutions available. Low = 16 samples/cycle, Med = 128 samples/cycle, High = 512 samples/cycle recording. The pre and post fault recording parameters for waveform capture are set up in the Power Quality configuration page.

High Speed RMS Recording


This recording is available with power quality options PQ1 and PQ3.

Upon a trigger, you can initiate the recording of RMS voltage and current at a rate of 2 measurements per cycle.

The meter will record the following:

- Record RMS voltage, current and phase angle per phase
 - 100/120 Hz recording rate (2 measurements per cycle)
 - 0 to 0.5 second configurable pre-fault recording (recording prior to trigger)
 - 0 to 1.0 second configurable post-fault recording (recording after it returns to normal)
 - Maximum 60 second total recording time

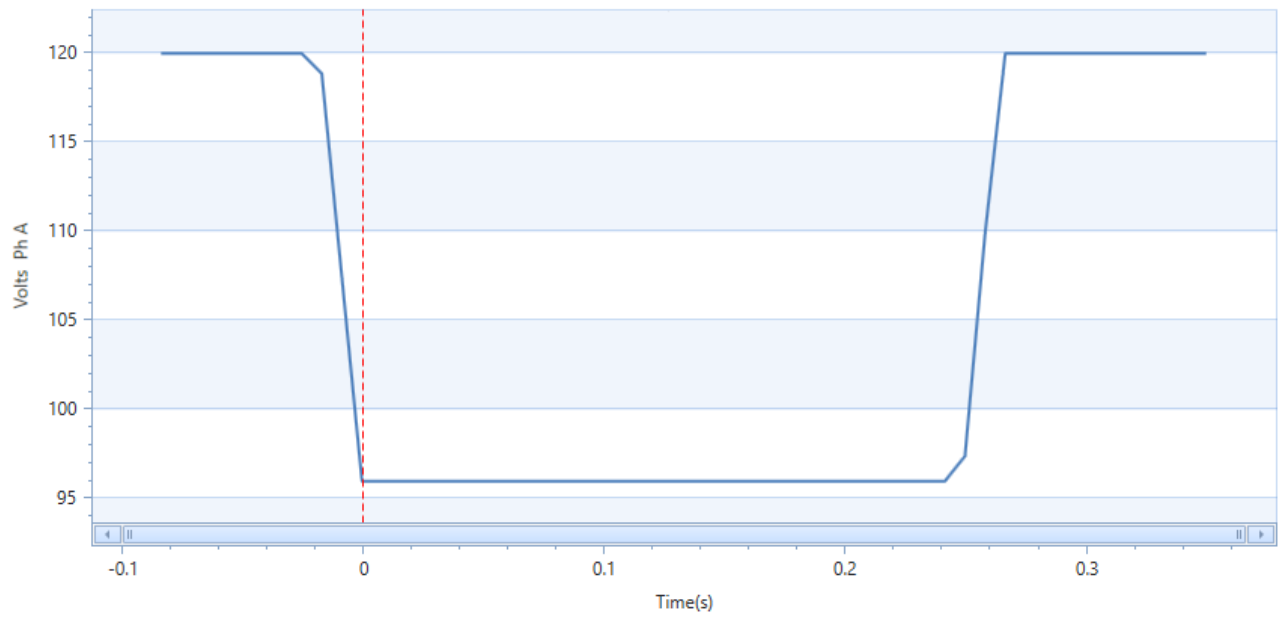
The settings for High Speed RMS Recording are in the JEMWARE Power Quality screen.

High Speed RMS	
	Cycle(s): Msec(s):
Pre-Fault Time:	15 250
Post Fault Time:	30 500
Max Recording Time:	1800 30006
	Record(s): Size in Kb:
Est # of Records:	3072 4

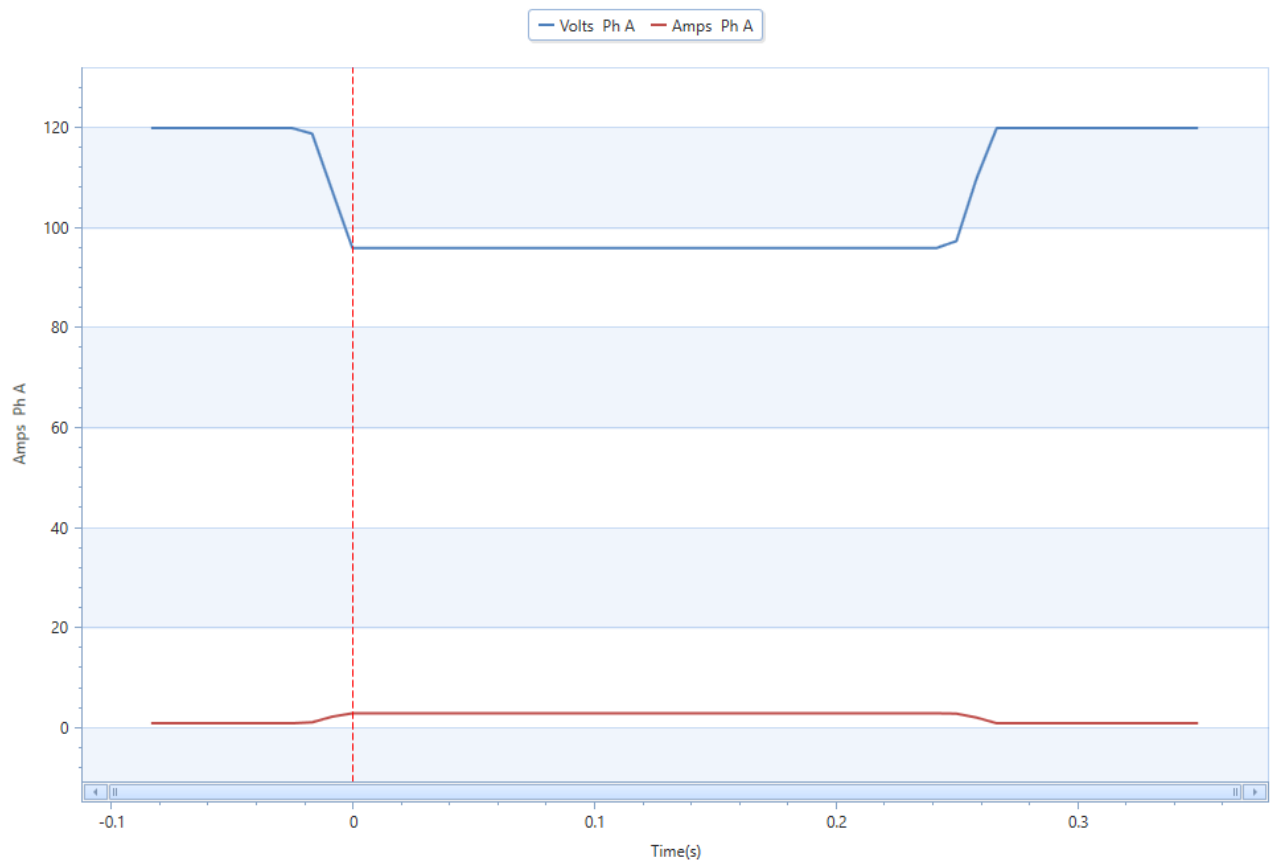
The entry is in cycles and the msec timing is automatically calculated in regards to your primary configuration setting of 50 or 60HZ frequency. The estimated quantity of records that can be stored in memory is displayed along with the file size for each record.

High Speed RMS measurements are calculated every cycle with updates on the half cycle. Two measurements are provided per cycle.

The High Speed RMS data is saved in non-volatile memory in a PQDIF File Format. It can be viewed in JEMWARE or other third party software that supports the PQDIF File Format.



High Speed RMS Plot in JEMWARE - Phase A Voltage Sag



High Speed RMS Plot in JEMWARE - Phase A Voltage Sag along with Phase A Current

Waveform Capture Recording

This recording is available with power quality options PQ2 and PQ3.

Upon a trigger, you can initiate the waveform recording of voltage and current at a low/medium/high resolution.

The meter will record the following:

- Voltage and current per phase
 - Three recording rates to choose from.
 - Low Resolution Recording
 - 900 Hz Recording rate (16 samples per cycle)
 - 0 to 30 cycle Pre-Fault/Post-Fault
 - 2 to 960 cycle Recording Time
 - Medium Resolution Recording
 - 7,680 Hz Recording rate (128 samples/cycle)
 - 0 to 10 cycle Pre-Fault/Post-Fault
 - 2 to 240 cycle Recording Time
 - High Resolution Recording
 - 30,720 Hz Recording rate (512 samples/cycle)
 - 0 to 5 cycle Pre-Fault/Post-Fault
 - 2 to 30 cycle Recording Time

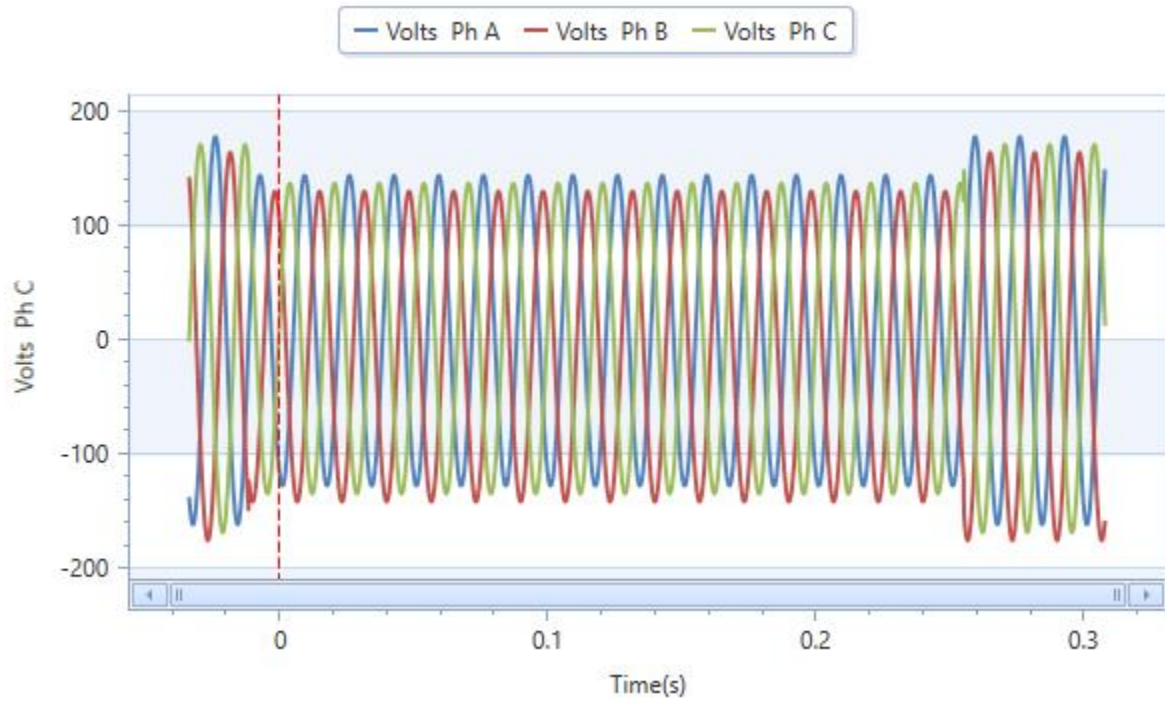
Values shown for 60 Hz.

The settings for Waveform Recording are in the JEMWARE Power Quality screen.

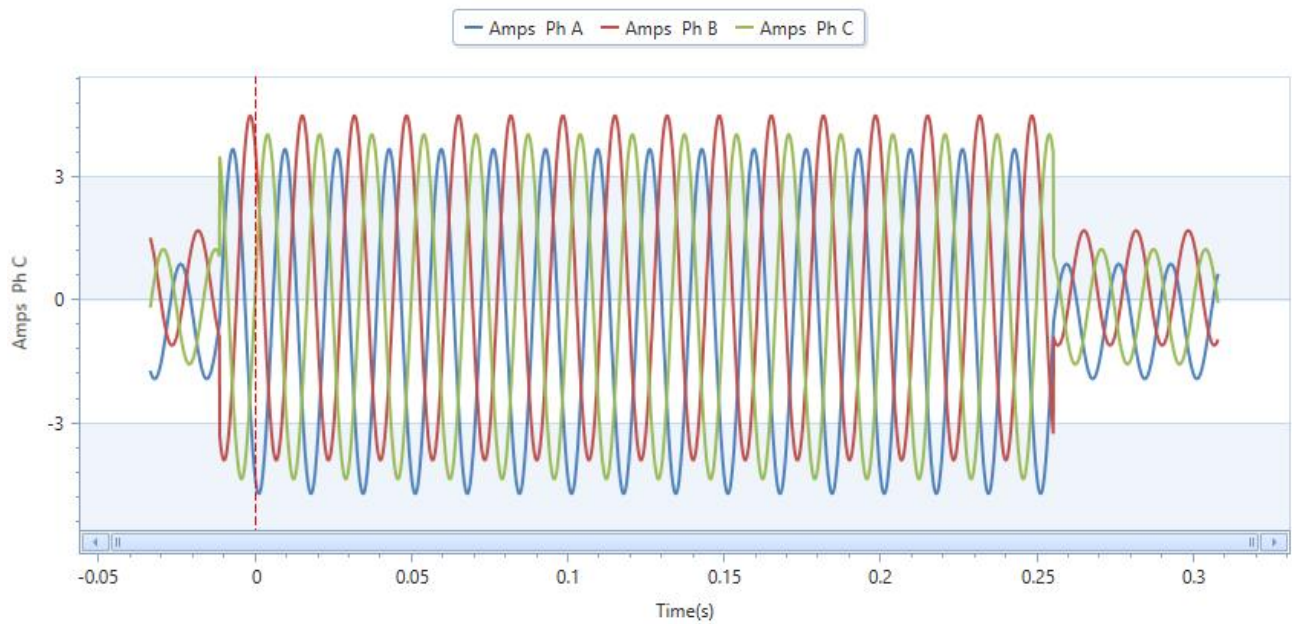
WaveForm Capture (LOW:16 samples/cycle)	WaveForm Capture (MEDIUM:128 samples/cycle)	WaveForm Capture (HIGH:512 samples/cycle)
Cycle(s): Msec(s): Pre-Fault Time: 15 250 Post Fault Time: 15 250 Max Recording Time: 480 8002 Record(s): Size in Kb: Est # of Records: 2458 5	Cycle(s): Msec(s): Pre-Fault Time: 5 83 Post Fault Time: 5 83 Max Recording Time: 120 2000 Record(s): Size in Kb: Est # of Records: 1365 9	Cycle(s): Msec(s): Pre-Fault Time: 2 33 Post Fault Time: 1 17 Max Recording Time: 15 250 Record(s): Size in Kb: Est # of Records: 585 21

The entry is in cycles and the msec timing is automatically calculated in regards to your primary configuration setting of 50 or 60HZ frequency. The estimated quantity of records that can be stored in memory is displayed along with the file size for each record.

The waveform capture data is saved in non-volatile memory in a PQDIF File Format. It can be viewed in JEMWARE or other third party software that supports the PQDIF File Format.



Waveform Capture Plot in JEMWARE - Phase ABC Voltage Sag



Waveform Capture Plot in JEMWARE - Phase ABC Current from above Voltage Sag

Power Quality Logs

Power Quality Logs are provided for the following:

- Alarm Log
- Sag/Swell Log
- Voltage Interruption Log
- Rapid Voltage Change Log

Alarm Log

Log of every alarm trigger with time/date, trigger number, trigger value. Includes alarm and return to normal (cleared) states

Read Alarm Log

Trigger ID	Trigger Description	Value	Date/Time
4	4,RVC,VLN:A,>,5,0,0,2.5 CLEARED	0.040	03/16/2020 13:11:17.852 PM
4	4,RVC,VLN:A,>,5,0,0,2.5	6.307	03/16/2020 13:11:17.546 PM
1	1,Inst,VLN:Any,<,90,0,0,92,A CLEARED	101.281	03/16/2020 13:10:25.918 PM
3	3,Voltage Interruption,VLN:A,<,20,0,0,20.4 CLEARED	33.306	03/16/2020 13:10:25.901 PM
3	3,Voltage Interruption,VLN:A,<,20,0,0,20.4	10.124	03/16/2020 13:10:25.187 PM
1	1,Inst,VLN:Any,<,90,0,0,92,A	78.483	03/16/2020 13:10:25.170 PM
2	2,Inst,VLN:Any,>,110,0,0,108,A CLEARED	101.271	03/16/2020 13:09:49.968 PM
2	2,Inst,VLN:Any,>,110,0,0,108,A	111.832	03/16/2020 13:09:49.440 PM
1	1,Inst,VLN:Any,<,90,0,0,92,A CLEARED	93.682	03/16/2020 13:09:01.131 PM
1	1,Inst,VLN:Any,<,90,0,0,92,A	89.688	03/16/2020 13:09:00.942 PM
4	4,RVC,VLN:A,>,5,0,0,2.5	6.307	03/16/2020 10:27:46.126 AM
1	1,Inst,VLN:Any,<,90,0,0,92,A CLEARED	101.281	03/16/2020 10:24:58.613 AM

Sag/Swell Log

Log of every voltage sag/swell triggers. Includes time/date, duration, trigger condition and recording of volts, amps, volts THD, amps THD, power factor and frequency (min/max/avg) during sag/swell event.

Read Sag/Swell Events Log

Card View	Table View	
<p>Event ID : 75</p> <p>Start: 03/16/2020 10:24:58.41... End: 03/16/2020 10:24:58.61... Cycles: 12 Event: Phase B Voltage Line to Neutral SAG < 90.00, A</p> <p>Volts A (AB): 12.15 101.26 20.87 Volts B (CA): 12.16 96.37 21.53 Volts C (BC): 12.15 78.78 18.29 Amps A: 2.00 9.98 9.06 Amps B: 1.99 9.97 8.99 Amps C: 1.99 9.98 9.09 Vthd A (AB): 0.01 0.01 0.01 Vthd B (CA): 0.01 0.01 0.01 Vthd C (BC): 0.01 0.01 0.01 Pf A (AB): -1.00 1.00 0.74 Pf B (CA): -0.55 1.00 0.86 Pf C (BC): -1.00 1.00 0.70 Athd A: 0.01 0.01 0.01 Athd B: 0.01 0.01 0.01 Athd C: 0.01 0.01 0.01 Fz: 60.00 60.00 60.00</p>	<p>Event ID : 74</p> <p>Start: 03/16/2020 10:24:13.16... End: 03/16/2020 10:24:13.36... Cycles: 12 Event: Phase B Voltage Line to Neutral SAG < 90.00, A</p> <p>Volts A (AB): 12.15 101.26 20.87 Volts B (CA): 12.16 96.37 21.53 Volts C (BC): 12.15 78.78 18.29 Amps A: 2.00 9.98 9.06 Amps B: 1.99 9.97 8.99 Amps C: 1.99 9.98 9.09 Vthd A (AB): 0.01 2.98 1.55 Vthd B (CA): 0.01 5.92 3.08 Vthd C (BC): 0.01 6.32 3.29 Pf A (AB): -1.00 1.00 0.74 Pf B (CA): -0.55 1.00 0.86 Pf C (BC): -1.00 1.00 0.70 Athd A: 0.01 5.39 2.81 Athd B: 0.01 10.82 5.63 Athd C: 0.01 11.57 6.02 Fz: 60.00 60.00 60.00</p>	<p>Event ID : 73</p> <p>Start: 03/16/2020 10:18:09.06... End: 03/16/2020 10:18:09.26... Cycles: 12 Event: Phase B Voltage Line to Neutral SAG < 90.00, A</p> <p>Volts A (AB): 24.32 101.06 31.64 Volts B (CA): 24.31 96.59 32.02 Volts C (BC): 24.30 79.89 29.22 Amps A: 2.00 9.98 9.06 Amps B: 1.99 9.97 8.99 Amps C: 1.99 9.98 9.09 Vthd A (AB): 0.01 0.01 0.01 Vthd B (CA): 0.01 0.01 0.01 Vthd C (BC): 0.01 0.01 0.01 Pf A (AB): -1.00 1.00 0.74 Pf B (CA): -0.55 1.00 0.87 Pf C (BC): -1.00 1.00 0.70 Athd A: 0.01 0.01 0.01 Athd B: 0.01 0.01 0.01 Athd C: 0.01 0.01 0.01 Fz: 60.00 60.00 60.00</p>

Voltage Interruption Log

Log of voltage interruption triggers. Includes time/date, duration and voltage levels during interruption event.

Read Voltage Interruption Log

Event ID	Start	End	Cycles	Phase A Voltage	Phase B Voltage	Phase C Voltage
15	03/16/2020 13:10:25.187 PM	03/16/2020 13:10:25.901 PM	43	10.125	10.124	10.119
14	03/16/2020 10:24:58.433 AM	03/16/2020 10:24:58.597 AM	10	12.152	12.155	12.147
13	03/16/2020 10:24:13.182 AM	03/16/2020 10:24:13.346 AM	10	12.152	12.155	12.147

Rapid Voltage Change Log

Log of rapid voltage change triggers. Includes time/date, duration, steady state and maximum voltages during RVC event.

Read Rapid Voltage Change Log



Event ID	Event Start	Event End	Duration	Phase A Umax	Phase A Uss	Phase B Umax	Phase B Uss	Phase C Umax	Phase C Uss	Polyphase Umax	Polyphase Uss
7	03/16/2020 10:27:4...	03/16/2020 10:27:4...	175	7.063	0.002	7.066	0.017	7.049	0.017	7.066	0.017
6	03/11/2020 09:35:0...	03/11/2020 09:35:0...	1108	16.214	0	16.206	0	16.192	0.012	16.214	0.012
5	03/11/2020 09:33:4...	03/11/2020 09:33:4...	1108	16.214	0	16.206	0	16.192	0.012	16.214	0.012
4	01/13/2020 13:59:3...	01/13/2020 13:59:3...	1078	12.584	0.05	12.578	0.055	12.525	0.104	12.584	0.104
3	01/13/2020 13:50:1...	01/13/2020 13:50:1...	1078	13.039	0.048	13.256	0.049	12.863	0.098	13.256	0.098

All of the PQ Logs can be manually retrieved from the meter using the JEMWARE Software. Once retrieved from the meter, you can print the log, download it as a Excel file or download it in the CSV format.



Print Excel CSV

Power Quality Data Storage

Power quality data is stored in the meter in logs and in PQDIF File Format based on your configuration settings in JEMWARE. The following methods are available for power quality data storage:

PQ Data	Internal log	PQDIF
Sags and Swells	X	optional
Voltage Interruptions	X	optional
Rapid Voltage Change	X	optional
High Speed RMS		X
Waveform Capture		X
Measurement Log Harmonics InterHarmonics Flicker Metering	X	optional

X = always included optional = Configurable in JEMWARE

PQDIF File Format

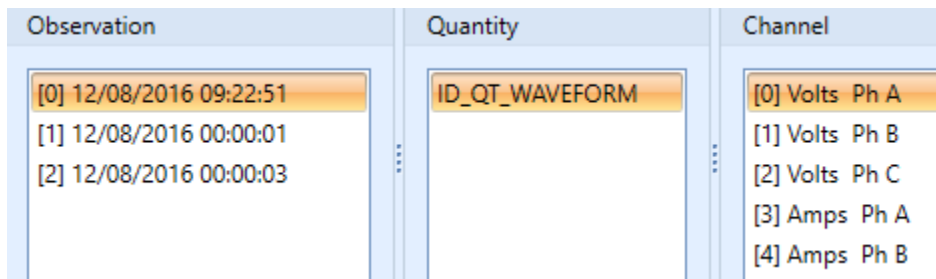
PQDIF (Power Quality Data Interchange Format) IEEE 1159.3 is a non-proprietary file format used for storing power quality data. It uses a standardized format for saving power quality information so different manufactures can present the data in one common format. While similar to the concept of COMTRADE which is a common open format for saving fault data, PQDIF is specifically designed for the type of data collected for power quality applications. The power quality data collected by the JEMStar II meter consists of an Observation, Quantity and Channel.

Observation	Quantity	Channel
<u>PQ Data Type</u>	<u>Type of Recording</u>	<u>Individual Measurements</u>
-Triggered Recording -Measurement Log (24 hour period) Each one is labeled with the Time and Date of occurrence	XY = Sag/Swell Record MAGDURTIME = Sag/Swell Record, RVC, Voltage Interruption Waveform = Waveform Capture Record Phasor = High Speed RMS Recording Value Log = Measurement Log	-Volts Phase A -Volts Phase B -Volts Phase C -AMPS Phase A -Volts Harmonic #3, Ph A (typical measurements)

With the above structure, it is possible to have a single PQDIF File that contains multiple observations and multiple recording methods. It provides a complete picture of the power quality anomaly.

The JEMStar II meter saves the power quality data internally in PQDIF format, so there is no need to retrieve data and convert it. There are two options available for storing data in the PQDIF format.

- Multiple Observations per PQDIF File
This file will include any PQ recordings saved by the meter for the 24 hour period starting at midnight. If nothing is recorded, there will be no PQDIF file created. In addition, you can select the time period for the measurement log duration from a minimum of 1 file every 10 minutes to 1 file every 7 days.



Example of a single PQDIF File displayed in JEMWARE Software. It has three observations over the 24 hour period. First observation at 12/08/2016 09:22:51 has a waveform capture.

Observation	Quantity	Channel
[0] 12/08/2016 09:22:51	ID_QT_VALUELOG	[0] VI-n Ph A
[1] 12/08/2016 00:00:01		[1] VI-n Ph B
[2] 12/08/2016 00:00:03		[2] VI-n Ph C
		[3] VI-n Ph A
		[4] VI-n Ph B

Same PQDIF File as above. The second observation at 12/08/2016 00:00:01 contains the 24 hr measurement log.

Note: The PQDIF File has a maximum size of 500K. In cases where the number of observations stored for this 24 hour period exceeds the 500K, a separate file(s) will be created to store the information.

- **Single Observation per PQDIF File**
In this mode, the PQDIF file will be generated upon every observation. An observation could be a trigger and associated data recordings. If a single trigger initiated the recording of a Sag/Swell Record, Waveform Capture and High Speed RMS recording, all three would be included in the same observation.

Observation	Quantity	Channel
[0] 09/23/2016 14:14:36	ID_QT_XY ID_QT_WAVEFORM ID_QT_PHASOR	[0] SS Volts Phase A [1] SS Volts Phase B [2] SS Volts Phase C [3] SS Amps Phase A [4] SS Amps Phase B

Example of a single PQDIF File with a single observation that contains a Sag/Swell Record, Waveform Capture and High Speed RMS recording.

Measurement Log Recording in PQDIF:

The measurement log will be stored in PQDIF format based on the PQDIF File Options and PQDIF File Contents selections.

If the meter is configured for 'Single Observation per PQDIF file', the observation frequency is then selected in the PQDIF File Contents selection with a range of 1 observation per 10 minutes to 1 observation per 7 days. If selected as 1 observation per hour, then a new PQDIF file will be created every hour. (If the measurement log is set to record measurements every 10 minutes, then each file will contain 6 intervals of data)

PQDIF Settings

PQDIF File Options	PQDIF File Contents
<input type="radio"/> Multiple Observations per PQDIF file <input checked="" type="radio"/> Single Observation per PQDIF file	<input checked="" type="checkbox"/> High Speed RMS <input checked="" type="checkbox"/> Waveform Capture <input checked="" type="checkbox"/> Sag/Swell/RVC/VI Data Enter Observations as: <input checked="" type="checkbox"/> ID_QT_XY (*Sag/Swell Only) <input checked="" type="checkbox"/> ID_QT_MAGDURTIME <input checked="" type="checkbox"/> Measurement Log Data Frequency of Observations: <input type="radio"/> 10 min(s) <input checked="" type="radio"/> 1 hour(s) <input type="radio"/> 7 days(s)
PQDIF File Compression	
<input checked="" type="checkbox"/> ZLIB File Compression	

If the meter is configured to create a PQDIF file from multiple observations and the 'PQDIF File Contents' is configured for measurement log data observations every 1 hour, then each 24 hour PQDIF file will contain 24 observations of measurement log data.

Recommended Settings:

If you are interested in real time power quality data as it's captured, then a selection of a single observation per PQDIF file is recommended. This way, a PQDIF file will be created immediately after a PQ event occurs. If you want to have access to measurement log every 10 minutes, then select the frequency of observations to 1 every 10 minutes. Just remember that you will end up with 144 PQDIF Files per day just for the measurement log in addition to any other files from PQ events.

If you are interested in a single PQDIF file once per day that contains all PQ events recorded in the previous 24 hours and all measurement log data, then select 'Multiple Observations per PQDIF file'. The measurement log frequency of observations can be from 1 day to 7 days. (If set for 7 days, you will get 6 daily PQDIF files with no measurement log and the 7th day will include the measurement log for the whole week)

PQDIF File Naming Convention

The PQDIF files generated by the meter follow a naming convention that include the meter serial number, time and date of the event and type of data recorded.

The file name format used is: `YYMMXXXXXX_TimeStamp_microsecond_DataType.pqd`

Where:

- **YYMMXXXXXX**
Serial number of the meter; with spaces removed

- **TimeStamp**
10 digit time format (number of seconds elapsed since Jan 1, 1970) of when this file was created
- **Microsecond**
Variable length number 0->999,999 indicating the microsecond of the TimeStamp when the first event occurred
- **DataType**
A number representing the type of data stored in this file. See table below.

Single PQDIF File Generated by Observation	
01	Sag/Swell Recording
02	Waveform Capture
03	Sag/Swell and Waveform Capture
04	High Speed RMS
05	Sag/Swell and High Speed RMS
06	Waveform Capture and High Speed RMS
07	Sag/Swell, Waveform Capture and High Speed RMS
08	Measurement Log
16	Rapid Voltage Change
18	Rapid Voltage Change and Waveform Capture
20	Rapid Voltage Change and High Speed RMS
22	Rapid Voltage Change, Waveform Capture and High Speed RMS
32	Voltage Interruption
34	Voltage Interruption and Waveform Capture
36	Voltage Interruption and High Speed RMS
38	Voltage Interruption, Waveform Capture and High Speed RMS

PQDIF File Generated Daily	
128	Can contain any or all of the following: Sag/Swell, Waveform Capture, High Speed RMS, Rapid Voltage Change, Voltage Interruption, Measurement Log

Example file name: 142300003_1454408745_133724_07.pqd

142300003	1454408745	133724	07
Meter Serial Number 14 23 00003 <i>23rd week of 2014</i> <i>Meter ID# 00003</i>	Febraury 02, 2016 10:25:45 GMT	133724 microseconds (when added to above, 02 Feb 2016 10:25:45:133724 GMT)	Sag/Swell, Waveform Capture, High Speed RMS Data

Note: For the Measurement Log, the log number from 1 thru 8 will precede the '08'. For example, ..._02_08.pqd' indicates Measurement Log #2.

PQDIF File Retrieval

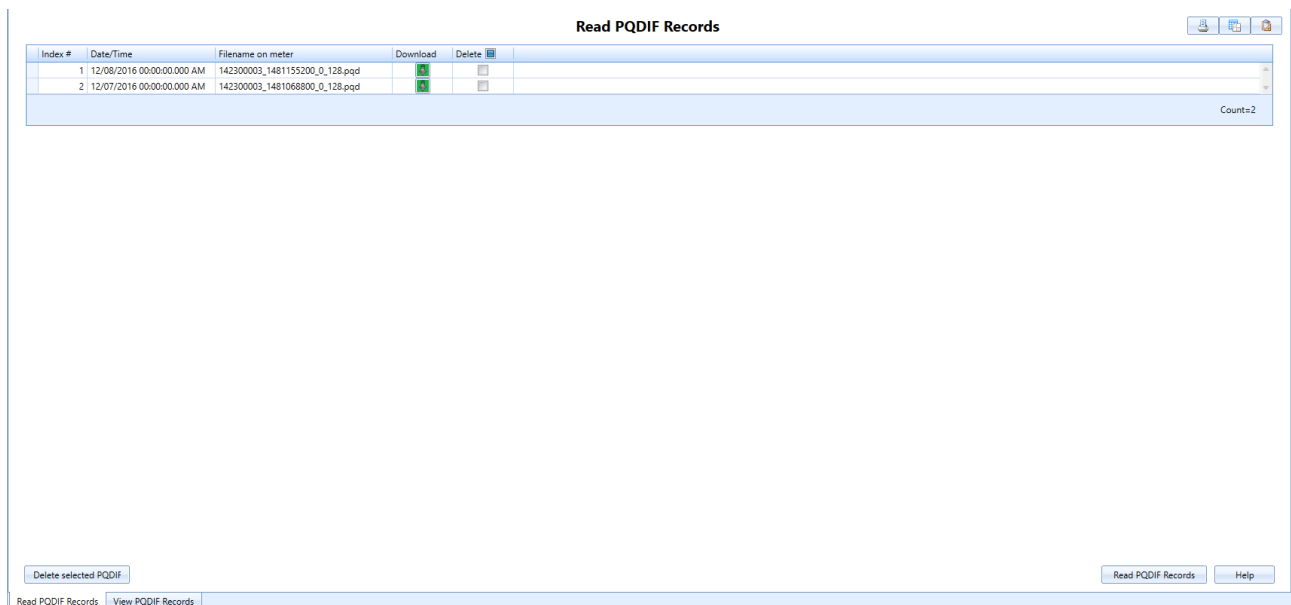
The PQDIF files generated by the meter can be retrieved in four different ways.

- Manual Retrieval via JEMWARE
- Scheduled Retrieval via JEMWARE
- Automatic Retrieval
- Via the WEB Browser

SFTP protocol is used for the transfer of files from the meter to the PC. The Ethernet Port designated for this is Port 22, but this can be changed in the Ethernet Configuration. When using the WEB Browser, the transfer is done via the web port 80.

Manual PQDIF Retrieval

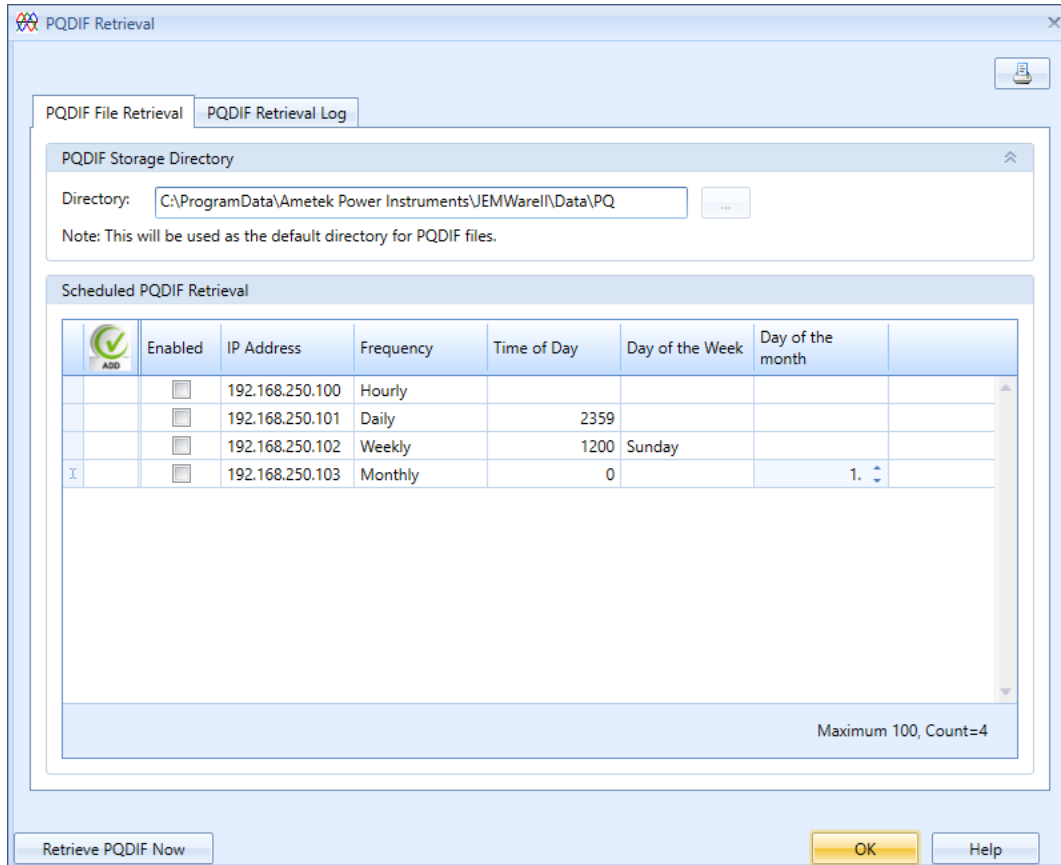
After connecting the meter to JEMWARE (see software manual), there is a Power Quality Screen that allows you to read the PQDIF Files from the meter. After pressing the 'Read PQDIF Records' button, you will see a list of all PQDIF files stored on the meter. To download a single file to the PC for viewing, select the download box next to the filename. To download multiple files, select all of the files with your mouse using the shift and control keys and right click the selection which will let you download all files selected. Once a file is downloaded to your PC, it will be shown in a green highlight.



Scheduled PQDIF Retrieval

With the scheduled retrieval, you create a database of all the meters you wish to retrieve data from and the timing when you wish to retrieve the data. In JEMWARE, the setup screen for this is shown below. After setting up the group of meters and their IP Addresses, you can enter a folder on your PC where all the files will be saved.

Note: The JEMWARE Software will display all PQ files for viewing in the default directory location shown on this screen. If you change the location, the files will not be visible on the PQDIF File viewer.



Automatic PQDIF Retrieval

With the automatic retrieval, the meter will export the PQDIF Files from the meter as they are created using FTP or SCP protocol.

Remote Server Setup

Remote File Transfer Protocol: SCP

Ethernet Port: Port 6

Host: 192.168.250.100

Username: admin

Password: •••••

Delete PQDIF Files

A file will be sent to the above remote server for testing. File: test_scp-tftp_server.txt

Test

You enter the IP Address of the PC you wish to download files to and it will transfer them as soon as they are generated. If the meter is set up to generate a single PQDIF file per day; this transfer will occur shortly after midnight (assuming there was a file created). If the meter is set up to generate a single PQDIF file per observation; this transfer will occur after the PQDIF file is created.

Note: The PC must be equipped with a file server application that can support the transfer of FTP or SCP files.

Retrieval via WEB Browser

Open up a web browser using the meter IP Address followed by /pqdif (Example: 192.168.250.100/pqdif)

Enter the username and password configured for the web browser. (Default is admin:admin or user:user)

Index of /pqdif/

Name	Last Modified	Size	Type
Parent Directory/		-	Directory
hsrms/	2020-Mar-16 10:25:26	-	Directory
pqcomms/	2020-Mar-16 10:27:57	-	Directory
wfc/	2020-Mar-16 10:28:09	-	Directory
154800417_1578578162_100772_06.pqd	2020-Jan-09 13:56:13	13.8K	application/octet-stream
154800417_1578578162_116528_01.pqd	2020-Jan-09 13:56:04	4.8K	application/octet-stream
154800417_1578587851_700958_07.pqd	2020-Jan-09 16:37:43	13.8K	application/octet-stream
154800417_1578647360_451208_07.pqd	2020-Jan-10 09:09:30	12.3K	application/octet-stream
154800417_1578647371_101293_07.pqd	2020-Jan-10 09:09:43	12.3K	application/octet-stream
154800417_1578647378_318014_07.pqd	2020-Jan-10 09:09:50	12.3K	application/octet-stream
154800417_1578647386_34738_07.pqd	2020-Jan-10 09:09:57	12.3K	application/octet-stream
154800417_1578647392_884793_07.pqd	2020-Jan-10 09:10:03	12.3K	application/octet-stream
154800417_1578647853_854977_07.pqd	2020-Jan-10 09:17:45	12.2K	application/octet-stream
154800417_1578647859_321686_07.pqd	2020-Jan-10 09:17:50	12.2K	application/octet-stream
154800417_1578648057_206646_07.pqd	2020-Jan-10 09:21:05	10.0K	application/octet-stream
154800417_1578648062_890020_07.pqd	2020-Jan-10 09:21:10	10.0K	application/octet-stream
154800417_1578648231_482812_07.pqd	2020-Jan-10 09:24:02	12.8K	application/octet-stream
154800417_1578648252_449641_07.pqd	2020-Jan-10 09:24:23	13.2K	application/octet-stream

When you select a file, the browser will prompt you to open up the file or save it to to your PC. After it has been downloaded from the meter, it will be shown as a gray color.

IEC 61000-4-30 Compliance

The IEC-61000-4-30 Standard specifies methods of measuring and recording various power quality information. The JEMstar II follows this standard when it is equipped with one of the power quality options: PQ, PQ1, PQ2, PQ3. The JEMStar II meter complies to this IEC 61000-4-30; Edition 3.0 standard as follows:

- Class A for all measurements
- 10/12 cycle measurements, aggregated over 150/180 cycles, 10 minutes and 120 minutes

The following parameters will be provided in accordance to the standard:

- Frequency
- Magnitude of Supply Voltage and Current
- Flicker
- Voltage and Current Unbalance
- Voltage and Current Harmonics
- Voltage and Current Interharmonics
- Voltage dips and swells
- Voltage interruptions
- Rapid voltage change events
- Flagging of PQ events

The Measurement Log will store the above measurements with the following recording intervals:

- 150/180 cycles
- 1, 2, 3, 4, 5, 10, 15, 20, 30, 60, 120 minutes

Note: While the standard only specifies 150/180 cycles, 10 minutes and 120 minutes recording intervals, we apply the same 10/12 cycle measurement aggregation over the other intervals.

Some measurements like flicker and harmonics require power quality options PQ2 or PQ3.

Voltage Dips and Swells

The detection of voltage dips and swells is in accordance to Class A with measurements synchronized to the zero crossing. The dip and swell threshold used is a percent of nominal. When we capture a voltage dip and swell, we record the start/stop time and date of the event, number of cycles duration, channel that triggered the dip or swell and we provide the min/max/avg measurements of voltage, current, THD, power factor and frequency.

Voltage Interruptions

The detection of voltage interruptions is in accordance to Class A with measurements synchronized to the zero crossing. We record Voltage Interruptions (Outage) when all three phases exceed the voltage dip threshold. Voltage Interruptions are recorded in the Voltage Interruption Log and contain the start/stop time, duration in cycles and date of the event.

Rapid Voltage Change

The detection of Rapid Voltage Changes is in accordance to Class A with measurements synchronized to the zero crossing. The RVC log includes the start and end time, duration and the steady state (U_{ss}) and max (U_{max}) values recorded. The Rapid Voltage Change events are used to record steady state changes in voltage that don't meet the criteria set for a Voltage Sag/Swell Trigger. The trigger threshold is based on comparing the previous cycle steady state RMS voltage to the current cycle.

TOTALIZATION

The JEMStar II meter may be purchased with an optional Totalization system. Totalization is the ability to sum the energy readings from several different instruments and display the result. The JEMStar II has 16 totalization channels. Each channel may be displayed as a register in the Normal, Alternate, and Test lists, as a Load Profile channel or a Measurement Log 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 II User Manual, (document 1079-699). 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 None (which accumulates only external energy)
- Phase: A, B, C, or Polyphase*
- Direction: Delivered, Received, Net, Absolute or a single quadrant for VARhours*
- Time of Use Rate: None, A through H or Total*
- Loss Compensation*
- Enabled
- Up to 8 external Digital Input channels (setup as Pulse Counter)
- Pulse Weight in Primary units for each Digital Input channel.
- Operation (Add/Subtract) for each each Digital Input channel.

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

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

1. Enabled set to Yes implies that the Totalization channel is setup to accumulate its own registration with that computed using the pulses recorded on the Digital Input channels associated with it. When set to No, the channel will only record registration based on the Digital Input channels.
2. Digital Input channels are external energy inputs setup as pulse counters on the JEMStar II. 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 channel's contents to obtain a totaled value.

NOTE: Input Pulse Weights are configured independently for each Totalization channel. For example, Totalization Channel 1 may count each transition on input 1 as 1.0 MWh, while Totalization Channel 2 may count each transition on input 1 as -3.8 MWh.

3. A Totalization channel may be displayed as well as recorded as a Load Profile or Measurement Log channel. To display a Totalization channel, add a register to the desired Display List (Normal, Alternate, or Test) in JEMWare II with the Category set to Register, Type as "Totalization" and select the desired Totalization channel number in the Quantity field. You may then set up the number of digits and decimal places, storage type, and label as for any other numeric register.
4. To record a Totalization channel in the Load Profile, add a Totalization type channel in JEMWare II. In the Quantity field, select the desired Totalization channel number. The Direction,

and Phase settings will be bypassed, but you may still select whether to record always or only during TOU Rate Override & specify the km value.

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.

- To record a Totalization channel in the Measurement Log, add a Totalization type channel in JEMWare II. In the Quantity field, select the desired Totalization channel number. The Direction, Phase, TLC, Recording Method & Scaling settings will be bypassed, but you may still configure the Units.

Totalization Calculation:

The output of a totalization channel is the arithmetic sum of the registration of the meter (if Enabled is set to Yes) and the registration computed using the pulses recorded on the Digital Input channels associated with it. Each Digital Input channel setup as a Pulse Counter & associated with the totalization channel can be assigned a pulse weight and an operation (addition/subtraction). The registration associated with such a Digital Input would be the product of the number of pulses recorded on it during an interval and the pulse weight.

$$Pulse\ Counter\ channel\ registration = Pulse\ Weight \times Number\ of\ pulses$$

$$Total\ Pulse\ Counter\ based\ registration = Pulse\ Counter\ channel\ 1\ registration\ +/-\ Pulse\ Counter\ channel\ 2\ registration\ +/-\\ Pulse\ Counter\ channel\ 'N'\ registration$$

Where N = total number of pulse counter channels associated with the totalization channel.

$$Totalized\ Value = Total\ Pulse\ Counter\ based\ registration + Meter\ registration\ (if\ Enabled\ set\ to\ Yes)$$

Example:

Consider the following settings for totalization channel 1 -

Totalization Settings

Totalization 9	Totalization 10	Totalization 11	Totalization 12	Totalization 13	Totalization 14	Totalization 15	Totalization 16
Totalization 1	Totalization 2	Totalization 3	Totalization 4	Totalization 5	Totalization 6	Totalization 7	Totalization 8

<p>Base Meter Settings</p> <p>Quantity: <input type="text" value="WHr"/></p> <p>Phase: <input type="text" value="A"/></p> <p>Direction: <input type="text" value="Delivered"/></p> <p>TOU: <input type="text" value="Total"/></p> <p>Loss Compensation: <input type="checkbox"/></p> <p>Enabled: <input checked="" type="checkbox" value="YES"/></p>	<p>Digital Inputs:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20px;">ID</th> <th style="width: 40%;">Digital Input Channel</th> <th style="width: 20%;">Pulse Weight</th> <th style="width: 20%;">Add/Subtract</th> </tr> </thead> <tbody> <tr><td>1</td><td>Channel1</td><td>100</td><td>Add</td></tr> <tr><td>2</td><td>Channel2</td><td>200</td><td>Add</td></tr> <tr><td>3</td><td>Channel3</td><td>300</td><td>Add</td></tr> <tr><td>4</td><td>Channel4</td><td>400</td><td>Add</td></tr> <tr><td>5</td><td>Channel5</td><td>500</td><td>Add</td></tr> <tr style="background-color: #e1ecf4;"><td>6</td><td>Channel6</td><td>600</td><td>Add</td></tr> </tbody> </table> <p style="text-align: right; font-size: small;">Maximum 8, Count=6</p>	ID	Digital Input Channel	Pulse Weight	Add/Subtract	1	Channel1	100	Add	2	Channel2	200	Add	3	Channel3	300	Add	4	Channel4	400	Add	5	Channel5	500	Add	6	Channel6	600	Add
ID	Digital Input Channel	Pulse Weight	Add/Subtract																										
1	Channel1	100	Add																										
2	Channel2	200	Add																										
3	Channel3	300	Add																										
4	Channel4	400	Add																										
5	Channel5	500	Add																										
6	Channel6	600	Add																										

Digital Input channels 1 to 6 are setup as Pulse Counters and are being used in totalization channel 1 with the shown pulse weights & operations (add). A make or break operation on these channels would imply that registration worth the value of the pulse weight be added to the totalized value.

This channel may now be used in the Load Profile, Display Registers and the Measurement Log. Consider the following example of a Load Profile channel using this totalization channel. The interval is set to 1 hour.

Load Profile

Load Profile 1 Load Profile 2

Configuration

	Channel	Type	Quantity	Phase	Direction	Records	Primary Km Value	TLC
	1	Totalization	Totalization 1	None	None	Always	0.0	<input type="checkbox"/>

Measurement Units set in Primary Configuration Screen Maximum 16, Count=1

Measurement Units Defaults

VARs, Q: Watts, VA:

Amp, A²: Volt:

V²:

Optional Settings

Interval Length:

Ext. Interval Sync:

Freeze Markers:

Assume a balanced three-phase input of 120V/5A per phase to the meter & 1 pulse on all Pulse Counter inputs per minute. The totalized value reported for a 1-hour interval in the Load Profile can be computed as follows –

$$\text{Meter WHr (Phase A) registration} = 120V * 5A = 600 \text{ WHr}$$

$$\text{Pulse Counter channel 1 registration} = 60 \text{ pulses} * 100 = 6000 \text{ WHr}$$

$$\text{Pulse Counter channel 2 registration} = 60 \text{ pulses} * 200 = 12000 \text{ WHr}$$

$$\text{Pulse Counter channel 3 registration} = 60 \text{ pulses} * 300 = 18000 \text{ WHr}$$

$$\text{Pulse Counter channel 4 registration} = 60 \text{ pulses} * 400 = 24000 \text{ WHr}$$

$$\text{Pulse Counter channel 5 registration} = 60 \text{ pulses} * 500 = 30000 \text{ WHr}$$

$$\text{Pulse Counter channel 6 registration} = 60 \text{ pulses} * 600 = 36000 \text{ WHr}$$

$$\text{Totalized WHr} = 600 + 6000 + 12000 + 18000 + 24000 + 30000 + 36000 = 126600 \text{ WHr}$$

APPENDIX A

DEFAULT SETTINGS

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

Meter Identification

ID String 1: (JemStarII ID)
ID String 2: (Ametek Power)
ID String 3: (Rochester, New York)
ID String 4: (Factory Default)
ID String 5: (1-888-222-6282)
ID String 6: (JemStar II)
ID String 7: (Company Name)
ID String 8: (-74.044500)
ID String 9: (40.689249)
ID String 10: (Custom Info)

Primary Configuration

Meter Settings:

Meter Form	9
Meter Class Amps	20
Voltage Range	69-480
Connection Type	4 Wire Y
Frequency	60hz

Primary and Secondary Settings:

PT:Primary	1
PT:Secondary	1
PT:Ratio	1
CT:Primary	1
CT:Secondary	1
CT:Ratio	1
Transformer Factor	1
Nominal Voltage	120
Nominal Current	5
Full Scale Watts	1,800
PQ Voltage Measurement	L-N
Flicker Measurement	120

Measurement Unit Defaults:

VARs, Q	KiloUnits
Watts, VA	KiloUnits
Amp, A ²	Amps
Volt	Volts

V²

KiloVolts

Display Registers

Normal Registers

Normal Registers | Alternate Registers | Test Registers

	ID	Category	Type	Quantity	Phase	Direction	TOU	Storage	Units	# of Digits	Decimal Point	TLC	Scaling	Self Read Register	Display Screen	Description
	0	IDStatus	MeterID	None	None	None	None	None	None	0	0	<input type="checkbox"/>	None	<input type="checkbox"/>		1 Meter ID
	1	Time	PresentTimea...	None	None	None	None	None	None	0	0	<input type="checkbox"/>	None	<input type="checkbox"/>		2 Time,PresTime&Date
	2	Register	Consumption	WHr	Polyph...	Delivered	Total	Working	KiloU...	8	0	<input type="checkbox"/>	Primary	<input type="checkbox"/>		3 kWhr Received
	3	Register	Consumption	WHr	Polyph...	Received	Total	Working	KiloU...	8	0	<input type="checkbox"/>	Primary	<input type="checkbox"/>		4 kWhr Delivered
	4	Register	Consumption	VARHr	Polyph...	Delivered	Total	Working	KiloU...	8	0	<input type="checkbox"/>	Primary	<input type="checkbox"/>		5 KVARhr Delivered
	5	Register	Consumption	VARHr	Polyph...	Received	Total	Working	KiloU...	8	0	<input type="checkbox"/>	Primary	<input type="checkbox"/>		6 KVARhr Received

Alternate Registers

Normal Registers | Alternate Registers | Test Registers

	ID	Category	Type	Quantity	Phase	Direction	TOU	Storage	Units	# of Digits	Decimal Point	TLC	Scaling	Self Read Register	Display Screen	Description
	100	Register	Consumption	WHr	Polyph...	Delivered	Total	BillingP...	KiloU...	8	0	<input type="checkbox"/>	Primary	<input type="checkbox"/>		1 kWhr Delivered BPR
	101	Register	Consumption	WHr	Polyph...	Received	Total	BillingP...	KiloU...	8	0	<input type="checkbox"/>	Primary	<input type="checkbox"/>		2 kWhr Received BPR
	102	Register	Consumption	VARHr	Polyph...	Delivered	Total	BillingP...	KiloU...	8	0	<input type="checkbox"/>	Primary	<input type="checkbox"/>		3 kVARhr Delivered B...
	103	Register	Consumption	VARHr	Polyph...	Received	Total	BillingP...	KiloU...	8	0	<input type="checkbox"/>	Primary	<input type="checkbox"/>		4 kVARhr Received B...
	104	Time	LastBPRTime...	None	None	None	None	None	None	0	0	<input type="checkbox"/>	None	<input type="checkbox"/>		5 Last BPR Time & D...
	105	IDStatus	PhasorDisplay	None	None	None	None	None	None	0	0	<input type="checkbox"/>	None	<input type="checkbox"/>		6 IDStatus,Phasor Dis...
	106	IDStatus	Communicati...	None	None	None	None	None	None	0	0	<input type="checkbox"/>	None	<input type="checkbox"/>		7 IDStatus,Comm Sta...
	107	StatusWord	SystemBit	None	None	None	None	None	None	0	0	<input type="checkbox"/>	None	<input type="checkbox"/>		8 Status Word, Syste...

Test Registers

Display Registers

Normal Registers | Alternate Registers | Test Registers

	ID	Register Category	Register Type	Quantity	Phase	Direction	Storage Type	Units	# of Digits	Decimal Point	Pulse Weight	TOU	TLC	Scaling Values	Display Screen	Description
	200	Register	Consumption	WHr	Pol...	Delivered	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	1	Watthour Delivered
	201	Register	Consumption	WHr	Pol...	Received	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	2	Watthour Received
	202	Register	Consumption	VARHr	Pol...	Delivered	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	3	VARhour Delivered
	203	Register	Consumption	WHr	A	Delivered	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	4	Watthour Del Phas...
	204	Register	Consumption	WHr	B	Delivered	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	5	Watthour Del Phas...
	205	Register	Consumption	WHr	C	Delivered	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	6	Watthour Del Phas...
	206	Register	Consumption	WHr	A	Received	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	7	Watthour Rec Phas...
	207	Register	Consumption	WHr	B	Received	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	8	Watthour Rec Phas...
	208	Register	Consumption	WHr	C	Received	Working	Units	6	2	1.80	Total	<input type="checkbox"/>	Primary	9	Watthour Rec Phas...

Load Profile

Channel ▲	Type	Quantity	Phase	Direction	Records	Primary Km Value	TLC
						Suggest Km	
1	Consumption	WHr	Polyphase	Delivered	Always	0.001	<input type="checkbox"/>
2	Consumption	WHr	Polyphase	Received	Always	0.001	<input type="checkbox"/>
3	Consumption	VARHr	Polyphase	Delivered	Always	0.001	<input type="checkbox"/>
4	Consumption	VARHr	Polyphase	Received	Always	0.001	<input type="checkbox"/>

Interval Length: 15 min
 External Interval Sync: No
 Freeze Markers: Yes
 Data Only: No
 Data and Events: Yes
 Data in Counts: Yes
 Data in Eng Units: No

Demand

Interval Length: 15 min
 Sub Interval Length: 5 min
 Enable Demand Sync: No
 Thermal Demand Time: 15 min
 Defer Demands for: 0 sec
 After Power Outage (secs): 1

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
 DST: not enabled

Input/Output

Channel 1: Output Energy Pulse Wh poly del, pke=0.1
 Channel 2: Output Energy Pulse Wh poly rec, pke=0.1
 Channel 3: Output Energy Pulse VARh poly del, pke=0.1
 Channel 4: Output Energy Pulse VARh poly rec, pke=0.1
 Channel 5: Output Triggered Alarm
 Channel 6: Output Clock Pulse Output
 Channel 7: Input Status Input

Channel 8 Input Status Input

Trigger Setup

Advanced Trigger Configuration														
	ID	Enabled	Trigger Measurement	Trigger On	Phase	Operator	Alarm	Trigger Delay	Reset	Reset Delay	Digital Output	Sag/Swell	High Speed RMS	Waveform Capture
<input checked="" type="checkbox"/>	1	<input type="checkbox"/>	Instantaneous	VoltsL-N	Any	<	108	0	110.4	0	None	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No
	2	<input type="checkbox"/>	Instantaneous	VoltsL-N	Any	>	132	0	129.6	0	None	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No
	3	<input type="checkbox"/>	VoltageInterr...	VoltsL-N	All	<	60	0	61.2	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	4	<input type="checkbox"/>	PhaseLossSta...	VoltsL-N	A	<	60	1000	60.18	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	5	<input type="checkbox"/>	PhaseLossSta...	VoltsL-N	B	<	60	1000	60.18	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	6	<input type="checkbox"/>	PhaseLossSta...	VoltsL-N	C	<	60	1000	60.18	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	7	<input type="checkbox"/>	PhaseRotatio...	Voltage	Polyp...	>	30	500	29.91	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	8	<input type="checkbox"/>	PhaseRotatio...	Current	Polyp...	>	60	500	59.82	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	9	<input type="checkbox"/>	Instantaneous	Volts Imbal...	None	>	6	500	5.982	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	10	<input type="checkbox"/>	Instantaneous	Amps Imba...	None	>	50	500	49.85	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	11	<input type="checkbox"/>	RapidVoltage...	VoltsL-N	Any	>	6	0	3	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No
	12	<input type="checkbox"/>	Transient	VoltsL-N	Any	<	10	0	120	0	None	<input type="checkbox"/>	<input type="checkbox"/>	No

Communication Setup

- Optical (Port 1):
 - 9600 baud
 - Binary protocol
 - Device Address = 01
 - Password timeout 5 min.
 - LED Test Pulse: Active Energy
 - Optical Test Pulse: Reactive Energy
 - Test Pulse Scaling: 0.1
- RS-232 (Port 2) N/A
- RS-232/485 (Port 3) RS485
 - 9600 baud
 - Binary protocol
 - Device Address = 01
 - Password timeout 5 min.
 - TX Start Delay =40
 - TX End Delay = 40
 - Turnaround Delay = 20
- RS-232/485 (Port 4) RS232
 - 9600 baud
 - Binary protocol
 - Device Address = 01
 - Password timeout 5 min.
 - TX Start Delay =0
 - TX End Delay = 0
 - Turnaround Delay = 0
- Int Modem (Port 5) 9600 baud
 - Binary protocol
 - Device Address = 01
 - Password timeout 10 min.
 - Modem Init String =ATV0E0

Normal Answer Window
 Answer Window Start: 00:00
 Duration: 1439
 Number of rings to answer: 2
 Frequency: Every Day

Delayed Answer Window
 Number of rings to answer: 0

Ethernet (Port 6): DHCP: Not selected
 IP Address: 192.168.250.100
 Subnet Mask: 255.255.0.0
 Default Gateway: 192.168.250.10
 Binary Port Timeout: 20

Port 2001: Binary, Device Address 1, enabled
 Port 2001: Binary, Device Address 1, enabled
 Port 2001: Binary, Device Address 1, enabled
 Port 2001: Binary, Device Address 1, enabled
 Port 502: Modbus Slave, Device Address 1, disabled
 Port 20000: DNP, Device Address 1, disabled
 Port 4059: DLMS, Device Address 1, disabled

Ethernet (Port 7): DHCP: Not selected
 IP Address: 192.168.250.101
 Subnet Mask: 255.255.0.0
 Default Gateway: 192.168.250.10

Port 2001: Binary, Device Address 1, enabled
 Port 2001: Binary, Device Address 1, enabled
 Port 2001: Binary, Device Address 1, enabled
 Port 2001: Binary, Device Address 1, enabled
 Port 502: Modbus Slave, Device Address 1, disabled
 Port 20000: DNP, Device Address 1, disabled
 Port 4059: DLMS, Device Address 1, disabled

Advanced Settings: DNS Source: Disabled
 SFTP: Enables
 SFTP Port: 22

Protocol Setup

Modbus Slave
 Modbus Counters: Start Address = 40001

Modbus Analogs: Start Address = 30001
Point 1 Watts Phase A del
Point 2 Watts Phase B del
Point 3 Watts Phase C del
Point 4 Watts Polyphase del
Point 5 PF Vectorial Rec
Point 6 Volts Phase B
Point 7 Amp²RMS
Point 8 Amp Imbalance
Point 9 VA Arithmetic Phase A Bi
Point 10 PF Arithmetic Phase B Bi

Modbus Binary : Read Output Coils
Start Address = 1

Read Input Status
Start Address = 10001

DNP Slave

DNP Counters: Write Time Interval = 1
Data Link Timeout = 1
Data Link Mode = never
Application Timeout = 1
Data Link Retries = 3
Restrict Counter = any
Time Set Tolerance = 2
Analog Input Variation = 3
Frozen Counter Events = yes
Inactivity Timeout = 120
Class 0 Counter type = Running Object 20
Class 0 Counter type = Frozen Object 21
Global Time Set = enabled

DNP Analogs: Analog Scaling 32 bit
Point 1 Watts Phase A
Point 2 Watts Phase B
Point 3 Watts Phase C
Point 4 Watts Polyphase
Point 5 VARS Phase A
Point 6 VARS Phase B
Point 7 VARS Phase C
Point 8 VARS Polyphase
Point 9 VA Phase A
Point 10 VA Phase B

DNP Binary: Read Binary Output: Object 10
Read Binary Inputs: Object 2

Display Setup

Display Scroll Rate: 10 sec
Display Timeout: 15 sec
Display Menu Timeout: Always On
Date Format: MM/DD/YYYY
Display Language: English
Preset mode timeout: 1 minutes
Test Mode timeout: 30 minutes
Demand Reset lockout: 5 minutes
User Menu Timeout: 120 sec

TLC

Loss Compensation disabled

User Management

Username: admin Password: admin
Access to all

Username: user1 Password: user1
Set time, freeze registers, activate test mode, billing period reset, preset registers, meter/battery status

Username: user2 Password: user2
Set time, billing period reset

Username: pq Password: pq
Configure I/O, Triggers, Power Quality, Measurement Logs, Configuration file access
Read Triggered alarms, meter events, diagnostics, power quality, measurement logs

APPENDIX B

ACCESSORIES

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

Description	Part Number
Non-Volatile RAM backup battery	6005-254
Security jumpers (for front panel lockout)	4195-263
Optical Pickup Assembly	Consult factory
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

DLMS COMMUNICATION PROTOCOL

INTRODUCTION

DLMS (Device Language Messaging Specification) / COSEM (Companion Specification for Energy Metering) is used for obtaining all the meter measurements for revenue and billing. This implementation is based on IEC-62056 in accordance with the DLMS Blue Book 11th edition, Blue Book 10th edition, Green Book seventh edition, Yellow book third edition.

PHYSICAL LAYER

DLMS is available on the following serial communications ports:

- Optical (IEC 62056-21 Model E)
- RS-232, RS-485
- PSTN Modem
- GPRS Modem
- Ethernet

DATA LINK LAYER

The following operation selections for HDLC (ISO/IEC 13239) were chosen for use with DLMS:

- unbalanced connection-mode data link operation
- two-way alternate data transfer
- the selected HDLC class of procedure is UNC, extended with UI frames
- non-basic frame format transparency (HDLC Frame format type 3)

DLMS/COSEM Specification	Supported
Maximum Info Field Transmit	128
Maximum info field Receive	128
Maximum Window Size Transmit	1
Maximum Window Size Receive	1
Transparent transfer of long MSDUs	Not supported
Inactivity timeout	120 seconds
Inter-frame timeout	Configured Rx Timeout register value
Device Addressing Length	4 bytes
Physical Device Address	Configured in meter's Unit ID register value
Logical Device(s) Management	Logical Deviceonlyatspecifiedaddress0x0001

APPLICATION LAYER

The following classes were implemented:

Class		Attributes	
1	Data	1	logical name
		2	value
3	Register	1	logical name
		2	value
		3	scaler unit
7	Profile Generic	1	logical name
		2	buffer
		3	capture objects
		4	capture period
		5	sort method
		6	sort object
		7	entries in use
		8	profile entries
8	Clock	1	logical name
		2	time
		3	time zone
		4	status
		5	daylight savings begin
		6	daylight savings end
		7	daylight savings deviation
		8	daylight savings enabled
		9	clock base
15	Association LN	1	logical name
		2	object list
		3	Associated partners list
		4	Application context name
		5	xDLMS context info
		6	Authentication mechanism
		7	LLS secret
		8	Association status
17	SAP Assignment	1	logical name
		2	SAP assignment list

DLMS/COSEM Specification	Supported Implementation
Supported application context	LN referencing
Available services	block-transfer-with-get
	get
	set (supported for time synchronization only)
	selective-access

COSEM LAYER

The meter supports Data, Registers, Load Profile, Clock and Association objects.

Data Objects (IC1)

Some of the data objects listed below are set at the factory; such as firmware versions, meter serial number. The remaining data items shown in *italics* are retrieved from the user configuration in JEMWARE.

Data Objects Available for DLMS

Description	OBIS						App Assoc	Type
	A	B	C	D	E	F	Attrib	Attrib 2
Register firmware version	0	0	0	2	1	255	RO	Visible string
Register firmware signature	0	0	0	2	8	255	RO	Octet string
Metrology firmware version	0	1	0	2	1	255	RO	Visible string
Metrology firmware signature	0	1	0	2	8	255	RO	Octet string
Service firmware version	0	2	0	2	1	255	RO	Visible string
Service firmware signature	0	2	0	2	8	255	RO	Octet string
PQ firmware version	0	3	0	2	1	255	RO	Visible string
PQ firmware signature	0	3	0	2	8	255	RO	Octet string
FPGA firmware version	0	4	0	2	1	255	RO	Visible string
FPGA firmware signature	0	4	0	2	8	255	RO	Octet string
Digital I/O firmware version	0	5	0	2	1	255	RO	Visible string
Analog Out/Modem firmware version	0	6	0	2	1	255	RO	Visible string
CPLD firmware version	0	7	0	2	1	255		
AMETEK Meter Serial Number	0	0	96	11	0	255	RO	Visible string
<i>Meter ID #</i>	0	0	96	11	1	255	RO	Visible string
<i>Meter Administrator</i>	0	0	96	11	2	255	RO	Visible string
<i>Meter Location</i>	0	0	96	11	3	255	RO	Visible string
<i>Meter Configuration ID</i>	0	0	96	11	4	255	RO	Visible string
<i>Meter Account Number</i>	0	0	96	11	5	255	RO	Visible string
<i>Ch.0 Transformer ratio - Current Primary</i>	1	0	0	4	2	255	RO	Double long unsigned(32 bit unsigned integer)
<i>Ch.0 Transformer ratio - Voltage Primary</i>	1	0	0	4	3	255	RO	Double long unsigned(32 bit unsigned integer)
<i>Ch.0 Transformer ratio - Current Secondary</i>	1	0	0	4	5	255	RO	Double long unsigned(32 bit unsigned integer)
<i>Ch.0 Transformer ratio - Voltage Secondary</i>	1	0	0	4	6	255	RO	Double long unsigned(32 bit unsigned integer)
<i>Load Profile Group 1 Recording Interval</i>	1	0	0	8	4	255	RO	Double long unsigned(32 bit unsigned integer)
<i>Load Profile Group 2 Recording Interval</i>	1	0	0	8	5	255	RO	Double long unsigned(32 bit unsigned integer)
<i>Load Profile Group 1 Scaling Factor (Km)</i>	1	128	103	0	0	255	RO	Array
<i>Load Profile Group 2 Scaling Factor (Km)</i>	1	128	104	0	0	255	RO	Array
<i>Energy pulse settings</i>	1	128	100	0	0	255	RO	Array
<i>LED and Optical pulse settings</i>	1	128	101	0	0	255	RO	Array

DLMS Details for Load Profile Recording Interval

Description	OBIS						App Assoc
	A	B	C	D	E	F	Attrib
Load Profile Group 1 Recording Interval	1	0	0	8	4	255	RO
Load Profile Group 2 Recording Interval	1	0	0	8	5	255	RO

Load Profile Recording Interval Values

(typical for Load Profile Group #1 and #2)

Recording Interval	DLMS Value
1 minute	0
2 minutes	1
3 minutes	2
4 minutes	3
5 minutes	4
6 minutes	5
10 minutes	6
12 minutes	7
15 minutes	8
20 minutes	9
30 minutes	10
60 minutes	11
Daily	12
Weekly	13
Monthly	14

Load Profile Recording Interval configuration in JEMWARE (15 minutes shown)

The screenshot shows the 'Load Profile' configuration window in JEMWARE. The 'Optional Settings' section is expanded, showing 'Interval Length' set to 15. Other settings include 'Ext. Interval Sync' (NO), 'Freeze Markers' (YES), 'Memory Storage' (Est. Days of Storage: 1016), and 'Data Settings' (Data only: NO, Data and events: YES, Data in counts: YES, Data in Eng units: NO). A blue arrow points from the text above to the 'Interval Length' dropdown menu.

DLMS Values from above

Load Profile Scaling Factor Settings		
Load Profile Settings	Setting	DLMS Value
Interval Length	15 minutes	8

DLMS Details for Load Profile Scaling Factor (Km)

Description	OBIS						App Assoc
	A	B	C	D	E	F	Attrib
Load Profile Group 1 Scaling Factor (Km)	1	128	103	0	0	255	RO
Load Profile Group 2 Scaling Factor (Km)	1	128	104	0	0	255	RO

DLMS Array Details for Load Profile Scaling Factor Settings
(typical for Load Profile Group #1 and #2)

Load Profile Scaling Factor Settings			
Value	DLMS Item	Load Profile Channel #	DLMS Value
	L1 Sub value (0)	1	Floating Point
	L1 Sub value (1)	2	Floating Point
	L1 Sub value (2)	3	Floating Point
	L1 Sub value (3)	4	Floating Point
	L1 Sub value (15)	16	Floating Point

Load Profile (Km) Scaling Factor configuration in JEMWARE
(2.15625 shown)

Load Profile

Load Profile 1 | Load Profile 2

Channel	Type	Quantity	Phase	Direction	Records	Primary Km Value	TLC
1	Consumption	WHR	Polyphase	Delivered	Always	2.15625	<input type="checkbox"/>
2	Consumption	WHR	Polyphase	Received	Always	2.15625	<input type="checkbox"/>
3	Consumption	VARHR	Polyphase	Delivered	Always	215.625	<input type="checkbox"/>
4	Consumption	VARHR	Polyphase	Received	Always	215.625	<input type="checkbox"/>

Optional Settings

Interval Length: 1
Ext. Interval Sync: NO
Freeze Markers: YES

Memory Storage

Est. Days of Storage: 70

Data Settings

Data only: YES
Data in counts: YES

Measurement Units set in Primary Configuration Screen | Maximum 16, Count=4

DLMS Values from above

Load Profile Scaling Factor Settings			
Value	Channel Settings	Setting	DLMS Value
	L1 Sub value (0)	Load Profile Channel 1 Km	2.15625
	L1 Sub value (1)	Load Profile Channel 2 Km	2.15625
	L1 Sub value (2)	Load Profile Channel 3 Km	2.15625
	L1 Sub value (3)	Load Profile Channel 4 Km	2.15625

DLMS Array Details for Energy Pulse Settings

Description	OBIS						App Assoc
	A	B	C	D	E	F	Attrib
<i>Energy Pulse Settings</i>	1	128	100	0	0	255	RO

Energy Pulse Settings Array details

Energy Pulse Settings			
Value	Output Channel #	Channel Settings	
	L1 Sub value (0)	L2 Sub value (0)	
		L2 Sub value (1)	
		L2 Sub value (2)	
		L2 Sub value (3)	
		L2 Sub value (4)	
	L1 Sub value (1)	L2 Sub value (0)	
		L2 Sub value (1)	
		L2 Sub value (2)	
		L2 Sub value (3)	
		L2 Sub value (4)	
	L1 Sub value (6)	L2 Sub value (0)	
		L2 Sub value (1)	
		L2 Sub value (2)	
		L2 Sub value (3)	
L2 Sub value (4)			

Output Channel #

L1 Sub value (0)	Channel 1	7 Possible Energy Output Channels
L1 Sub value (1)	Channel 2	
L1 Sub value (2)	Channel 3	
L1 Sub value (3)	Channel 4	
L1 Sub value (4)	Channel 5	
L1 Sub value (5)	Channel 6	
L1 Sub value (6)	Channel 7	

Note: There are a maximum of 7 Digital Output Channels that can be used as Energy Outputs.

Channel Settings

L2 Sub value (0)	Output Channel #		DLMS Value
	Channel #1 thru 7		1-7
L2 Sub value (1)	Quantity	Measurement	DLMS Value
		Whr	0
		VARhr	1
		VAhr Vectorial	2
		VAhr Arithmetic	3
		Ahr	4
		Qhr	5
		ASqhr	6
VSqhr	7		
L2 Sub value (2)	Direction	Setting	DLMS Value
		None	0
		Delivered	1

		Received	2
		Bidirectional	3
		Total	4
		Net	5
		Q1	6
		Q2	7
		Q3	8
		Q4	9
		Absolute	10
L2 Sub value (3)	Phase	Setting	DLMS Value
		A	0
		B	1
		C	2
		Polyphase	3
		Average	4
		Neutral	5
		System	6
L2 Sub value (4)	Pulse Weight	Setting	DLMS Value
		As configured	Floating Point Value

Note: Only Digital I/O channels configured as 'Energy Outputs' will be displayed.

Example of a JEMWARE Configuration:

Input/Output

The screenshot shows the 'Input/Output' configuration window. It has tabs for 'Internal I/O' and 'External I/O', and sub-tabs for 'Digital I/O' and 'Analog Output'. Under 'Digital I/O', there are two sub-sections: 'Input/Output' and 'Selection'. The 'Input/Output' section lists 8 channels. Channels 1-7 are 'Output' type and set to 'Energy Pulse, Normally Open'. Channel 8 is 'Input' type and set to 'Pulse Counter'. Each channel has a 'Settings' button. The 'Selection' section on the right shows configuration for the selected channel (Channel 1):

- Quantity: WHr
- Direction: Delivered
- Phase: Polyphase
- TLC:
- Full Scale Wh: Primary 0.174, Secondary 17.4
- Measurement Units: Units
- Pulse Output Scaling: Ke
- Pulse Weight: 0.004833333 (with 'Suggest' button)
- Full Scale Pulse Freq: 1 (with 'Suggest' button)
- Energy/Pulse: 0.00483
- Pulse Duration (ms): 40

DLMS Values from above

Energy Pulse Settings				
Value	Output Channel #	Channel Settings	Setting	DLMS Value
L1 Sub value (0)	L2 Sub value (0)	L2 Sub value (0)	Channel 1	0
		L2 Sub value (1)	Whr	0
		L2 Sub value (2)	Delivered	1
		L2 Sub value (3)	Polyphase	3
		L2 Sub value (4)	Pulse weight	0.004833

Note: Only Channel 1 of 7 shown above.

DLMS Array Details for LED and Optical Pulse Settings

Description	OBIS						App Assoc
	A	B	C	D	E	F	Attrib
LED and Optical pulse settings	1	128	101	0	0	255	RO

Energy Pulse Settings Array details

Energy Pulse Settings			
Value	L1 Sub value (0)	LED Test Pulse Selection	DLMS Value
		Active Energy	0
		Reactive Energy	1
L1 Sub value (1)		LED Test Pulse Sealing	DLMS Value
		As configured	Floating Point
L1 Sub value (2)		Optical Test Pulse Selection	DLMS Value
		Active Energy	0
		Reactive Energy	1
L1 Sub value (3)		Optical Test Pulse Sealing	DLMS Value
		As configured	Floating Point

Example of a JEMWARE Configuration:

Optical Port Settings ⌵

Baud Rate :

Protocol Type :

Detailed Settings

Device Address :

Password Timeout :

LED Test Pulse : Active Energy Reactive Energy

Optical Test Pulse : Active Energy Reactive Energy

Test Pulse Scaling :

DLMS Values from above

Energy Pulse Settings			
Value	Channel Settings	Setting	DLMS Value
	L1 Sub value (0)	LED Test Pulse: Active Energy	0
	L1 Sub value (1)	LED Test Pulse Sealing: 1.8	1.8
	L1 Sub value (2)	Optical Test Pulse: Reactive Energy	1
	L1 Sub value (3)	Optical Test Pulse Sealing: 1.8	1.8

Register Objects (IC3)

The register and profile attributes listed in the table below are scaled by 1000 to provide resolution to three decimal points.

There is no configuration required in the meter to access any of the measurements listed below. The following Register objects are available in all meters.

Register Measurements Available for DLMS

Description	OBIS						App Assoc	Type	Unit
	A	B	C	D	E	F	Attrib	Attrib 2	Attrib 2
Active power+ (QI+QIV) Watts Del A	1	0	21	7	0	255	RO	Double long unsigned	W
Watts Del B	1	0	41	7	0	255	RO	Double long unsigned	W
Watts Del C	1	0	61	7	0	255	RO	Double long unsigned	W
Watts Del Poly	1	0	1	7	0	255	RO	Double long unsigned	W
Active power- (QII+QIII) Watts Rec A	1	0	22	7	0	255	RO	Double long unsigned	W
Watts RecB	1	0	42	7	0	255	RO	Double long unsigned	W
Watts Rec C	1	0	62	7	0	255	RO	Double long unsigned	W
Watts Rec Poly	1	0	2	7	0	255	RO	Double long unsigned	W
Reactive power+ (QI+QII) VARs Del A	1	0	23	7	0	255	RO	Double long unsigned	VAR
VARs Del B	1	0	43	7	0	255	RO	Double long unsigned	VAR
VARs Del C	1	0	63	7	0	255	RO	Double long unsigned	VAR
VARs Del Poly	1	0	3	7	0	255	RO	Double long unsigned	VAR
Reactive power- (QIII+QIV) VARs Rec A	1	0	24	7	0	255	RO	Double long unsigned	VAR
VARs Rec B	1	0	44	7	0	255	RO	Double long unsigned	VAR
VARs Rec C	1	0	64	7	0	255	RO	Double long unsigned	VAR
VARs Rec Poly	1	0	4	7	0	255	RO	Double long unsigned	VAR
Apparent power+ (QI+QIV) VA Arithmetic Delivered A	1	0	29	7	0	255	RO	Double long unsigned	VA
VA Arithmetic Delivered B	1	0	49	7	0	255	RO	Double long unsigned	VA
VA Arithmetic Delivered C	1	0	69	7	0	255	RO	Double long unsigned	VA
VA Arithmetic Delivered Poly	1	0	9	7	0	255	RO	Double long unsigned	VA
Apparent power- (QII+QIII) VA Arithmetic Received A	1	0	30	7	0	255	RO	Double long unsigned	VA
VA Arithmetic Received B	1	0	50	7	0	255	RO	Double long unsigned	VA
VA Arithmetic Received C	1	0	70	7	0	255	RO	Double long unsigned	VA
VA Arithmetic Received Poly	1	0	10	7	0	255	RO	Double long unsigned	VA
Voltage: any phase Volts RMS Phase A	1	0	32	7	0	255	RO	Double long unsigned	V
Volts RMS Phase B	1	0	52	7	0	255	RO	Double long unsigned	V
Volts RMS Phase C	1	0	72	7	0	255	RO	Double long unsigned	V
Volts RMS Average	1	0	12	4	0	255	RO	Double long unsigned	V
Current: any phase Amps RMS A	1	0	31	7	0	255	RO	Double long unsigned	A
Amps RMS B	1	0	51	7	0	255	RO	Double long unsigned	A
Amps RMS C	1	0	71	7	0	255	RO	Double long unsigned	A
Amps RMS Poly	1	0	90	7	0	255	RO	Double long unsigned	A
Amps RMS Neutral	1	0	91	7	0	255	RO	Double long unsigned	A
Amps RMS Average	1	0	90	4	0	255	RO	Double long unsigned	A
PF Arithmetic A	1	0	33	7	0	255	RO	Double long unsigned	
PF Arithmetic B	1	0	53	7	0	255	RO	Double long unsigned	
PF Arithmetic C	1	0	73	7	0	255	RO	Double long unsigned	
PF Arithmetic Poly	1	0	13	7	0	255	RO	Double long unsigned	

Frequency	1	0	34	7	0	255	RO	Double long unsigned	HZ
Fundamental Volts A Phase Angle	1	0	81	7	0	255	RO	Double long unsigned	Deg
Fundamental Volts B Phase Angle	1	0	81	7	1	255	RO	Double long unsigned	Deg
Fundamental Volts C Phase Angle	1	0	81	7	2	255	RO	Double long unsigned	Deg
Fundamental Amps A Phase Angle	1	0	81	7	4	255	RO	Double long unsigned	Deg
Fundamental Amps B Phase Angle	1	0	81	7	5	255	RO	Double long unsigned	Deg
Fundamental Amps C Phase Angle	1	0	81	7	6	255	RO	Double long unsigned	Deg
Watthours A Delivered	1	0	21	8	0	255	RO	Double long unsigned	Wh
Watthours B Delivered	1	0	41	8	0	255	RO	Double long unsigned	Wh
Watthours C Delivered	1	0	61	8	0	255	RO	Double long unsigned	Wh
Watthours Poly Delivered	1	0	1	8	0	255	RO	Double long unsigned	Wh
Watthours A Received	1	0	22	8	0	255	RO	Double long unsigned	Wh
Watthours B Received	1	0	42	8	0	255	RO	Double long unsigned	Wh
Watthours C Received	1	0	62	8	0	255	RO	Double long unsigned	Wh
Watthours Poly Received	1	0	2	8	0	255	RO	Double long unsigned	Wh

Register Object Details

Each Register Object (IC3) includes the following items:

(Sum Li Active power+ [QI+QIV] Instantaneous value shown below):

Name	Value	Time Stamp	Data Type	Access Right
Logical Name	1-0-1-7-0-255	Time of read	Octet String	RO
Value	X watts	Time of read	Double long unsigned	RO
Scaler Unit	0	Time of read	Structure	RO

Load Profile Objects (IC7)

Up to 16 channels of Load Profile can be retrieved in IC7. Load profile can be retrieved by data range or by the number of records as determined by the selective access buffer.

Configuring Load Profile for DLMS using JEMWARE

The individual measurements used for DLMS need to be configured in the meter’s Load Profile Configuration via JEMWARE first.

The Load Profile screen in JEMWARE contains parameters that set up the Load Profile storage areas in the meter. A meter can be equipped with 16 Load Profile channels (*standard*) or an additional 16 channels in a second Load Profile (*optional*). If the meter has the “Dual Load Profile” option installed, a second tabbed page will be available to configure the 16 additional and independent Load Profile settings.

Load Profile

Channel	Type	Quantity	Phase	Direction	Records	Primary Km Value	TLC
1	Consumption	WHr	Polyphase	Delivered	Always	0.001	<input type="checkbox"/>
2	Consumption	WHr	Polyphase	Received	Always	0.001	<input type="checkbox"/>
3	Consumption	VARHr	Polyphase	Delivered	Always	0.001	<input type="checkbox"/>
4	Consumption	VARHr	Polyphase	Received	Always	0.001	<input type="checkbox"/>
5	StatusWord	TriggerBit	None	None	None	0.0	<input type="checkbox"/>
6	StatusWord	SystemBit	None	None	None	0.0	<input type="checkbox"/>

Optional Settings

Interval Length: 1

Ext. Interval Sync: NO

Freeze Markers: YES

Memory Storage

Est. Days of Storage: 54

Data Settings

Data only: NO Data and events: YES

Data in counts: NO Data in Eng units: YES

Reference the JEMWARE Manual 1079-699 for additional details on how to configure Load Profile.

The list of available measurements supported by DLMS are shown in Table 2 below.

- Note 1: Only the measurements included in the meter’s Load Profile setup will be available for DLMS IC7.
- Note 2: The Load Profile setup in the meter must not include any measurements outside of this list of available measurements.

In the Load Profile screenshot above, 6 channels of Load Profile are configured, consisting of:

1. Whr Delivered Polyphase
2. Whr Received Polyphase
3. VARhr Delivered Polyphase
4. VARhr Received Polyphase
5. Status Word (Triggered Bit)
6. Status Word (System Bit)

Refer to Table 2 for other measurements supported in DLMS.

The interval length configured above is 1 minute.

Other selectable intervals are: 2,3,4,5,6,10,12,15,20,30,60 minutes.

DLMS Details for Load Profile (IC7)

Description	OBIS						App Assoc
	A	B	C	D	E	F	Attrib
Load Profile Group 1	1	0	99	1	0	255	RO
Load Profile Group 2	1	0	98	1	0	255	RO

Load Profile Details

The Load Profile Object (IC7) includes the following items: (typical for Load Profile Group #1 and #2)

Name	Value	Time Stamp	Data Type	Access Right
Logical Name	1.0.99.1.0.255	Time of Read	Octet String	RO
Buffer	Load Profile Values		Array	RO
Capture Objects	Defines list of buffer items		Array	RO
Capture Period	Interval length (sec)		Double Long Unsigned	RO
Sort Method	1 (oldest events first)		Enum	RO
Sort Object	None		Structure	RO
Entries in Use	Number of entries stored in the buffer		Double Long Unsigned	RO
Profile Entries	Maximum number of entries to be retained in the Buffer – dependent on number of LP channels configured.		Double Long Unsigned	RO
Selective Access for Buffer	User configurable range of load profile entries, defined by date range or number of values		Structure	RW

Buffer Objects shown

This is a list of Load Profile intervals in the meter.

Entry	Name	Value	Data Type
0	Value (0)	Clock Timestamp	Octet String
	Value (1)	Status	Double Long Unsigned
	Value (2)	Load Profile Ch 1 measurement	Float 32
	Value (3)	Load Profile Ch 2 measurement	Float 32
	Value (4)	Load Profile Ch 3 measurement	Float 32
	Value (5)	Load Profile Ch 4 measurement	Float 32
	Value (6)	Load Profile Ch 5 measurement	Float 32
	Value (7)	Load Profile Ch 6 measurement	Float 32
1	Value (0)	Clock Timestamp	Octet String
	Value (1)	Status	Double Long Unsigned
	Value (2)	Load Profile Ch 1 measurement	Float 32
	Value (3)	Load Profile Ch 2 measurement	Float 32
	Value (4)	Load Profile Ch 3 measurement	Float 32
	Value (5)	Load Profile Ch 4 measurement	Float 32
	Value (6)	Load Profile Ch 5 measurement	Float 32
	Value (7)	Load Profile Ch 6 measurement	Float 32

Two LP intervals shown above. The number of intervals provided is based on the selective access buffer.

Buffer Object Status

For every Load Profile Interval, the Value (1) in the Buffer Object will provide the status for that Load Profile Interval. The available Status Types are shown below:

Status Type	Status Value (in Hex)	Status Value (in Decimal)
Normal Interval	00 01	1
Midnight Event	00 02	2
Midnight Normal	00 03	3
Midnight Time Set	00 0A	10
Power Outage	00 04	4
Midnight Power Outage	00 06	6
Time Set	00 08	8
Daylight Savings Time Change	00 10	16
Test Mode	00 20	32
Meter Configuration	00 40	64
Freeze	00 80	128
Freeze Midnight	00 82	130
Billing Period Reset (BPR)	01 00	256
BPR Midnight	01 02	258
Register Preset (n/a for IEC Meter)	02 00	512
Midnight Register Preset	02 02	514
Recalibration	04 00	1024
Midnight Recalibration	04 02	1026
Diagnostic	08 00	2048
Midnight Diagnostic	08 02	2050

Note: When an event coincides with a Midnight timeframe, it will combine the Midnight event. For example, if a Billing Period Reset is configured to occur exactly at Midnight, we will report a single event called BPR Midnight.

Capture Objects shown

This provides a list of Load Profile Channels configured in the meter.

Entry	Name	Value	Data Type
0	Class ID	8	Long Unsigned
	Logical Name	Clock Timestamp	Octet String
	Att Index	2	Integer
	Data Index	0	Long Unsigned
1	Class ID	1	Long Unsigned
	Logical Name	Operating Status	Octet String
	Att Index	2	Integer
	Data Index	0	Long Unsigned
2	Class ID	3	Long Unsigned
	Logical Name	Load Profile Ch 1 measurement	Octet String
	Att Index	2	Integer
	Data Index	0	Long Unsigned
3	Class ID	3	Long Unsigned
	Logical Name	Load Profile Ch 2 measurement	Octet String
	Att Index	2	Integer
	Data Index	0	Long Unsigned

Two Load Profile channels shown in above example. A maximum of 16 channels is available.

Table 2: Load Profile Measurements Available for DLMS

Type	Quantity	Direction Phase	OBIS code
Consumption	<u>Watt hours</u>	Delivered A	1.0.21.29.0.255
		Delivered B	1.0.41.29.0.255
		Delivered C	1.0.61.29.0.255
		Delivered Poly	1.0.1.29.0.255
		Received A	1.0.22.29.0.255
		Received B	1.0.42.29.0.255
		Received C	1.0.62.29.0.255
		Received Poly	1.0.2.29.0.255
		Net A	1.0.36.29.0.255
		Net B	1.0.56.29.0.255
		Net C	1.0.76.29.0.255
		Net Poly	1.0.16.29.0.255
		Abs A	1.0.35.29.0.255
		Abs B	1.0.55.29.0.255
		Abs C	1.0.75.29.0.255
		Abs Poly	1.0.15.29.0.255
Consumption	VAR hours	Delivered A	1.0.23.29.0.255
		Delivered B	1.0.43.29.0.255
		Delivered C	1.0.63.29.0.255
		Delivered Poly	1.0.3.29.0.255
		Received A	1.0.24.29.0.255
		Received B	1.0.44.29.0.255
		Received C	1.0.64.29.0.255
		Received Poly	1.0.4.29.0.255
		Net A	1.128.23.29.0.255
		Net B	1.128.43.29.0.255
		Net C	1.128.63.29.0.255
		Net Poly	1.128.3.29.0.255
		Q1 A	1.0.25.29.0.255
		Q1 B	1.0.45.29.0.255
		Q1 C	1.0.65.29.0.255
		Q1 Poly	1.0.5.29.0.255
		Q2 A	1.0.26.29.0.255
		Q2 B	1.0.46.29.0.255
		Q2 C	1.0.66.29.0.255
		Q2 Poly	1.0.6.29.0.255
		Q3 A	1.0.27.29.0.255
		Q3 B	1.0.47.29.0.255
		Q3 C	1.0.67.29.0.255
		Q3 Poly	1.0.7.29.0.255
		Q4 A	1.0.28.29.0.255
		Q4 B	1.0.48.29.0.255
		Q4 C	1.0.68.29.0.255
		Q4 Poly	1.0.8.29.0.255
		Abs A	1.128.24.29.0.255
		Abs B	1.128.44.29.0.255

		Abs C	1.128.64.29.0.255
		Abs Poly	1.128.4.29.0.255
Consumption	VA hours Arithmetic	Delivered A	1.0.29.29.0.255
		Delivered B	1.0.49.29.0.255
		Delivered C	1.0.69.29.0.255
		Delivered Poly	1.0.9.29.0.255
		Received A	1.0.30.29.0.255
		Received B	1.0.50.29.0.255
		Received C	1.0.70.29.0.255
		Received Poly	1.0.10.29.0.255
		Net A	1.128.29.29.0.255
		Net B	1.128.49.29.0.255
		Net C	1.128.69.29.0.255
		Net Poly	1.128.9.29.0.255
		Abs A	1.128.30.29.0.255
		Abs B	1.128.50.29.0.255
		Abs C	1.128.70.29.0.255
		Abs Poly	1.128.10.29.0.255

Type	Phases	Direction Phase	OBIS code
Instantaneous	<u>Watts(Avg)</u>	Delivered A	1.0.21.27.0.255
		Delivered B	1.0.41.27.0.255
		Delivered C	1.0.61.27.0.255
		Delivered Poly	1.0.1.27.0.255
		Received A	1.0.22.27.0.255
		Received B	1.0.42.27.0.255
		Received C	1.0.62.27.0.255
		Received Poly	1.0.2.27.0.255
		BiDir A	1.128.21.27.0.255
		BiDir B	1.128.41.27.0.255
		BiDir C	1.128.61.27.0.255
		BiDir Poly	1.128.1.27.0.255
		Abs A	1.128.35.27.0.255
		Abs B	1.128.55.27.0.255
		Abs C	1.128.75.27.0.255
		Abs Poly	1.128.15.27.0.255
Instantaneous	Vars(avg)	Delivered A	1.0.23.27.0.255
		Delivered B	1.0.43.27.0.255
		Delivered C	1.0.63.27.0.255
		Delivered Poly	1.0.3.27.0.255
		Received A	1.0.24.27.0.255
		Received B	1.0.44.27.0.255
		Received C	1.0.64.27.0.255
		Received Poly	1.0.4.27.0.255
		BiDir A	1.128.23.27.0.255
		BiDir B	1.128.43.27.0.255
		BiDir C	1.128.63.27.0.255
		BiDir Poly	1.128.3.27.0.255
		Q1 A	1.0.25.27.0.255
		Q1 B	1.0.45.27.0.255
		Q1 C	1.0.65.27.0.255
		Q1 Poly	1.0.5.27.0.255
		Q2 A	1.0.26.27.0.255
		Q2 B	1.0.46.27.0.255
		Q2 C	1.0.66.27.0.255
		Q2 Poly	1.0.6.27.0.255
		Q3 A	1.0.27.27.0.255
		Q3 B	1.0.47.27.0.255
		Q3 C	1.0.67.27.0.255
		Q3 Poly	1.0.7.27.0.255
		Q4 A	1.0.28.27.0.255
		Q4 B	1.0.48.27.0.255
		Q4 C	1.0.68.27.0.255
		Q4 Poly	1.0.8.27.0.255
		Abs A	1.128.24.27.0.255
		Abs B	1.128.44.27.0.255
		Abs C	1.128.64.27.0.255
		Abs Poly	1.128.4.27.0.255

Instantaneous	VA Arithmetic(Avg)	Delivered A Delivered B Delivered C Delivered Poly Received A Received B Received C Received Poly BiDir A BiDir B BiDir C BiDir Poly Abs A Abs B Abs C Abs Poly	1.0.29.27.0.255 1.0.49.27.0.255 1.0.69.27.0.255 1.0.9.27.0.255 1.0.30.27.0.255 1.0.50.27.0.255 1.0.70.27.0.255 1.0.10.27.0.255 1.128.30.27.0.255 1.128.50.27.0.255 1.128.70.27.0.255 1.128.10.27.0.255 1.128.29.27.0.255 1.128.49.27.0.255 1.128.69.27.0.255 1.128.9.27.0.255
Instantaneous	Volts Line-Line(Avg)	A B C Avg	1.0.32.27.0.255 1.0.52.27.0.255 1.0.72.27.0.255 1.0.12.27.0.255
Instantaneous	Amps RMS(Avg)	A B C Poly Neutral	1.0.31.27.0.255 1.0.51.27.0.255 1.0.71.27.0.255 1.0.90.27.0.255 1.0.91.27.0.255
Instantaneous	PF Arithmetic(Avg)	BiDir A BiDir B BiDir C BiDir D	1.0.33.27.0.255 1.0.53.27.0.255 1.0.73.27.0.255 1.0.13.27.0.255
Instantaneous	Frequency(Avg)	n/a	1.0.34.27.0.255
Consumption	VAh <u>Vectorial</u>	Delivered A Delivered B Delivered C Delivered Poly Received A Received B Received C Received Poly Net A Net B Net C Net Poly Abs A Abs B Abs C Abs Poly	1.0.128.29.0.255 1.0.129.29.0.255 1.0.130.29.0.255 1.0.131.29.0.255 1.0.132.29.0.255 1.0.133.29.0.255 1.0.134.29.0.255 1.0.135.29.0.255 1.0.136.29.0.255 1.0.137.29.0.255 1.0.138.29.0.255 1.0.139.29.0.255 1.0.140.29.0.255 1.0.141.29.0.255 1.0.142.29.0.255 1.0.143.29.0.255
Consumption	<u>Amp hours</u>	None A None B None C	1.0.31.29.0.255 1.0.51.29.0.255 1.0.71.29.0.255

		None Poly	1.0.90.29.0.255
Consumption	<u>Q hours</u>	Delivered A Delivered B Delivered C Delivered Poly Received A Received B Received C Received Poly Net A Net B Net C Net Poly Abs A Abs B Abs C Abs Poly	1.0.143.29.0.255 1.0.144.29.0.255 1.0.145.29.0.255 1.0.146.29.0.255 1.0.147.29.0.255 1.0.148.29.0.255 1.0.149.29.0.255 1.0.150.29.0.255 1.0.151.29.0.255 1.0.152.29.0.255 1.0.153.29.0.255 1.0.154.29.0.255 1.0.155.29.0.255 1.0.156.29.0.255 1.0.157.29.0.255 1.0.158.29.0.255
Consumption	Amp squared hours	None A None B None C None Poly None Avg	1.128.88.29.0.255 1.129.88.29.0.255 1.130.88.29.0.255 1.0.88.29.0.255 1.131.88.29.0.255
Consumption	Volt squared hours	None A None B None C None Poly	1.128.89.29.0.255 1.129.89.29.0.255 1.130.89.29.0.255 1.0.89.29.0.255
Instantaneous	<u>VA Vectorial</u>	Delivered A Delivered B Delivered C Delivered Poly Received A Received B Received C Received Poly BiDir A BiDir B BiDir C BiDir Poly Abs A Abs B Abs C Abs Poly	1.0.128.27.0.255 1.0.129.27.0.255 1.0.130.27.0.255 1.0.131.27.0.255 1.0.132.27.0.255 1.0.133.27.0.255 1.0.134.27.0.255 1.0.135.27.0.255 1.0.136.27.0.255 1.0.137.27.0.255 1.0.138.27.0.255 1.0.139.27.0.255 1.0.140.27.0.255 1.0.141.27.0.255 1.0.142.27.0.255 1.0.143.27.0.255
Instantaneous	Volts Line-Neutral	None A None B None C None Avg	1.0.159.27.0.255 1.0.160.27.0.255 1.0.161.27.0.255 1.0.162.27.0.255
Instantaneous	Power Factor Arithmetic	Delivered A Delivered B Delivered C	1.128.33.27.0.255 1.128.53.27.0.255 1.128.73.27.0.255

		Delivered Poly Received A Received B Received C Received Poly	1.128.13.27.0.255 1.129.33.27.0.255 1.129.53.27.0.255 1.129.73.27.0.255 1.129.13.27.0.255
Instantaneous	Power Factor <u>vectorial</u>	Delivered A Delivered B Delivered C Delivered Poly Received A Received B Received C Received Poly BiDir A BiDir B BiDir C BiDir Poly	1.0.163.27.0.255 1.0.164.27.0.255 1.0.165.27.0.255 1.0.166.27.0.255 1.0.167.27.0.255 1.0.168.27.0.255 1.0.169.27.0.255 1.0.170.27.0.255 1.0.171.27.0.255 1.0.172.27.0.255 1.0.173.27.0.255 1.0.174.27.0.255
Instantaneous	Volts THD	None A None B None C	1.0.32.24.124.255 1.0.52.24.124.255 1.0.72.24.124.255
Instantaneous	Amps THD	None A None B None C	1.0.31.24.124.255 1.0.51.24.124.255 1.0.71.24.124.255
Instantaneous	Q	Delivered A Delivered B Delivered C Delivered Poly Received A Received B Received C Received Poly BiDir A BiDir B BiDir C BiDir Poly Abs A Abs B Abs C Abs Poly	1.0.143.27.0.255 1.0.144.27.0.255 1.0.145.27.0.255 1.0.146.27.0.255 1.0.147.27.0.255 1.0.148.27.0.255 1.0.149.27.0.255 1.0.150.27.0.255 1.0.151.27.0.255 1.0.152.27.0.255 1.0.153.27.0.255 1.0.154.27.0.255 1.0.155.27.0.255 1.0.156.27.0.255 1.0.157.27.0.255 1.0.158.27.0.255
Instantaneous	Amps squared RMS	None A None B None C None Poly None Neutral	1.0.175.27.0.255 1.0.176.27.0.255 1.0.177.27.0.255 1.0.178.27.0.255 1.0.179.27.0.255
Instantaneous	Volts squared L-N	None A None B None C None Avg	1.0.180.27.0.255 1.0.181.27.0.255 1.0.182.27.0.255 1.0.183.27.0.255
Instantaneous	Volts square L-L	None A	1.0.184.27.0.255

		None B	1.0.185.27.0.255
		None C	1.0.186.27.0.255
		None Avg	1.0.187.27.0.255
Instantaneous	Volts imbalance	None	1.0.188.27.0.255
Instantaneous	Amps imbalance	None	1.0.189.27.0.255
Status Input	Channel 1->8	Channel 1	1.1.144.128.0.255
		Channel 2	1.2.144.128.0.255
		Channel 3	1.3.144.128.0.255
		Channel 4	1.4.144.128.0.255
		Channel 5	1.5.144.128.0.255
		Channel 6	1.6.144.128.0.255
Pulse Counter	Channel 1->8	Channel 1	1.1.82.128.0.255
		Channel 2	1.2.82.128.0.255
		Channel 3	1.3.82.128.0.255
		Channel 4	1.4.82.128.0.255
		Channel 5	1.5.82.128.0.255
		Channel 6	1.6.82.128.0.255
Status Word	Trigger Bit	None	1.0.191.27.0.255
	System Bit	None	1.0.192.27.0.255

Example showing 6 channels of Load Profile configured in JEMWARE II

Load Profile

Load Profile 1 Load Profile 2

Configuration

	Channel	Type	Quantity	Phase	Direction	Records	Primary Km Value Suggest Km	TLC
	1	Consumption	WHR	Polyphase	Delivered	Always	0.001	<input type="checkbox"/>
	2	Consumption	WHR	Polyphase	Received	Always	0.001	<input type="checkbox"/>
	3	Consumption	VARHr	Polyphase	Delivered	Always	0.001	<input type="checkbox"/>
	4	Consumption	VARHr	Polyphase	Received	Always	0.001	<input type="checkbox"/>
	5	StatusWord	TriggerBit	None	None	None	0.0	<input type="checkbox"/>
	6	StatusWord	SystemBit	None	None	None	0.0	<input type="checkbox"/>

Example of data provided:

In the Load Profile screenshot above, 6 channels of Load Profile are configured, consisting of:

1. Whr Delivered Polyphase
2. Whr Received Polyphase
3. VARhr Delivered Polyphase
4. VARhr Received Polyphase
5. Status Word (Triggered Bit)
6. Status Word (System Bit)

5 Minute intervals were used

5 intervals of Data Recorded in the meter: (as retrieved by JEMWARE II)

Record No	Event Type	Start Time	End Time	Channel: 1 WHR, Polyphase, Delivered	Channel: 2 WHR, Polyphase, Received	Channel: 3 VARHr, Polyphase, Delivered	Channel: 4 VARHr, Polyphase, Received	Channel: 5 StatusWord TriggerBit	Channel: 6 StatusWord SystemBit
0	Configuration	6/26/2019 13:18.13	6/26/2019 13:18.13	0.01	0.00	0.02	0.00	0x0000	0x0500
1	Normal	6/26/2019 13:18.13	6/26/2019 13:20.00	2.23	0.00	3.86	0.00	0x0000	0x0500
2	Normal	6/26/2019 13:20.00	6/26/2019 13:25.01	6.26	0.00	10.83	0.00	0x0000	0x0500
3	Normal	6/26/2019 13:25.01	6/26/2019 13:30.00	6.23	0.00	10.79	0.00	0x0000	0x0100
4	Normal	6/26/2019 13:30.00	6/26/2019 13:35.00	6.25	0.00	10.83	0.00	0x0000	0x0100

Note: The Status Word Trigger Bit and System Bit is displayed in JEMWARE II is in Hex Format.
 Per above, System Bit: 0x500 Hex = 1280 (decimal) = 0000 0101 0000 0000 (binary)
 Refer to the manual to identify what each bit of the status word is used for.

The same 5 intervals of Load Profile Data were retrieved by DLMS.

DLMS Details

Name	Value	Time Stamp	Data Type	Access Right
Logical Name	1.0.99.1.0.255	Time of read	Octet String	RO
Buffer	Refer to array below		Array	RO
Capture Objects	List of Load Profile measurements		Array	RO
Capture Period	300 sec (5 min intervals)		Double Long Unsigned	RO
Sort Method	1		Enum	RO
Sort Object	n/a		Structure	RO
Entries in Use	5		Double Long Unsigned	RO
Profile Entries	78624		Double Long Unsigned	RO
Selective Access for Buffer	# records or date range		Structure	RW

Array of Buffer Values			
Entry	Name	Value	Data Type
0	Value (0)	6/26/2019 13:18	Octet String
	Value (1)	64	Double Long Unsigned
	Value (2)	0.01	Float 32
	Value (3)	0	Float 32
	Value (4)	0.017999999	Float 32
	Value (5)	0	Float 32
	Value (6)	0	Float 32
	Value (7)	1280	Float 32
1	Value (0)	6/26/2019 13:20	Octet String
	Value (1)	1	Double Long Unsigned
	Value (2)	2.230999947	Float 32
	Value (3)	0	Float 32
	Value (4)	3.861000061	Float 32
	Value (5)	0	Float 32
	Value (6)	0	Float 32
	Value (7)	1280	Float 32
2	Value (0)	6/26/2019 13:25	Octet String
	Value (1)	0	Double Long Unsigned
	Value (2)	10.82699966	Float 32
	Value (3)	0	Float 32
	Value (4)	0	Float 32
	Value (5)	1280	Float 32
	Value (6)	6.255000114	Float 32
	Value (7)	0	Float 32
3	Value (0)	6/26/2019 13:30	Octet String
	Value (1)	0	Double Long Unsigned
	Value (2)	10.7869997	Float 32
	Value (3)	0	Float 32
	Value (4)	0	Float 32
	Value (5)	256	Float 32
	Value (6)	6.231999874	Float 32
	Value (7)	0	Float 32
4	Value (0)	6/26/2019 13:35	Octet String
	Value (1)	0	Double Long Unsigned
	Value (2)	10.82600021	Float 32
	Value (3)	0	Float 32
	Value (4)	0	Float 32
	Value (5)	256	Float 32
	Value (6)	6.254000187	Float 32
	Value (7)	0	Float 32

Note:
 The DLMS Status Word Value (5) is in decimal Format.
 1280 (decimal) = 0000 0101 0000 0000 (binary)
 Refer to the manual for the decoding of each status bit

DLMS Details for Ethernet Connection Status Log (IC7)

Description	OBIS						App Assoc
	A	B	C	D	E	F	Attrib
Ethernet Connection Log	0	0	99	98	0	255	RO

Ethernet Connection Log Details

Name	Value	Time Stamp	Data Type	Access Right
Logical Name	0.0.99.98.0.255	Time of Read	Octet String	RO
Buffer	Ethernet Status		Array	RO
Capture Objects	Array of two		Array	RO
Capture Period	N/A		Double Long Unsigned	RO
Sort Method	1 (oldest events first)		Enum	RO
Sort Object	None		Structure	RO
Entries in Use	Number of entries stored in the buffer		Double Long Unsigned	RO
Profile Entries	Maximum number of entries to be retained in the Buffer		Double Long Unsigned	RO
Selective Access for Buffer	User configurable range of Log entries, defined by date range or number of values		Structure	

Array of Buffer Objects

This is a list of the Ethernet Connection Status log in the meter.

Array of entry			
Entry = structure of {event timestamp, event value (ethernet status)}			
Entry	Name	Value	Data Type
0	Value (0)	Clock Timestamp	Octet String
	Value (1)	Status	Double Long Unsigned
1	Value (0)	Clock Timestamp	Octet String
	Value (1)	Status	Double Long Unsigned
2	Value (0)	Clock Timestamp	Octet String
	Value (1)	Status	Double Long Unsigned
3	Value (0)	Clock Timestamp	Octet String
	Value (1)	Status	Double Long Unsigned

Status: 0 = Ethernet Connect 1 = Ethernet Disconnect

Capture Objects shown

Array of two
[0] = {IC=8, OBIS 0.0.1.0.0.255, Attribute = 2//Event Timestamp}
[1] = {IC=8, OBIS 0.0.96.11.0.255, Attribute = 2//Ethernet Status}

Example of Ethernet Connection Status from JEMWARE Security Log.

Read Security Log



Event ID	Event Description	Date/Time
40335	Configuration Access	07/07/2020 14:09:44.925 PM
40334	admin Logged On from Ethernet 1-1 (192.168.250.1:00:00:00:00:00:00)	07/07/2020 14:09:26.626 PM
40310	admin Logged On from Ethernet 1-1 (192.168.250.1:00:00:00:00:00:00)	06/26/2020 14:16:33.799 PM
40309	admin Logged On from Ethernet 1-1 (192.168.250.1:00:00:00:00:00:00)	06/26/2020 13:41:32.847 PM
40308	admin Logged Off from Ethernet 1-1	06/26/2020 11:50:07.094 AM
40307	Configuration Access	06/26/2020 11:48:52.718 AM
40306	admin Logged On from Ethernet 1-1 (192.168.250.1:00:00:00:00:00:00)	06/26/2020 11:48:36.581 AM
40305	admin Logged On from Ethernet 1-1 (192.168.250.1:00:00:00:00:00:00)	06/26/2020 10:33:28.156 AM

DLMS Values for above:

Array of Buffer Values			
Entry	Name	Value	Data Type
0	Value (0)	6/26/2020 10:33:28	Octet String
	Value (1)	0	Double Long Unsigned
1	Value (0)	6/26/2020 11:48:52	Octet String
	Value (1)	0	Double Long Unsigned
2	Value (0)	6/26/2020 11:50:07	Octet String
	Value (1)	1	Double Long Unsigned
3	Value (0)	6/26/2020 13:41:32	Octet String
	Value (1)	0	Double Long Unsigned
4	Value (0)	6/26/2020 14:16:33	Octet String
	Value (1)	0	Double Long Unsigned
5	Value (0)	7/07/2020 14:09:26	Octet String
	Value (1)	0	Double Long Unsigned

Clock Objects (IC8)

This implementation of DLMS time synchronization uses the SET service to write a new value for attribute 2 (time) on the Clock object.

Type	Access	OBIS code
Logical Name	Read Only	0.0.1.0.0.255
Time	Read/Write	
Time Zones	Read Only	
Status	Read Only	
Daylight Savings begin	Read Only	
Daylight Savings end	Read Only	
Daylight Savings deviation	Read Only	
Daylight Savings enabled	Read Only	
Clock Base	Read Only	

Association LN Objects (IC15)

Type	OBIS code
Logical Name	0.0.40.0.1.255
Object List	
Associated Partners	
Application Context Name	
xDLMS Context Info	
Authentication Mechanism	
LLS Secret	
Association Status	

COMMUNICATION EVENTS

COM_FAULT
DLMS Protocol is configured and Serial/Socket Port Open fails
Serial/TCP :Port read/write function fails
COM_READY
Port Initialization completed and No client has been connected/communicated
COM_ACTIVE
Server is in connected/Associated state (Communicating with Client)
COM_ALERT
Client has not been communicated to server for Inactivity Timeout period (120seconds) or Interframe timeout happens

APPENDIX E

IEC 61850 COMMUNICATION PROTOCOL

IEC 61850 is an optional communication protocol used over Ethernet. It is used to make the meter measurements and I/O status available for other IED's and applications.

In this implementation, the meter will be used as an IEC 61850 Server, publishing the status of the analog and digital I/O wired to the meter to other IEC 61850 enabled IED's.

It will support GOOSE messaging by transmitting the status of the digital inputs to other devices.

IED SETUP

ICD File

Each meter shall have an ICD file that describes all available options. The file will include information such as Internal I/O, External I/O and how it is configured for inputs or outputs. The ICD file shall also identify whether it is configured for power quality measurements and PMU.

CID File

The CID file shall be created using a software application (provided by Ametek) that allows you to take the ICD file and configure the various application requirements, including IED Properties, Goose Messaging, Buffered and Unbuffered Reports and definition of the Dataset. The Software shall allow the use of FTP to transfer the CID file into the meter.

IED Properties

The IED properties shall include the IED Name, Manufacture, Model Type, Station ID, Device ID, Firmware and Identification

LOGICAL NODES

The meter will support the following logical nodes:

Logical Node	IEC 61850 Name	Description	Measurements	Variations
Physical Device	LPHD	Contains physical information about our meter		
Logical	LLNO	Contains data about our meter		
Measuring- for operative purpose	MMXU1	Total Active Power Total Reactive Power Total Apparent Power Average Power factor Frequency Phase to phase voltages Phase to ground voltages Phase currents Phase active power Phase reactive power Phase apparent power Phase power factor	TotW TotVAR TotVA TotPF Hz PPV PhV A W VAr VA PF	phsAB, phsBC, phsCA phsA, phsB, phsC phsA, phsB, phsC phsA, phsB, phsC phsA, phsB, phsC phsA, phsB, phsC
Metering - for commercial purpose	MMTR1	Total Watt hours Total VAR hours Total VA hours Delivered Watt Hours Delivered VAR hours Received Watt hours Received VAR hours	TotWh TotVARh TotVAh SupWh SupVARh DmdWh DmsVARh	
Metering Statistics	MSTA	Average current Maximum current Minimum current Average voltage Maximum voltage Minimum voltage Average apparent power Maximum apparent power Minimum apparent power Average real power Maximum real power Minimum real power Average reactive power Maximum reactive power Minimum reactive power	AvAmps MaxAmps MinAmps AvVolts MaxVolts MinVolts AvVA MaxVA MinVA AvW MaxW MinW AvVAr MaxVAr MinVAr	
Digital Inputs	IN_GGIO1	Channel 1 Channel 2 Channel 3 Channel 4 Channel 5 Channel 6	Ind1 Ind2 Ind3 Ind4 Ind5 Ind6	
Digital Outputs	Out_GGIO2	Channel 1 Channel 2 Channel 3 Channel 4 Channel 5 Channel 6	Ind1 Ind2 Ind3 Ind4 Ind5 Ind6	

GOOSE MESSAGING

GOOSE messaging is supported to allow re-transmission of any of the JEMStar II hardwired digital inputs.

REPORTS

The IEC-61850 Protocol supports up to 12 Un-buffered reports and 12 Buffered Reports. The reports shall be configured using the IEC-61850 Software application.

The reports shall be triggered for retrieval from any of three methods:

- Configurable trigger based on a change in a value as selected by a deadband value
- Report retrieved at a configurable time interval
- Report requested for retrieval by a client device

Data Set	Report Type
Meter Status	Unbuffered
Instantaneous	Unbuffered
Energy	Unbuffered
Statistics	Unbuffered
I/O	Buffered

DATASET

The 61850 Configuration Software shall provide the ability to configure 8 Data Sets of meter data (max 50 measurements) which will become available for the buffered and unbuffered reports. They shall start as a default list of values which the user can add/edit/delete the entries.

The Data Sets shall consist of:

Meter Status	This shall contain various health check conditions of the meter
Instantaneous	Group of instantaneous measurements from MMXU node
Energy	Group of energy measurements from MMTR node
Statistics	Group of min/max/avg measurements from MSTA node
Sequence	Group of sequence components from MSQI node
Power Quality	<i>(Future) Group of power quality measurements from MHAI node</i>
Disturbance	<i>(Future) Group of disturbance measurements from RADR, RBDR, RDRE</i>
I/O	<i>(Future) Group of analog and digital I/O from GGIO node</i>

PERFORMANCE CLASS

The meter meets performance class M2 for revenue metering with accuracy class 0.2 (IEC 62053-22) and 0.1 (IEC 60044-8) and up to the 13th harmonic.

CONFIGURATION SOFTWARE

Configuration Software is provided for mapping the JEMStar II data items to other IED's using GOOSE Messaging and for selecting items in the Data set and Reports. The Software allows the import of other manufacture ICD files to assist with the mapping. The software creates a CID file that can be sent to the meter via FTP.

Refer to the 61850 Configuration Software manual for details.

APPENDIX F

IEC-870-5-102 COMMUNICATION PROTOCOL

IEC 870-5-102 protocol is used for retrieving power measurements from the JEMStar II IEC meter.

PROTOCOL DETAILS

Network Configuration:

- Point to Point
- Multiple Point to Point

Physical Layer

- Baud Rate up to 19,200 bit/s

Link Layer

- One octet
- Two octets

Application Layer

- Manufacture code

MEASUREMENTS

Load Profile

Type	Quantity	Enum
Consumption	Watt hr	0
	VAR hr	1
	VA hr vectorial	2
	VA hr arithmetic	3
	Amp hr	4
	Q hr	5
	A ² hr	6
	V ² hr	7
	Computed Meas	8
	Communicated Meas	9

Type	Quantity	Enum
Instantaneous	Watts	0
	VARs	1
	VA Vectorial	2
	Volts	3
	Amps	4
	PF Vectorial	5
	Freq-Hz	6
	Volts THD	7
	Amps THD	8
	Q	9
	Pulse Count	10
	Input Status	11
	Amps ²	12
	Volts ²	13
	Computed Meas	14
	Volts Imbalance	15
	Amps Imbalance	16
	Positive Sequence	17
	Negative Sequence	18
	Zero Sequence	19
	VA Arithmetic	20
	PF Arithmetic	21
	Volt Harmonic	22
	Amp Harmonic	23
Communication Meas	24	

Type	Quantity	Enum
Phase	A	0
	B	1
	C	2
	Polyphase	3
	Average	4
	Neutral	5
	System	6

Type	Quantity	Enum
Direction	None	0
	Delivered	1
	Received	2
	BiDirectional	3
	Total	4
	Net	5

	Q1	6
	Q2	7
	Q3	8
	Q4	9

APPENDIX G

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 II 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 II, 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 Distributed Network Protocol (DNP) 3.0 within the JEMStar II 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 II meter via the DNP 3.0 protocol.

JEMStar II uses the Triangle MicroWorks™, Inc. DNP 3.0 Slave Source Code Library Version 3.12.0. 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 II meter:

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

<h1 style="margin: 0;">DNP V3.00</h1> <h2 style="margin: 0;">DEVICE PROFILE DOCUMENT</h2>	
Vendor Name: AMETEK Power Instruments	
Device Name: JEMStar II, using the Triangle MicroWorks, Inc. DNP 3.0 Slave Source Code Library, Ver 3.12.0	
Highest DNP Level Supported: For Requests: Level 2 For Responses: Level 2	Device Function: <input type="checkbox"/> Master <input checked="" type="checkbox"/> 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 II	Maximum Application Layer Re-tries: None
Requires Data Link Layer Confirmation: Configurable as: Never, Only for multi-frame messages, or Always via JEMWare II	
Requires Application Layer Confirmation: When sending multi-fragment responses Sometimes	
Timeouts while waiting for: Data Link Confirm: Configurable via JEMWare II Complete Appl. Fragment: None Application Confirm: Configurable via JEMWare II Complete Appl. Response: None Others: Transmission Delivereday: Configurable, via JEMWare II Inter-character Timeout: 1 sec. Need Time Delivereday: Configurable, via JEMWare II Frozen Counter Event scanning period: FIXED AT 5 seconds	

<h1 style="margin: 0;">DNP V3.00</h1> <h2 style="margin: 0;">DEVICE PROFILE DOCUMENT</h2>																											
<p>Sends/Executes Control Operations:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">WRITE Binary Outputs</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td style="padding: 2px;">SELECT/OPERATE</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td style="padding: 2px;">DIRECT OPERATE</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td style="padding: 2px;">DIRECT OPERATE – NO ACK</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td colspan="2" style="padding: 10px 0 0 0;"> </td> </tr> <tr> <td style="padding: 2px;">Count > 1</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td style="padding: 2px;">Pulse On</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td style="padding: 2px;">Pulse Off</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td style="padding: 2px;">Latch On</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td style="padding: 2px;">Latch Off</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td colspan="2" style="padding: 10px 0 0 0;"> </td> </tr> <tr> <td style="padding: 2px;">Queue</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> <tr> <td style="padding: 2px;">Clear Queue</td> <td style="text-align: right; padding: 2px;">Never</td> </tr> </table>		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
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-List is user-configurable via JEMWareII	Counters Roll Over at: 32 Bits: 999,999,999 or user-configurable from 3–8 digits. 16 Bits: 5 digits = 65535, or user-configurable 3–4 digits.																										
Sends Multi-Fragment Responses: Yes																											

IMPLEMENTATION

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

- (6) Single-bit Binary Output (Object 10 Variations 0, 1, 2)
- (64) Single Bit Binary Inputs (Digital Input, Trigger Status, Meter Status (Object 1 Variations 0, 1, 2, Object 2 Variations 0,1, 2)
- (200) Analog Inputs, configurable with JEMWareII for either 32-bit analog input w/o flag points (Object 30 Variation 3), or 16-bit analog input w/o flag points (Object 30 Variation 4)
- A configurable number (up to 300) of 16 or 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 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 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)	129 (response)	00 , 01 (start-stop) 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)
1	2	Binary Input Change with Time	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)
2	0	Binary Input Change (Variation 0 is default)	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)
2	1	Binary Input Change w/o Time	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)

Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
2	2	Binary Input Change with Time	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)
10	0	Binary Output (Variation 0 is default)	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)
10	1	Binary Output w/o Status	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)
10	2	Binary Output with Status	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)
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)	129 (response)	00 , 01 (start-stop) 17 , 28 (index)
20	1	32-Bit Binary Counter	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)
20	2	16-Bit Binary Counter	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)
20	5	32-Bit Binary Counter w/o 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)
20	6	16-Bit Binary Counter w/o 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)
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)	129 (response)	00 , 01 (start-stop) 17 , 28 (index)
21	1	32-Bit Frozen Counter	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)

Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
21	2	16-Bit Frozen Counter	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)
21	9	32-Bit Frozen Counter w/o 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)
21	10	16-Bit Frozen Counter w/o 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)
23	0	Frozen Counter Event (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)	129 (response)	00 , 01 (start-stop) 17 , 28 (index)
23	1	32-Bit Frozen Counter Event w/o Time	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)
23	2	16-Bit Frozen Counter Event w/o Time	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)
23	5	32-Bit Frozen Counter Event with Time	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)
23	6	16-Bit Frozen Counter Event with Time	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)
30	0	Analog 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)	129 (response)	00 , 01 (start-stop) 17 , 28 (index)
30	1	32-Bit Analog 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)
30	2	16-Bit Analog 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)

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	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)
30	4	16-Bit Analog Input 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)
30	5	Short Floating Point Analog 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)
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)
50	1	Time and Date	1 (Read) 2 (Write)	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)
52	2	Time Delivereday Fine	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)
60	0	Class 0, 1, 2, and 3 Data	1 (Read)	06 (no range , or all)	129 (response)	00, 01 (start-stop) 17, 28 (index)
60	1	Class 0 Data	1 (Read)	06 (no range , or all)	129 (response)	00, 01 (start-stop) 17, 28 (index)
60	2	Class 1 Data	1 (Read)	00, 01(start-stop) 06 (no range , or all) 07, 08(limited qty)	129 (response)	00, 01 (start-stop) 17, 28 (index)
60	3	Class 2 Data	1 (Read)	00, 01(start-stop) 06 (no range , or all) 07, 08(limited qty)	129 (response)	00, 01 (start-stop) 17, 28 (index)
60	4	Class 3 Data	1 (Read)	00, 01(start-stop) 06 (no range , or all) 07, 08(limited qty)	129 (response)	00, 01 (start-stop) 17, 28 (index)
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 (Delivereday 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 meter is not restarted, but the DNP process is restarted.

DNP Mapping

The JEMStar II meter supports a flexible mapping scheme where you can select any data point in the location you want. The following categories of DNP objects are supported:

- Binary Inputs (Object 2)
- Binary Outputs (Object 10)
- Counters (Object 20, 21)
- Analog Inputs (Object 30)
- Time and Date (Object 50)
- Class Polls (Object 60)

Binary Input Points (Object 2, variation 0,1,2)

The Binary input points represent such things as:

- Digital Input Status
- Trigger Status (Measurement Alarms)
- Meter Status (Potential Input Status, Battery Status, etc.)

JEMStar II may be configured with up to 64 Binary Input Points in DNP. You may assign any of the following Binary Inputs to any Binary Input Point:

Digital Input Status

The Binary Input follows the status of the digital inputs. Only the Digital I/O channels configured as Inputs will be shown. ON indicates digital input closed, OFF indicates digital input open.

- Channel 1
- Channel 2
- Channel 3
thru
- Channel 14

Trigger Status

The Binary Inputs will follow the status of the alarm triggers configured in the meter. ON indicates it is in the trigger condition, OFF indicates it is not in the trigger condition.

- Trigger 1
- Trigger 2
- Trigger 3
thru
- Trigger 64

Meter Status

The binary inputs will follow the status of each meter alarm condition. ON indicates that it is in alarm, OFF indicates that it is normal.

- Volts Phase A active
- Volts Phase B active
- Volts Phase C active

- Clock Sync Status
- Battery Status
- Internal Comm Status
- Class 20 Calibration Status
- Class 2 Calibration Status
- Configuration Status
- Service Firmware Status
- Metrology Firmwarer Status
- PQ Firmware Status
- Test Mode Status

Binary Output Points (Object 10, variation 0,1,2)

The Binary Output points represent the status of the digital outputs as configured by the meter. Only the Digital I/O channels configured as Outputs will be shown. ON indicates digital output closed, OFF indicates digital output open.

- Channel 1
- Channel 2
- Channel 3
thru
- Channel 14

Counters (Object 20, 21)

Counters are implemented as 16 and 32-bit counter with and without flag.)

- Object 20 Var 1 32-bit Counter with flag
- Object 20, Var 2 16-bit Counter with flag
- Object 20, Var 5 32-bit Counter without flag
- Object 20, Var 6 16-bit Counter without flag

For the counter point list, the user may select any Normal, Alternate, (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 300 counter points. Using JEMWare II, the counter point list can be configured to be any mix of Normal or Alternate registers (up to a total of 300 points). Each numeric counter point value is represented as the corresponding register value times a user-selected scaling factor from 1 to 1,000.

Registers in the Normal and Alternate display lists are set by the user.

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 16 (32)-bit mask value.

The corresponding frozen counter object is implemented as Object 21. The values of the points in this object represent the values of the corresponding counter points at the time of the last register freeze. The objects and variations supported are:

- Object 21 Var 1 32-bit Frozen Counter with flag
- Object 21, Var 2 16-bit Frozen Counter with flag
- Object 21, Var 9 32-bit Frozen Counter without flag
- Object 21, Var 10 16-bit Frozen Counter without flag

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

A JEMStar II 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 II 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.

Note: The DNP Counter table, in the JEMStarII, must be configured by the user after all Normal/Alternate display registers have been created for the configuration.

Analog Inputs

Analog Inputs are implemented as 32-bit analog input with or without flag (object 30 Var 1 or 3) points, 16-bit analog input with or without flag (object 30 Var 2 or 4) points, or short floating analog input (Object 30 Var 5) points. A total of up to 200 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. Scaling for 32-bit Analogs is defaulted at x 1000 but can be changed to anything from 1-1000. For conversion to primary units, the point value should be multiplied by the appropriate PT and/or CT ratio, then divided by 1000. For each measurement, you can select the Phase (A,B,C or Polyphase); the direction (Delivered, received, bi-directional (Delivered-received), absolute (Delivered + received), Q1-4 for VARS; transformer loss compensation (enabled or disabled) and the scaling.

For 32 Bit Scaling, the default will be 1000 which will enable you to provide three places to the right of the decimal. For example, if the measured value is 236.439 watts, the 1000 scaling will present a value of 236439.

16-Bit Inputs

These inputs are also in SECONDARY units and can be scaled from 1 to 100.

To obtain primary units, multiply by the appropriate PT and/or CT ratios and divide by the desired unit of measure (e.g. one thousand for kilowatts, one million for megawatts, etc.) Similar to above, each measurement can be selected for Phase (A,B,C or Polyphase); the direction (Delivered, received, bi-directional (Delivered-received), absolute (Delivered + received), Q1-4 for VARS; transformer loss compensation (enabled or disabled) and the scaling.

For 16 Bit Scaling, the default will be 1 which will provide nothing to the right of the decimal. For example, if the measured value is 236.439 watts, the x1 scaling will present a value of 236. A selection of x10 scaling will present a value of 2364. The maximum 16 bit value allowed is 32,767

Events

The JEMStar II DNP implementation includes frozen counter event objects. These are implemented as Object 23 Variations 0, 1, 2, 5 and 6. These provide a time-stamped snapshot of the corresponding counters at the time of freeze. The JEMStar II has storage for up to 500 frozen event objects when all 300 points are configured. 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 II.

In JEMStar II, 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 II, you can configure the "Write Time Interval", which is the interval after which the JEMStar II will set the "Need Time" bit in the Internal Indications.

Configuration

JEMWare II software must be used to set up the configurable parameters that relate to DNP 3.0 in the meter, as well as configurable point assignments for the various DNP Objects that the meter supports. Please refer to the section in this manual titled "Protocols" for detailed procedures.

APPENDIX H

MODBUS COMMUNICATIONS

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, the JEMStarII supports MODBUS RTU protocol only.

RTU mode essentially means binary mode, where each byte of information is transmitted as an actual 8-bit binary byte.

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 II software.

JEMStar II will usually be a MODBUS slave device, but in some applications it may be a MODBUS master..

Communications

The following MODBUS communications parameters are configurable via JEMWare II:

- RTU mode
- Parity (None)
- Baud Rate (1200, 2400, 9600, 19200, 38400)
- RS-232 (half 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 RS-232 or RS-485

This method is used for connecting the JEMStar II 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. Refer to the section Serial Communications for instructions on wiring/connecting serial ports.

Notes:

- For RS-485 mode communications, we suggest using RS-485 port *TX Start Delivereday* value to be set to 40ms initially, *TX End Delivereday* value must be set to 40ms initially and *Turnaround Delivereday* value set to 0ms.
- JEMStar II 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. For Switchboard type meters, the MODBUS port is connected via the terminal block on the rear of the meter case.

Data Transfers using MODBUS RTU

The JEMStar II 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 II 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 or a single 16-bit register if *Analog Scaling = 16* in JEMWareII *Protocol Setup*. 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 supported Register Sets and the MODBUS Function Codes (FC) used to retrieve the data are as follows.

<u>Function Code (FC)</u>	<u>Register Set</u>
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

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 II 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 II 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

Communication Errors

Communication errors, consisting of 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 II 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 than 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 than 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 than 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 II's Device Address, the function value with the High Order Bit set to 1, and the Exception Code followed by the CRC. For example, an **Illegal Data Address** exception to a function 03 request would be:

Exception Byte	Contents	Example
1	JEMStar II 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

The timeout period from the reception of a matching Device Address until that message is completed is software assignable using JEMWare II 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, but can be configured for 100 – 65000ms.

Register Presets

In the JEMStar II Modbus implementation, meter registers (Normal and Alternate) may be cleared or set to a given value with the Preset Multiple Registers command (Function Code 16).

Note that the start register specified in the command must be the Hi-order register number of the appropriate register pair. There can not be more than 120 registers per request.

In addition, **“Allow Register Presets” must be specifically enabled in the meter with JEMWare II** (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 II digital outputs may be forced to a high or low state via MODBUS using either the Force Single coil (Function 5) or Force Multiple Coils (Function 15) command. To use this feature, **“Allow Digital Output Control”** must be enabled in the meter with JEMWare II. If not enabled, Modbus exception 01 (illegal function) will be returned if this is attempted.

REGISTER MAPS

JEMStar II Modbus implementation supports a similar group of objects as DNP with the same flexibility to custom map each data object in any location. The Modbus functions that are supported include:

- Binary Inputs (Function 02)
- Binary Outputs (Function 01)
- Counters (Function 03)
- Analog Inputs (Function 04)

Binary Input Points (Function 02)

The Binary input points represent such things as:

- Digital Input Status
- Trigger Status (Measurement Alarms)
- Meter Status (Potential Input Status, Battery Status, etc.)

JEMStar II may be configured with up to 64 Binary Input Points in Modbus. You may assign any of the following Binary Inputs to any Binary Input Point:

Digital Input Status

The Binary Input follows the status of the digital inputs. Only the Digital I/O channels configured as Inputs will be shown. ON indicates digital input closed, OFF indicates digital input open.

- Channel 1
- Channel 2
- Channel 3
thru
- Channel 14

Trigger Status

The Binary Inputs will follow the status of the alarm triggers configured in the meter. ON indicates it is in the trigger condition, OFF indicates it is not in the trigger condition.

- Trigger 1
- Trigger 2
- Trigger 3
thru
- Trigger 64

Meter Status

The binary inputs will follow the status of each meter alarm condition. ON indicates that it is in alarm, OFF indicates that it is normal.

- Volts Phase A active
- Volts Phase B active
- Volts Phase C active
- Clock Sync Status
- Battery Status
- Internal Comm Status
- Class 20 Calibration Status
- Class 2 Calibration Status
- Configuration Status
- Service Firmware Status
- Metrology Firmwarer Status
- PQ Firmware Status
- Test Mode Status

Binary Output Points (Function 01)

The Binary Output points represent the status of the digital outputs as configured by the meter. Only the Digital I/O channels configured as Outputs will be shown. ON indicates digital output closed, OFF indicates digital output open.

- Channel 1
- Channel 2
- Channel 3
thru
- Channel 14

Counters (Function 03)

Counters are used to represent integrated values configured in the normal or alternate display register list. Two 16-bit registers are combined to form a single 32 bit value.

For the counter point list, the user may select any Normal, Alternate, (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 150 ‘32-bit’ counter points. Each numeric counter point value is represented as the corresponding register value times a user-selected scaling factor from 1 to 1,000.

Note: The Modbus Counter table, in the JEMStarII, must be configured by the user after all Normal/Alternate display registers have been created for the configuration.

32 Bit Modbus Values

As Modbus only supports 16 bit values, we combine two 16 bit registers to form a single 32 bit register. In the default protocol setup, the Modbus Starting Address is shown below as 40001. The first point number shown in the register list is Display Register 1, Watthour Deliverivered. Modbus Register 40001 is the high order bit and Modbus Register 40002 is the low order bit.

Modbus Address	Point #	Register ID, Description	High/Low Bit
40001	1	1, Watthour	High
40002		Deliveredivered	Low
40003	2	2, Watthour Received	High
40004			Low

Protocol Setup


Modbus Counters [FN 03] Modbus Analog Objects [FN 04] Modbus Binary Objects [FN 01,02]

General Settings

Adjust Start Address : Register Presets

Frame Timeouts : Digital I/O Control

Modbus Counters: FN03, Read Holding Registers

	Point #	Register Set	Register ID, Description	Scaling
I	1	Normal	1,Watthour Delivered	1,000.
	2	Normal	2,Watthour Received	1,000.
	3	Normal	3,VARhour Delivered	1,000.
	4	Alternate	105,BPR VARhour Del	1,000.
	5	Normal	1,Watthour Delivered	1,000.
	6	Normal	1,Watthour Delivered	1,000.

Analog Inputs (Function 04)

Analog Inputs are implemented as 16-bit analog input. A total of up to 200 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 V² and A²
- Bi-directional Watts and VARs

16-Bit Inputs

These inputs are in SECONDARY units and can be scaled from 1 to 100.

To obtain primary units, multiply by the appropriate PT and/or CT ratios and divide by the desired unit of measure (e.g. one thousand for kilowatts, one million for megawatts, etc.) Similar to above, each measurement can be selected for Phase (A,B,C or Polyphase); the direction (Delivered, received, bi-directional (Delivered-received), absolute (Delivered + received), Q1-4 for VARS; transformer loss compensation (enabled or disabled) and the scaling.

For 16 Bit Scaling, the default will be 1 which will provide nothing to the right of the decimal. For example, if the measured value is 236.439 watts, the x1 scaling will present a value of 236. A selection of x10 scaling will present a value of 2364. The maximum 16 bit value allowed is 32,767

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 II

calculates Apparent Power = $\sqrt{\text{Watts}^2 + \text{VARs}^2}$

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 meter readings, 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 II.

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 II 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 or Thermal Demand.

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 II 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 K_e , "energy constant") that has been consumed. *JEMStar II* 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 II) 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 Delivered day 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 Deliver 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 Delivered day 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 II 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 II 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 II 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 II 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 II 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.

METER MEASUREMENTS

Display Registers

The meter has provisions to display and store up to 50 Normal, 50 Alternate and 50 Test Registers. The measurement selections available are shown below.

Meas Type	Measurement	Phase	Direction	Meas. Type
Instantaneous	Volts	A,B,C,Polyphase	Bi-Directional	Primary Secondary
	Amps	A,B,C,Polyphase, Neutral, Average	Bi-Directional	
	Frequency	Phase A	N/A	
	Volts THD	A,B,C,Polyphase	Bi-Directional	
	Amps THD	A,B,C,Polyphase	Bi-Directional	
	Volts ²	A,B,C,Polyphase	Bi-Directional	
	Amps ²	A,B,C,Polyphase	Bi-Directional	
	Watts	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute	
	VARs	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute, Q1,2,3,4	
	VA (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute	
	VA (Vectorial)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute	
	Q	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute	
	PF (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute	
	PF (Vectorial)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute	
	Volts Imbalance	Polyphase	N/A	
Amps Imbalance	Polyphase	N/A		

Meas Type	Measurement	Phase	Direction	Meas Type	Storage Type
Energy	WHR	A,B,C,Polyphase	Delivered, Received, Net, Absolute	Primary Secondary	Working Billing Period Reset Season Change Previous Hour Previous Day
	VARHr	A,B,C,Polyphase	Delivered, Received, Net, Absolute, Q1,2,3,4		
	VAHr (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Net, Absolute		
	VAHr (Vectorial)	A,B,C,Polyphase	Delivered, Received, Net, Absolute		
	QHR	A,B,C,Polyphase	Delivered, Received, Net, Absolute		
	AMPHr	A,B,C,Polyphase, Average	Bi-Directional		
	Volts ² Hr	A,B,C,Polyphase	Bi-Directional		
	AMP ² Hr	A,B,C,Polyphase, Average	Bi-Directional		
Integrated Values (Consumption)					

Meas Type	Measurement	Phase	Direction	Meas Type	Storage Type
Minimum Maximum Average	Volts	A,B,C,Polyphase	Bi-Directional	Primary Secondary	Working Billing Period Reset Season Change Previous Hour Previous Day
	Amps	A,B,C,Polyphase, Neutral, Average	Bi-Directional		
	Frequency	Phase A	N/A		
	Volts THD	A,B,C,Polyphase	Bi-Directional		
	Amps THD	A,B,C,Polyphase	Bi-Directional		
	Volts ²	A,B,C,Polyphase	Bi-Directional		
	Amps ²	A,B,C,Polyphase	Bi-Directional		
	Watts	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	VARs	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute, Q1,2,3,4		
	VA (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	VA (Vectorial)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	Q	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	PF (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	PF (Vectorial)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	Volts Imbalance	Polyphase	N/A		
Amps Imbalance	Polyphase	N/A			

Each of the above measurements can be selected as Compensated or Un-Compensated.

Min/Max/Avg Registers are reset after a BPR (Billing Period Reset)

Demand Registers

Demand Meas	Measurement	Phase	Direction	Meas Type	Storage Type
Peak (Max)	Watts	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute	Primary Secondary	Working Billing Period Reset Season Change Cumulative Continuous Cumulative Previous Hour Previous Day
Present	VARs	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute, Q1,2,3,4		
Past	VA	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
Thermal	Q	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
Peak Thermal	Amps	A,B,C,Polyphase, Neutral, Average	Delivered, Received, Bi-Directional, Absolute		
Demand	Amps ²	A,B,C,Polyphase, Average	Delivered, Received, Bi-Directional, Absolute		
	Time	Time when demand measurement above is recorded			
Coincident Demand (coincides with a peak demand measurement)	Watts	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute	Primary Secondary	Working Billing Period Reset Season Change Previous Hour Previous Day
	VARs	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute, Q1,2,3,4		
	VA	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	Q	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	PF	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	Amps	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		
	Amps ²	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute		

Storage Types are defined as:

A *Working Register* will store the selected data in real time and update the displayed quantity on a continual basis. When a BPR is performed, the contents of the working register are transferred to the BPR storage register. All peak registers will reset to zero when a BPR is performed. All other register types will continue to increment.

A *Billing Period Reset* register will update the selected quantity only when a BPR occurs. The quantity in this register will be saved until the next BPR command, at which time the old quantity is overwritten.

A *Season Change* register stores the selected quantity only when a Season Change command occurs. The quantity in the register is saved until the next Season Change command, at which time the data is overwritten.

A *Cumulative* register will store the selected quantity when a BPR occurs. The quantity in the register is saved until the next BPR command, at which time the quantity is added to the existing quantity.

A *Continuous Cumulative* register will sum the selected quantity read at BPR plus the quantity from the Working register. The sum is continuously updated. Note that any alteration to the BPR configuration will reset these registers.

A *Previous Hour* register will store the selected energy measurement that occurred in the last hour. It starts accumulating at the top of the hour and the value is replaced every hour with the previous hour's data.

A *Previous Day* register will store the selected energy measurement that occurred in the last day. It starts accumulating at midnight and the value is replaced every day with the previous day's data.

Load Profile

The meter comes with 16 channels of Load Profile that can be selected with any of the measurements below. There is an option to add a second group of 16 Channels Load Profile. The recording interval for each measurement is selectable from 1 to 60 minutes.

Measurement	Phase	Direction	Meas Type	Storage Type	
Volts	A,B,C,Polyphase	Bi-Directional	16 Bit Counts (scaled)	Selectable Storage Intervals (minutes)	
Amps	A,B,C,Polyphase, Neutral, Average	Bi-Directional			
Frequency	Phase A	N/A			
Volts THD	A,B,C,Polyphase	Bi-Directional			
Amps THD	A,B,C,Polyphase	Bi-Directional			
Volts ²	A,B,C,Polyphase	Bi-Directional			
Amps ²	A,B,C,Polyphase	Bi-Directional			
Watts	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute			
VARs	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute, Q1,2,3,4			
VA (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute			
VA (Vectorial)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute			
Q	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute			
PF (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute			
PF (Vectorial)	A,B,C,Polyphase	Delivered, Received, Bi-Directional, Absolute			
Volts Imbalance	Polyphase	N/A			32 Bit (eng units)
Amps Imbalance	Polyphase	N/A			
WHR	A,B,C,Polyphase	Delivered, Received, Net, Absolute			
VARHr	A,B,C,Polyphase	Delivered, Received, Net, Absolute, Q1,2,3,4			
VAHr (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Net, Absolute			
VAHr (Vectorial)	A,B,C,Polyphase	Delivered, Received, Net, Absolute			
QHr	A,B,C,Polyphase	Delivered, Received, Net, Absolute			
AMPHr	A,B,C,Polyphase, Average	Bi-Directional			
Volts ² Hr	A,B,C,Polyphase	Bi-Directional			
AMP ² Hr	A,B,C,Polyphase, Average	Bi-Directional			

Each of the above measurements can be selected as Compensated or Un-Compensated

Instantaneous measurements such as Volts, Amps, Frequency, THD, Volts2, AMPS2, Watts, VARs, VA, Q and PF will store the average value over the selected time interval, selectable from 1-60 minutes. The remaining energy measurements will store the accumulated consumption for that interval and start again from 0 for the next interval.

The Load Profile Data is stored in either 32 bit engineering units or 16 bit counts.

When 32 bit engineering units are used, we store the value as a 32 bit floating point with a maximum value of 4,294,967,296 per recording interval.

When 16 bit counts are used, you have a maximum 16,383 counts per recording interval. To avoid exceeding this number of counts, the measurements can be scaled by a factor called Km.

The number of counts for a given measurement is shown below:

$$\frac{\text{Total Measurement}}{\text{Km}} = \# \text{ of Counts in Load Profile}$$

Note: In order to increase your measurement resolution when using 16 bit counts, it is best to pick a Km scale factor to maximize the total number of 16,383 counts available per interval. You don't want to exceed the 16,383 counts per interval, so try to get at least 13,000 counts for your full scale input, allowing some room for exceeding full scale.

Measurement Log (option ML)

This continuous recording option provides 100 channels divided into two groups of 50, each with their own recording interval. The following measurements are available in the measurement log.

Meas Type	Measurement	Phase	Direction	Recording	Storage Type
Measurement Logging 50 Channels x 2 Groups	Volts L-N	A,B,C,Polyphase (average)	N/A	Min/Max/Avg/Snap	Selectable Storage Intervals
	Volts L-L	A,B,C,Polyphase (average)	N/A	Min/Max/Avg/Snap	
	Amps	A,B,C,Polyphase (total)	N/A	Min/Max/Avg/Snap	
	Frequency	A,B,C,Polyphase	N/A	Min/Max/Avg/Snap	
	Volts ² L-N	A,B,C,Polyphase (average)	N/A	Min/Max/Avg/Snap	
	Volts ² L-L	A,B,C,Polyphase (average)	N/A	Min/Max/Avg/Snap	
	Amps ²	A,B,C,Polyphase (total)	N/A	Min/Max/Avg/Snap	
	Watts	A,B,C,Polyphase	Del. Rec. Bi-Dir, Abs	Min/Max/Avg/Snap	
	VARS	A,B,C,Polyphase	Del. Rec. Bi-Dir, Abs, Q1-Q4	Min/Max/Avg/Snap	
	VA (Arithmetic)	A,B,C,Polyphase	Del. Rec. Bi-Dir, Abs	Min/Max/Avg/Snap	
	VA (Vectorial)	A,B,C,Polyphase	Del. Rec. Bi-Dir, Abs	Min/Max/Avg/Snap	
	Q	A,B,C,Polyphase	Del. Rec. Bi-Dir, Abs	Min/Max/Avg/Snap	
	PF (Arithmetic)	A,B,C,Polyphase	Del. Rec. Bi-Dir	Min/Max/Avg/Snap	
	PF (Vectorial)	A,B,C,Polyphase	Del. Rec. Bi-Dir	Min/Max/Avg/Snap	
	Volts Imbalance	Polyphase	N/A	Min/Max/Avg/Snap	
	Amps Imbalance	Polyphase	N/A	Min/Max/Avg/Snap	
	WHR	A,B,C,Polyphase	Delivered, Received, Net, Absolute	Total	
	VARHr	A,B,C,Polyphase	Delivered, Received, Net, Absolute, Q1,2,3,4	Total	
	VAHr (Arithmetic)	A,B,C,Polyphase	Delivered, Received, Net, Absolute	Total	
	VAHr (Vectorial)	A,B,C,Polyphase	Delivered, Received, Net, Absolute	Total	
	QHr	A,B,C,Polyphase	Delivered, Received, Net, Absolute	Total	
	AMPHr	A,B,C,Polyphase, Average	N/A	Total	
	Volts ² Hr	A,B,C,Polyphase	N/A	Total	
	AMP ² Hr	A,B,C,Polyphase, Average	N/A	Total	
	Harmonic Volts L-N	A,B,C	Magnitude: Harmonics 2 thru 64	Min/Max/Avg/Snap	
	Harmonic Volts L-N	A,B,C	Phase Angle: Harmonics 2 thru 64	Min/Max/Avg/Snap	
	Harmonic Volts L-L	A,B,C	Magnitude: Harmonics 2 thru 64	Min/Max/Avg/Snap	
	Harmonic Volts L-L	A,B,C	Phase Angle: Harmonics 2 thru 64	Min/Max/Avg/Snap	
	Harmonic Amps	A,B,C	Magnitude: Harmonics 2 thru 64	Min/Max/Avg/Snap	
	Harmonic Amps	A,B,C	Phase Angle: Harmonics 2 thru 64	Min/Max/Avg/Snap	
	Volts THD	A,B,C	N/A	Min/Max/Avg/Snap	
	Amps THD	A,B,C	N/A	Min/Max/Avg/Snap	
	Volts THD even	A,B,C	N/A	Min/Max/Avg/Snap	
	Volts THD odd	A,B,C	N/A	Min/Max/Avg/Snap	
	Amps THD even	A,B,C	N/A	Min/Max/Avg/Snap	
	Amps THD odd	A,B,C	N/A	Min/Max/Avg/Snap	
	TDD	A,B,C	N/A	Min/Max/Avg/Snap	
	TDD even	A,B,C	N/A	Min/Max/Avg/Snap	
	TDD odd	A,B,C	N/A	Min/Max/Avg/Snap	
	Crest Factor	A,B,C	N/A	Min/Max/Avg/Snap	
	InterHarmonic Volts L-N	A,B,C	Magnitude: InterHarmonics 2 thru 40	Min/Max/Avg/Snap	
	InterHarmonic Volts L-L	A,B,C	Magnitude: InterHarmonics 2 thru 40	Min/Max/Avg/Snap	
	InterHarmonic Amps	A,B,C	Magnitude: InterHarmonics 2 thru 40	Min/Max/Avg/Snap	
	Flicker Pinst	A,B,C	N/A	Min/Max/Avg/Snap	
	Flicker Pst	A,B,C	N/A	Average	
	Flicker Plt	A,B,C	N/A	Average	
	Negative Sequence	Polyphase	Current Magnitude	Snapshot	
	Negative Sequence	Polyphase	Current Phase Angle	Snapshot	
	Negative Sequence	Polyphase	Voltage Magnitude	Snapshot	
	Negative Sequence	Polyphase	Voltage Phase Angle	Snapshot	
Positive Sequence	Polyphase	Current Magnitude	Snapshot		
Positive Sequence	Polyphase	Current Phase Angle	Snapshot		
Positive Sequence	Polyphase	Voltage Magnitude	Snapshot		
Positive Sequence	Polyphase	Voltage Phase Angle	Snapshot		
Zero Sequence	Polyphase	Current Magnitude	Snapshot		
Zero Sequence	Polyphase	Current Phase Angle	Snapshot		
Zero Sequence	Polyphase	Voltage Magnitude	Snapshot		
Zero Sequence	Polyphase	Voltage Phase Angle	Snapshot		
Digital Input	Digital Input Ch 1-6	Status Input	Total		
Digital Input	Digital Input Ch 1-6	Pulse Counter	Total		

Storage Types for Measurement Logging is defined as:

Min – Minimum value over that interval.

Max – Maximum value over that interval

Avg – Average value computed over that interval

Total – Total quantity computed over that interval (similar to Load Profile)

Snapshot – Value recorded at the end of the interval

MEASUREMENT FORMULAS

Volts_{RMS}

Volts_{RMS} is calculated using the square root of the sum of the squares over one cycle which is sampled 512 times.

$$V_{RMS} = \sqrt{\frac{1}{N} \sum_n V_n^2} \quad 3Phase \sqrt{\frac{1}{N} \sum_n V_a^2 + \sum_n V_b^2 + \sum_n V_c^2}$$

Amps_{RMS}

Amps_{RMS} is calculated using the square root of the sum of the squares over one cycle which is sampled 512 times.

$$I_{RMS} = \sqrt{\frac{1}{N} \sum_n I_n^2} \quad \sum_n I_n^2 = \sum_n I_a^2 + \sum_n I_b^2 + \sum_n I_c^2$$

Watts

Watts is calculated using the product of voltage and current updated every half cycle

$$Watts = \frac{1}{N} \sum_n V_n I_n$$

VARs

VARs is calculated using the product of voltage and current updated every half cycle

$$VARs = \frac{1}{N} \sum_n V_n I_{Sn} \quad I_{Sn} = I_n \text{ advanced } 90^\circ \text{ with respect to fundamental frequency}$$

Apparent Power

Apparent Power is calculated both Vectorially and Aritmetically every half cycle.

$$VA \text{ Vectorial} = \sqrt{Watts^2 + VARs^2} \quad (\text{same sign as Watts})$$

$$VA \text{ Arithmetic} = V_{RMS} * I_{RMS} \quad (\text{same sign as Watts})$$

Vectorial Versus Arithmetic kVA Calculation

The vectorial method (or phasor method) uses the square root of the sum of the squares for Watts and VARs. This does not take into effect the impact of harmonics on the voltage and current inputs.

The arithmetic method uses the product of RMS Voltage and Current which does reflect the added impact of harmonics on the voltage and current inputs.

In the case of no harmonics outside of the fundamental, the two results will be the same. When additional harmonics are introduced, the arithmetic calculation will end up with a higher result.

In all cases, the arithmetic method will result in the same or higher result as compared to the vectorial method.

The end result depends on what you are using the value for. The arithmetic method may be more physically appropriate to reflect utility capacity while the vectorial method is more indicative of actual customer load.

Q

Q is calculated using the sum of Watts and VARs as shown every half cycle.

$$Q = \frac{Watts}{2} + \frac{VARs\sqrt{3}}{2}$$

PF Arithmetic

PF Arithmetic is calculated using the ratio of Watts over the Apparent Power calculated arithmetically every half cycle.

$$PF_{ARITH} = \frac{Watts}{VA_{Arithmetic}} \quad \text{Sign positive for Lag (Quad I \& III), Negative for Lead (Quad II\&IV)}$$

PF Vectorial

PF Arithmetic is calculated using the ratio of Watts over the Apparent Power calculated vectorially every half cycle.

$$PF_{VECT} = \frac{Watts}{VA_{Vectorial}} \quad \text{Sign positive for Lag (Quad I \& III), Negative for Lead (Quad II\&IV)}$$

Unbalance

Unbalance is calculated using the ratio of the maximum deviation from average over the average.

$$Unbalance = 100 * VrmsMaxDev / VrmsAvg$$

(Voltage shown. Typical for current)

Unbalance (with PQ Options installed)

Unbalance is calculated using the ratio of Negative Sequence and Zero Sequence Ratios. (based on the IEEE and IEC 61000-4-30 standard)

Negative Sequence = S2

Positive Sequence = S1

Zero Sequence = S0

Negative Sequence Unbalance = $100 * S2/S1$ (Negative Sequence / Positive Sequence)

Zero Sequence Unbalance = $100 * S0/S1$ (Zero Sequence / Positive Sequence)

Percent THD

Percent THD is calculated using the Total RMS (over all harmonics) and the RMS over the Fundamental frequency. (typical for volts and amps)

$$\% \text{ THD} = \frac{\sqrt{\text{Total RMS}^2 - \text{Fundamental RMS}^2}}{\text{Fundamental RMS}} \times 100$$

Percent THD (with PQ Options installed)

With PQ enabled, Percent THD is calculated per IEC61000-4-7, and includes harmonic content (up to and including the 128th harmonic).

$$\% \text{ THD} = \sqrt{\sum_{H=2}^{128} \left(\frac{\text{Total RMS}_{H 2-128}}{\text{Total RMS}_{H 1}} \right)^2} \times 100$$

Harmonics, Interharmonics

Voltage/Current magnitudes and phase angles are calculated per IEC61000-4-7

Individual harmonics are calculated up to the 64th. Individual interharmonics are calculated up to the 50th.

Flicker

Pinst (instantaneous), Pst (10 minute), Plt (2 hour) are calculated per IEC61000-4-15

TDD

Total demand distortion as defined in the IEEE 519 standard is the total root-sum-square harmonic current distortion, in percent of the maximum demand load current and can be calculated using the following formula

$$\text{Total Demand distortion (TDD)} = \frac{\sqrt{\sum_{h=2}^{63} I_h^2}}{I_L}$$

Crest Factor

Crest factor is defined as the ratio of peak value to rms value of a current waveform: The crest factor for a sinusoidal current waveform, such as that which a pure resistive load would draw, is 1.414 since the peak of a true sinusoid is 1.414 times the rms value.

Sequence Components

Sequences are calculated by the Method of Symmetrical Components as required by IEC61000-4-30

Zero Sequence:

$$\text{Zero Sequence Vector} = \mathbf{V0} = 1/3(\mathbf{Va} + \mathbf{Vb} + \mathbf{Vc})$$

$$\text{Zero Sequence Magnitude} = \text{sqrt}(\text{real}(\mathbf{V0})^2 + \text{imag}(\mathbf{V0})^2)$$

$$\text{Zero Sequence Phase} = \text{arctan}(\text{imag}(\mathbf{V0}) / \text{real}(\mathbf{V0}))$$

Positive Sequence:

$$\text{Positive Sequence Vector} = \mathbf{V1} = 1/3(\mathbf{Va} + n\mathbf{Vb} + m\mathbf{Vc})$$

(where n = vector rotation 120 deg counter-clockwise, m = vector rotation 240 deg counter-clockwise)

$$\text{Positive Sequence Magnitude} = \text{sqrt}(\text{real}(\mathbf{V1})^2 + \text{imag}(\mathbf{V1})^2)$$

$$\text{Positive Sequence Phase} = \text{arctan}(\text{imag}(\mathbf{V1}) / \text{real}(\mathbf{V1}))$$

Negative Sequence:

$$\text{Negative Sequence Vector} = \mathbf{V2} = 1/3(\mathbf{Va} + m\mathbf{Vb} + n\mathbf{Vc})$$

(where n = vector rotation 120 deg counter-clockwise, m = vector rotation 240 deg counter-clockwise)

$$\text{Negative Sequence Magnitude} = \text{sqrt}(\text{real}(\mathbf{V2})^2 + \text{imag}(\mathbf{V2})^2)$$

$$\text{Negative Sequence Phase} = \text{arctan}(\text{imag}(\mathbf{V2}) / \text{real}(\mathbf{V2}))$$

Zero Sequence Ratio

$$= 100 \times (\text{Zero Sequence Magnitude} / \text{Positive Sequence Magnitude})$$

Negative Sequence Ratio

$$= 100 \times (\text{Negative Sequence Magnitude} / \text{Positive Sequence Magnitude})$$

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. **MoDelivered** 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.