PART 2  PRODUCTS

2.01 MANUFACTURERS

A. Eaton products
B. __________
C. __________

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 MICROPROCESSOR-BASED METERING EQUIPMENT

A. Power Xpert Meter Series 4000/6000/8000

1. Where indicated on the drawings, provide a microprocessor based line of Power Quality complete Meters, designated PX-M. PX-M consists of a Power Quality Meter Base(s) designated PX-B along with an integrally mounted Power Quality Meter Display designated PX-D or combination of PX-Bs and remotely located PX-Ds as indicated on the drawings. The PX-M, PX-B, and PX-D shall be equal to Eaton type Power Xpert Meter (PX-M) Series 4000, 6000, or 8000 having the features and functions as shown on the drawings and herein specified. PX-B shall be NEMA 1 rated and PX-D shall be NEMA 12 rated.

2. Complete PX-M, combination PX-B and/or PX-D shall have the following minimum listings and/or certifications:
   a. Safety: UL 61010-1, EN 610101.
   b. Accuracy: ANSI C12.20 Class 0.2, IEC/EN60687 0.2 for revenue meters.
   c. EMC: FCC Part 15 Subpart B Class A immunity.
   d. IEC Standards: 50081-2, 61000-3, 61000-4, and 61326.

3. Meter shall be supplied suitable for standard 120/240 Vac or 110/250 Vdc inputs as required or indicated on the drawings.

4. Current inputs for each channel shall be from standard instrument current transformers.
   a. The analog current input shall be converted to 4096 samples per cycle with a delta-sigma converter digitally filtered down to 512 samples per cycle for anti-aliasing.
   b. Meter burden shall be less than 10 milliohms.
   c. Overload withstand capability shall be a minimum of 500A for 1 second, non-repeating.
   d. Input range capability shall be 0.005 to 20 amperes.

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5. Voltage inputs for each channel shall allow for connection into circuits with the following parameters:
   a. Input range of 600V L-L, 347V L-N direct connected.
   b. PT primary input of 120 volts to 500,000 volts.
   c. Nominal full-scale value of 700 volts rms.
   d. Input impedance of 2 mega ohms.
   e. The analog voltage input shall be converted to 4096 samples per cycle by means of a delta sigma converter and digitally filtered down to 512 samples per cycle for anti-phasing.

6. The PX-Metering series shall be capable of monitoring, displaying, and communicating the below true rms minimum information where applicable with the accuracy as indicated of read or calculated values based on 3 to 300% full scale. The PX-Metering series shall be suitable for installation in single phase, two or three wire systems or in three phase, three or four wire systems
   a. AC current (amperes) in A, B and C phase, 3-phase average, Neutral (N) and Ground (G). A total of five (5) current inputs shall be provided. Accuracy of all current inputs shall be 0.05% reading, +/- 0.01% of full scale. Provide neutral and ground current transformers. The 5 ampere current inputs shall withstand 40 amperes continuous and 300 amperes for 1 second. Current transformer ratios shall be selectable.
   b. AC voltage (volts) for A-B, B-C and C-A, phase average, A-N, B-N and C-N, average phase to N, and N to G. Accuracy of all voltage inputs shall be +/- 0.1% reading, +/- 0.05% maximum of full scale. Capable of metering up to 600 volt without external Potential Transformers (PTs) and up to 500 kV with appropriate PTs.
   c. Auxiliary AC voltage (volts) for A2-B2, B2-C2, and C2-A2, phase average. Accuracy of all voltage inputs shall be +/- 0.1% reading, +/- 0.05% maximum of full scale. Capable of metering up to 600 volt without external Potential Transformers (PTs) and up to 500 kV with appropriate PTs.
   d. Real Power (Watts), Reactive Power (vars), Apparent Power (VA), for each phase and system. Accuracy +/- 0.10% reading and +/- 0.0025% full scale. Forward/Reverse indication shall be provided.
   e. Accumulated, Incremental and conditional measurement for Real Energy (WH), Reactive Energy (VARH), Apparent Energy (VAH) for each phase and system. Accuracy +/- 0.10% reading and +/- 0.0025% full scale. Forward/Reverse and Net difference indication shall be provided.
   f. Frequency (Hz) Accuracy +/- 0.01 hertz.
   g. Demand values including present, running average, last complete interval and peak for System Current (Amperes). Demand values including present, running average, last complete interval, peak and coincident with peak kVA and kW demand for System Real Power (Watts), System Reactive Power (vars), and System Apparent Power (VA).
   h. Power Factor for both Displacement only 60-cycle fundamental Watts to VA and Apparent total Watts to total vars including harmonics for A, B and C phase and 3 phase average. Accuracy +/- 0.10% at unity PF and +/- 0.30% at 0.5 PF.
   i. Current percent Total Harmonic Distortion (THD) in A, B and C phase and N.
   j. Voltage percent THD in A-B, B-C and C-A phase, A-N, B-N and C-N.
   k. K-Factor (sum of the squares of harmonic currents times the square of their harmonic numbers).
l. Transformer Derating Factor (1.414 divided by the Crest Factor).
m. Crest Factor (ratio of peak current to rms current).

n. (PXM 6000/8000 only) CBEMA (ITIC) curve data

o. (PXM 6000/8000 only) Flicker data

p. Nines (9’s) availability data.

q. Power Quality Index

7. The PX series shall provide the following sampling capabilities:

a. A/D technology, sampling at 4096 samples per cycle.

b. Over-sampling and quantizing filtering to eliminate false signal noise.

c. (PXM 6000/8000 only) ITIC representation of power events.

d. (PXM 8000 only) DV/dt triggers for sub-cycle oscillatory transients.

e. (PXM 8000 only) Six (6) MHz/ one (1) MHz capture of impulsive transients.

f. Waveform recorded at 512 standard samples-PXM 4000/6000) (100,000 high rate samples-PXM 8000) per cycle.

g. (PXM 8000 only) Three-phase voltage and neutral-to-ground fast transient capture.

h. (PXM 8000 only) Absolute threshold and dV/dt triggering.

8. The PX series shall provide the following advanced analysis features:

a. Calculation of harmonic magnitudes and phase angle for each phase voltage and current through the 85th harmonic.

b. Waveforms shall be available in non-volatile memory and retrievable via file transfer protocol (ftp) in COMTRADE file format over the Internet network.

c. Historical Trending: Historical trend logging for graphical viewing from the Local PX-D display or from an embedded WEB server. The graphical views of historical data shall support both pan and zoom functions. All standard metering parameters shall be logged as part of the standard meter functionality including minimum, maximum and average for each metered parameter. The minimum and maximum readings shall be based on 200ms calculations. The averages shall be calculated over the user selected time interval period. Minimum storage capacity for standard trend plots shall be as follows:
   1. Five-minute intervals for 48 hours (2 days).
   2. Fifteen-minute intervals for 192 hours (8 days)
   3. One-hour intervals for 28 days
   4. Eight-hour intervals for 56 weeks
   5. One-week intervals for 44 months
   6. Data storage available in *(2GB-PXM 4000 only), (4GB-PXM 6000 only), or (8GB-PXM 8000 only).

d. Energy Profile: Energy profile data shall include recording of real and reactive energy forward, reverse, net and absolute sum as well as apparent energy (KVAH). Up to eight

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(8) status inputs shall be configurable as energy accumulators for counting KYZ pulse inputs. These readings shall be stored over a configurable interval from 1 to 60 minutes as well as in daily and weekly totals. Storage capacity shall be as follows:

1. Sixty-two (62) days of fifteen (15) minute interval energy and pulse interval data. (Fixed interval capacity shall equal 5,952 intervals configurable from 1 to 60 minutes).
2. Three hundred and seventy-two (372) days of 1 day accumulated energy and pulse interval data.
3. Two Hundred and eight (208) weeks of one (1) week accumulated energy and pulse interval data.

**e. Event Triggers:** The PX-M shall have a quantity of five (5) types of configurable event triggers consisting of 1) Out of limits, 2) Demand overload, 3) ITIC, 4) Sub-Cycle disturbance and 5) Fast Transient. These triggers shall permit pickup, reset and pickup delay to be user configurable. When a trigger occurs, actions shall include Performance monitoring (Nines (9s) analysis, Capturing Waveform, Capture all metered parameters, and ability to send by email and/or activate a relay output. The meter graphic display PX-D shall flash an LED to annunciate the alarm condition and an audible alarm shall be available. The following trigger options shall be included:

1. Out of limits – one hundred and five (105) triggers.
2. Demand overload – Ten (10) triggers.
4.  \( ^{\text{ITIC curve display sag or swell voltage events \text{- Eight (8) triggers.}}\) 
5. \( ^{\text{(PXM 8000 only)Fast transient \text{- dV/dt and absolute per phase.}}\) 

**f. Event Logging:** The PX-M or embedded WEB Server shall allow the user to view a list of triggered events along with any captured parameters, event details, and triggered waveforms. In addition, a separate event log shall include logging of activities including acknowledged triggers, new minimum and maximum events, and systems operations, such as resets. The size of each event log shall be virtually unlimited based only on the memory option selected.

**g. ITIC Analysis Plot:** The PX-D or embedded WEB Server shall include a graphic display of the Information Technology Industry Council (ITIC) plot with counts of disturbances and transients that have occurred. The ITIC plot shall organize events into eight (8) distinct disturbance zones corresponding to the severity of the event and a ninth (9th) zone for transients. A pass/fail count shall be displayed to indicate how many events are outside the ITIC limits. Operator clicking of any counter in the ITIC WEB page shall link the user to the event view and display all triggered events in the selected zone making it easy to view disturbance waveforms associated with the ITIC plot.

**h. Sag/Swell and Waveform recording:** Sixty (60) cycles of waveform shall be recorded at 512 samples per cycle including 30 cycles of pre and post event data. The embedded WEB server shall be capable of supporting viewing of all triggered waveforms one channel at a time and shall include the ability to zoom and to scroll horizontally using a slider bar. Waveforms shall be stored in non-volatile flash memory using industry standard COMTRADE format. Waveforms shall have the capability to be automatically sent out as COMTRADE attachments to an email following an event, or shall be retrievable from a ftp directory structure from the meter's memory.
i. Minimum and Maximum values for the following parameters:
   1. Voltage L-L and L-N
   2. Current per phase
   3. Apparent Power Factor and Displacement Power Factor
   4. Real, Reactive, and Apparent total Power
   5. THD voltage L-L and L-N
   6. THD Current per phase
   7. Frequency

9. The PX-M and PX-B shall have (provisions for) a digital Input/Output (I/O) card which shall include:
   a. Eight (8) digital inputs – self sourced 24 Vdc. These shall be interrupt driven, allowing
      for 1ms accuracy of digital events time stamps when utilizing local NTP server. Inputs
      shall be configurable for demand synch, and pulse counting. Inputs selected for pulse
      counting shall be scalable. Interval by interval pulse recordings shall be maintained in
      the PX-M/PX-B profile memory and shall be capable of being displayed graphically.
   b. Three (3) relay outputs – 5A maximum form C continuous, 380Vac maximum, 125Vdc
      maximum. Outputs shall be suitable for KYX or alarm annunciation. Relay outputs shall
      have the following minimum ratings:
      1. Make: 30A, 30 Vdc, 120-240 Vac.
      3. Resistive load: 0.5A, 125Vdc; 0.25A, 250 Vdc.
      4. Mechanical Operations: 1,000,000 no-load and100,000 under rated voltage and
         current.
      5. Output Relay when event triggered shall be capable of operating in timed, normal or
         latched mode.
   c. Two (2) solid state outputs – 80 mA maximum continuous, 30 Vdc maximum.

10. The PX-M and/or PX-B shall be provided with multiple communications ports and protocols,
    including the following capability:
    a. RS-485 remote display port
    b. RS-485 Modbus RTU
    c. RJ-45 10/100 baseT Local Ethernet Configuration Port for local WEB server connection
    d. HTML web pages
    e. File transfer protocol (ftp)
    f. RJ-45 Selectable 100FX or 10/100Base-T Ethernet network port
    g. RS-232
    h. RS-485 Modbus RTU selectable master/slave port
    i. Modbus TCP
    j. SMTP(Simple Mail Transfer Protocol) for email support
    k. SNMP(Simple Network Management Protocol) MIB support
    l. Ethernet TCP/IP
    m. NTP(Network Time Protocol) support

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11. The PXM468K-DISP-6 graphical display shall utilize a 6 inch color touch screen interface to easily navigate the menus, select links to related pages, and to drill down into increasing levels of further details. A “back” key shall be provided for easy navigation to higher level screens. The graphical display shall have the following features:
   a. 6 inch backlight color LCD remote graphics display with 320 x 240 pixels.
   b. Capable of being mounted to the Meter base unit with optional mounting bracket or remote mounting of display up to 2000 ft away.
   c. A set of screens including Meter, Quality, I/O and Events.
   d. Present, Minimum, and Maximum values, Trends and Events.

12. The PXM468K-DISP-12 color touch screen display shall provide full access to all measured and stored parameters in the meter. It shall also provide graphical real time information, trend charts of key circuit measurements, waveform, harmonics and calendar displays. 12 inch 1024 x 768 pixel backlit LCD graphic touch screen display.
   1. Information, trend charts of key circuit measurements, waveform, harmonics and calendar displays.
   2. IP65 aluminum front panel.

13. The WEB server shall provide the user with remote WEB access to all metered, trend and waveform information. The WEB server shall include real time monitored information in both numeric and graphical visual formats.

14. A reset button shall be provided on the PX-M and PX-B to be able to reset communications to factory defaults. Reset capabilities shall be provided in conjunction with various lockable dip switch settings.

15. The 12 inch display and WEB server shall be capable of providing the graphical display of the following Main Meter Menu Screens:
   a. Overview Tab providing:
      1. Volts: L-L and L-N, and average
      2. Frequency
      3. Current and average phase A, B, and C, N & G
      4. Power Quality Index
      5. Demand Comparison
      6. Events Summary
   b. Trends Tab providing:
      1. Meter
      2. Power
      3. Quality
      4. Phasor
   c. Energy Tab providing:
      1. Energy and Demand Data
      2. Time of Use Information
   d. Timeline Tab providing:
      1. Latest events
      2. Enabled Triggers
      3. Historical Events
      4. Calendar view of Events
      5. Events Timeline screen
      6. ITIC Curve
e. (For meters with a PXMIO card) I/O Tab providing:
   1. Discrete input status
   2. Relay output status
   3. Counter data