Bitronics

70 SERIES MEASUREMENT SYSTEM

UCA 2.0 Protocol Manual

September 30, 2009
ML0022 Document Revision C
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Disclaimer: IEC 61850 Protocol has superseded UCA 2.0 Protocol any references appearing in this manual will continue to use the term goose. In all other software and documentation the term GSSE will replace UCA GOOSE as a result of the IEC61850 standard. This protocol manual will not be updated, so it contains the former terminology.

UCA International Usersgroup MEMBER

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SAFETY

Before installation or maintenance work, please refer to the M87x and M57x User Manuals, ML0021 and ML032 respectively for information regarding safety, installation, commissioning and decommissioning.

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FIRMWARE REVISIONS

This Manual describes the UCA 2.0 Protocol provided in the 70 Series Host Firmware for the following revisions: revision # 2.19 issued September 30, 2009 and revision #3.02.0 issued September 30, 2009.

70 SERIES MANUAL SET

This UCA Protocol Manual is part of the 70 Series Manual Set.

The total Manual Set of 70 Series is as follows:

Manual Ref	**70 SERIES**
ML0021	M87X User Manual
ML0032	M57X User Manual
ML0022	UCA 2.0 ® Protocol Manual
ML0024	Modbus Plus Module & Protocol Manual
ML0025	Modbus Protocol Manual
ML0026	DNP3 Protocol Manual
ML0027	M870D Remote Display Manual
ML0033	M570DX Remote Display Manual
ML0034	70 Series IEC61850® Protocol Manual

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Please refer to the appropriate 70 Series IED manual for the appropriate warranty statement

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1.0 UCA 2.0 Network Protocol

1.1 Applicability

The UCA 2.0 Network Protocol is available with any 70 Series IED equipped with the Ethernet option. Every effort has been made to ensure that this implementation of the UCA 2.0 Network Protocol shall meet EPRI's Utility Communication Architecture 2.0 Generic Object Models for Substation & Feeder Equipment (GOMSFE); and the IEEE-SA TR 1550-1999 Part 3 UCA Common Application Service Models (CASM) and Mapping to MMS.

A 70 Series IED is model M871 and M872 from the M870 Modular Family of substation monitoring and recording IEDs. The M870 Modular Family is sometimes represented in the short form of M87x or M87X, where "x" can be "1" or "2".

A 70 Series IED can also be model M571 and M572 from the M570 Compact Family of substation monitoring and recording IEDs. The M570 Compact family is sometimes represented in the short form as M57x or M57X, where "x" can be "1" or "2".

1.1.1 Exceptions

Bitronics has made every attempt to meet the GOMSFE 0.92 specifications, with the following exceptions:

- A new brick AMXU has been added as a temporary placeholder for miscellaneous measurements.
- Object "CF.Ether" has been added to GLOBE with Ethernet card statistics, status, and reset object.
- Some verbal brick changes from the May 1999 (Albuquerque), May 2000 (Grand Rapids), and September 2000 (Andover) Utility Initiative meeting were made:
    - The DI (Device Identity) info has been moved to DEVID
    - All brick suffixes were incremented by one (first brick is now "BRCK1" instead of "BRCK0")

1.2 UCA International Users Group & IEC Technical Committee 57

Bitronics actively participates in working groups of the UCA International Users Group and the IEC Technical Committee 57 efforts. Bitronics works with these Groups to resolve different technical issues related to the first edition of IEC61850 amendments to the standard and to the interoperability demonstrations.

Future versions of the 70 Series IEDs many contain functions beyond those contained in this document, as required by the future evolution to IEC61850.

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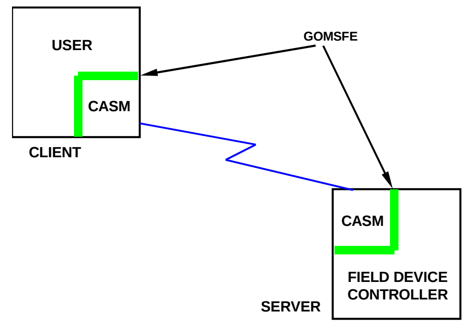
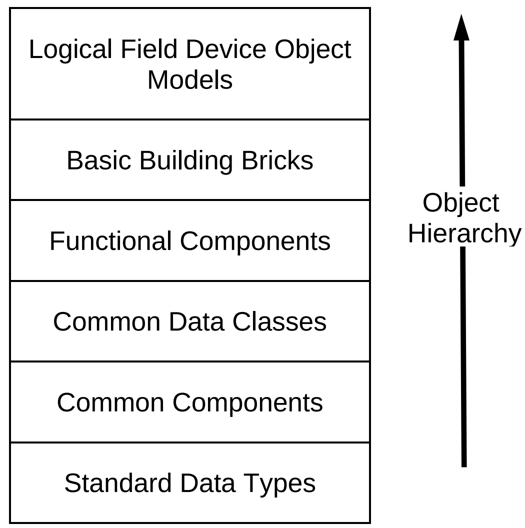
1.3 UCA 2.0 Application

Any 70 Series IED is implemented as an UCA2.0 SERVER.
The adjacent picture is Figure 1.3 taken from the GOMSFE specification that presents the SERVER as a FIELD DEVICE and the CLIENT as a USER.
CASM defines the common utility communications services that are supported in most utility communication systems. These services are defined independent of the protocols used. However, CASM does map these services to the MMS protocol as instructions for the IED developers such as Bitronics MMS protocol is what is used in the 70 Series IEDs.
These communication services have Objects as targets. Figure 1.5 in the GOMSFE specification defines an Object Hierarchy pertinent to the typical FIELD DEVICES found in Utility Substations. The Bitronics IED designers employed these mapping of Services and Object definitions to ensure any CLIENT would access the 70 Series IED in the same way as any other UCA 2.0 Compliant IED and thereby minimize integration costs.





1.4 Networking Layer

All 70 Ethernet options on the 70 Series IEDs include a TCP/IP and a 7-layer OSI network layer for networking with other UCA devices.

1.4.1 TCP/IP Network Layer

The TCP/IP and ISO network layers over the Ethernet 10 or 100 Mb copper or fiber physical links.

The TCP/IP network layer requires that each UCA Server have a unique IP address, a SUBNET mask, and ROUTER (GATEWAY) address that is appropriate for the network. The TCP port is set to 102. The table below lists port assignments for all Ethernet based protocols supported by the 70 Series.

PROTOCOL	PORT NUMBER
DNP	20000 (TCP, UDP)
FTP (recommend passive mode)	20, 21 (TCP)
Modbus	502 (TCP)
MMS (UCA & 61850)	102 (TCP)
SMTP	25 (TCP)
SNTP	123 (UDP)

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PROTOCOL	PORT NUMBER
Telnet	23 (TCP)

1.4.2 ISO - OSI Network Layer

The OSI network layer requires that each UCA Server have a unique NSAP address.

1.4.3 Network Layer Configuration

The above TCP/IP settings and the NSAP address can me made via the service com port of the 70 Series IED or the Ethernet port. A PC running application software, such as a terminal emulator program, or the 70 Series Configurator program would be needed. Please refer to the IED user manual for more instructions.

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1.5 Setting for UCA Clients

1.5.1 Selector Settings

An UCA 2.0 host will require "Selector" settings to act as a UCA Client accessing the 70 Series IED. The selector settings used by the 70 Series IED are:

Selector	Setting
Transport (TSel)	00 01
Session (SSel)	00 01
Presentation (PSel)	00 00 01

1.5.2 Application Program Title (AP Title)

Each 70 Series IED will support any Application Program Title with a valid form. The valid form is:

1 3 9999 x

Where "x" is a small decimal, e.g. "106"

1.5.3 Application Entity Qualifier (AE Qualifier)

Each 70 Series IED supports an optional Application Entity Qualifier. This qualifier is normally required to allow other UCA clients to write to the 70 Series IED. The valid form is an integer, e.g. "106". The following are some useful notes about the AE Qualifier.

- Specific restraints on writing to the 70 Series IED are presented in Section 3.
- The "Writes" to manually trigger the Waveform and disturbance recorders does not require an AE Qualifier.
- Writes to reset the 70 Series IED require a special AE Qualifier of a value equal to 6673 (refer to RsServer control bit in the GLOBE object)

2.0 UCA 2.0 Objects

2.1 UCA 2.0 Object Hierarchy

All monitoring and recording parameters available to be accessed by the UCA protocol are grouped into an addressable hierarchy, where one parameter can be referenced as element (or property) of an object.

This grouping of elements has this form:

Domain/Brick$FunctionalComponent$Object$Element

An example would be "M871$DIAG1$MXTf" which would return the internal temperature of the IED with a domain name of "M871", and the temperature value would be represented as a 32 bit floating point value(FLT32).

More then one element can be accessed by the UCA protocol by using the following form:

Domain/Brick$FunctionalComponent$Object

By removing the $element, all elements of the Object are addressable. The example of "M871$DIAG1$MX$T" would be the 32 bit floating point value, the integer values, the quality of the value and the time the value was updated.

Similarly, using the form… **Domain/Brick$FunctionalComponent**

…would return all elements of the all objects within the functional component of the brick. The example of "M871$DIAG1$MX" would be the same as "M871$DIAG1$MX$T" since there is only one functional component.

However, using the form… **Domain/Brick**

… would return all elements of the brick. The example "M871$DIAG1" would return not only the four elements of "T" temperature, but also the analog configuration parameter, description parameter, and measurement report control parameter.

2.2 UCA 2.0 Domains

Each 70 Series IED will be a UCA Server on a network and contain two logical devices or Domains. See Section 2.3 for a list of Bricks provided part of this domain hierarchy.

2.2.1 LD0 Domain

The Domain "LD0" for "Logical Device Zero" is common to all UCA Servers. The **LD0** domain has two instances of Bricks, they are:

DEVID
Device identification contains the name, address, and location information

GLOBE
This model attributes that are global to the UCA Server

2.2.2 UCA Domain

The 70 Series supports a second Domain with the default name of "UCA Domain". The "UCA Domain" has the balance of the Bricks that define the 70 Series IED Model.

2.2.3 UCA Domain Name Configuration

The “UCA Domain” name can be changed via the service com port of the 70 Series IED or the Ethernet port. A PC running the 70 Series Configurator program would be needed. Please refer to the IED user manual for more instructions.

2.3 UCA 2.0 Bricks

Using the UCA2.0 Bricks, a UCA Object Model for each 70 Series IED Model can be represented. The following sections presents the M571, M871, M572 and M872 as UCA Object Models.

2.3.1 M571 Two Bus, One Line IED UCA Object Model

M571	Voltage Bus 1(V1), Voltage Bus 2(V2), Current Line 1(L1)
DEVID	Information that describes this instance of an M571, e.g. IP address
GLOBE	Clock, GOOSE, Virtual Inputs & Outputs, Health bits, Time sync, Ethernet, Reset
AMXU1	V1, V2, L1: % THD (total, odd, even); RMS Fund. & Ang; K factor; Disp. PF; Watt/VAR/VA Fund.
dmdprsAMXU1	V1, V2, L1: % THD Demand
dmdmaxAMXU1	V1, V2, L1: % THD Max Demand since last reset
DIAG1	Internal temperature
GCTL1[1]	Control Outputs from optional Digital I/O
GIND1[1]	Status Inputs from optional Digital I/O
MHAI1	V1, L1: Magnitude & Ang, Fundamental & Individual (to 63[Rd]) Harmonics
MHAI2	V2: Magnitude & Ang, Fundamental & Individual Harmonics (to 63[Rd]) Harmonics
MMTR1	V1, L1: Energy counter, Watt/VAR/VA, In&Out/Lead&Lag/Total, Pulse Outputs, Reset counters
MMXU1	V1, L1: RMS Volts, AMPs, Watts, VARs, VA, PF, PhsAng, Frequency, Impedance; Reset
dmdprsMMXU1	V1, L1: RMS Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdmaxMMXU1	V1, L1: Max Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdminMMXU1	V1, L1: RMS Min Demand of Volts, Watts, VARs, VA, PF
MMXU2	V2: RMS Volts, Frequency; Reset Demands
dmdprsMMXU2	V2: RMS Demand of Volts
dmdmaxMMXU2	V2: RMS Max Demand of Volts
dmdminMMXU2	V2: RMS Min Demand of Volts
MSQI1	V1, L1: Positive, Negative, Zero Sequence
MSQI2	V2: Positive, Negative, Zero Sequence
RATO1	V1, L1: Primary/Secondary winding ratios; Phase rotation indication
RATO2	V1: Primary/Secondary winding ratios; Phase rotation indication
RDRE1	Disturbance Recorder #1 status; write to initiate recorder
RDRE2	Disturbance Recorder #2 status; write to initiate recorder
RSYN1	V1, V2: Phase A Freq, AngDiff, FreqDiff
RSYN2	V1, V2: Phase B Freq, AngDiff, FreqDiff
RSYN3	V1, V2: Phase C Freq, AngDiff, FreqDiff
RWRE1	Waveform Recorder #1 status; write to initiate recorder
RWRE2	Waveform Recorder #2 status; write to initiate recorder

[1]Instance is dependent on optional hardware installed.

2.3.2 M871 Two Bus, One Line IED UCA Object Model

M871	Voltage Bus 1(V1), Voltage Bus 2(V2), Auxiliary Voltages (Aux), Current Line 1(L1)
DEVID	Information that describes this instance of an M871, e.g. IP address
GLOBE	Clock, GOOSE, Virtual Inputs & Outputs, Health bits, Time sync, Ethernet, Reset
AMXU1	V1, V2, L1: % THD (total, odd, even); RMS Fund. & PhsAng; K factor; DPF; Watt/VAR/VA Fund.
dmdprsAMXU1	V1, V2, L1: % THD Demand
dmdmaxAMXU1	V1, V2, L1: % THD Max Demand since last reset
DIAG1	Internal temperature
GCTL1[1]	Control Outputs from optional Digital I/O Virtual Slot 0
GCTL2[1]	Control Outputs from optional Digital I/O Virtual Slot 1
GCTL3[1]	Control Outputs from optional Digital I/O Virtual Slot 2
GCTL4[1]	Control Outputs from optional Digital I/O Virtual Slot 3
GCTL5[1]	Control Outputs from optional Digital I/O Virtual Slot 4
GCTL6[1]	Control Outputs from optional Digital I/O Virtual Slot 5
GCTL7[1]	Control Outputs from optional Digital I/O Virtual Slot 6
GIND1[1]	Status Inputs from optional Digital I/O Virtual Slot 0
GIND2[1]	Status Inputs from optional Digital I/O Virtual Slot 1
GIND3[1]	Status Inputs from optional Digital I/O Virtual Slot 2
GIND4[1]	Status Inputs from optional Digital I/O Virtual Slot 3
GIND5[1]	Status Inputs from optional Digital I/O Virtual Slot 4
GIND6[1]	Status Inputs from optional Digital I/O Virtual Slot 5
GIND7[1]	Status Inputs from optional Digital I/O Virtual Slot 6
MHAI1	V1, L1: Magnitude & Ang, Fundamental & Individual (to 63^{Rd}) Harmonics
MHAI2	V2: Magnitude & Ang, Fundamental & Individual Harmonics (to 63^{Rd}) Harmonics
MMTR1	V1, L1: Energy counter, Watt/VAR/VA, In&Out/Lead&Lag/Total, Pulse Outputs, Reset counters
MMXU1	V1, L1: RMS Volts, AMPs, Watts, VARs, VA, PF, PhsAng, Frequency, Impedance; Reset
dmdprsMMXU1	V1, L1: RMS Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdmaxMMXU1	V1, L1: Max Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdminMMXU1	V1, L1: RMS Min Demand of Volts, Watts, VARs, VA, PF
MMXU2	V2: RMS Volts, Frequency; Reset Demands
dmdprsMMXU2	V2: RMS Demand of Volts
dmdmaxMMXU2	V2: RMS Max Demand of Volts
dmdminMMXU2	V2: RMS Min Demand of Volts
MMXU3	AUX: AC/DC Volts, VDiff
MSQI1	V1, L1: Positive, Negative, Zero Sequence
MSQI2	V2: Positive, Negative, Zero Sequence
RATO1	V1, L1: Primary/Secondary winding ratios; Phase rotation indication
RATO2	V1: Primary/Secondary winding ratios; Phase rotation indication
RATO3	AUX: Primary/Secondary winding ratios
RDRE1	Disturbance Recorder #1 status; write to initiate recorder
RDRE2	Disturbance Recorder #2 status; write to initiate recorder
RSYN1	V1, V2: Phase A Freq, AngDiff, FreqDiff
RSYN2	V1, V2: Phase B Freq, AngDiff, FreqDiff
RSYN3	V1, V2: Phase C Freq, AngDiff, FreqDiff
RWRE1	Waveform Recorder #1 status; write to initiate recorder
RWRE2	Waveform Recorder #2 status; write to initiate recorder

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2.3.3 M572 Two Bus, Two Line IED UCA Object Model

M572	Voltage Bus 1(V1), Voltage Bus 2(V2), Current Line 1(L1), Current Line 2 (L1)
DEVID	Information that describes this instance of an M572, e.g. IP address
GLOBE	Clock, GOOSE, Virtual Inputs & Outputs, Health bits, Time sync, Ethernet, Reset
AMXU1	V1,V2,L1,L2: % THD (total, odd, even); RMS Fund. & PhsAng; K factor; DPF; Watt/VAR/VA Fund.
dmdprsAMXU1	V1, V2, L1, L2: % THD Demand
dmdmaxAMXU1	V1, V2, L1, L2: % THD Max Demand since last reset
DIAG1	Internal temperature
GCTL1[1]	Control Outputs from optional Digital I/O
GIND1[1]	Status Inputs from optional Digital I/O
MHAI1	V1, L1: Magnitude & Ang, Fundamental & Individual (to 63^{Rd}) Harmonics
MHAI2	V2, L2: Magnitude & Ang, Fundamental & Individual Harmonics (to 63^{Rd}) Harmonics
MMTR1	V1, L1: Energy counter, Watt/VAR/VA, In&Out/Lead&Lag/Total, Pulse Outputs, Reset counters
MMTR2	V2, L2: Energy counter, Watt/VAR/VA, In&Out/Lead&Lag/Total, Pulse Outputs, Reset counters
MMXU1	V1, L1: RMS Volts, AMPs, Watts, VARs, VA, PF, PhsAng, Frequency, Impedance; Reset
dmdprsMMXU1	V1, L1: RMS Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdmaxMMXU1	V1, L1: Max Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdminMMXU1	V1, L1: RMS Min Demand of Volts, Watts, VARs, VA, PF
MMXU2	V2, L2: RMS Volts, AMPs, Watts, VARs, VA, PF, PhsAng, Frequency, Impedance; Reset
dmdprsMMXU2	V2, L2: RMS Demand of Volts , AMPs, Watts, VARs, VA, PF
dmdmaxMMXU2	V2, L2: RMS Max Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdminMMXU2	V2, L2: RMS Min Demand of Volts, AMPs, Watts, VARs, VA, PF
MMXU3	V2: RMS Volts, Frequency
MSQI1	V1, L1: Positive, Negative, Zero Sequence
MSQI2	V2, L2: Positive, Negative, Zero Sequence
RATO1	V1, L1: Primary/Secondary winding ratios; Phase rotation indication
RATO2	V2, L2: Primary/Secondary winding ratios; Phase rotation indication
RATO3	V2: Primary/Secondary winding ratios
RDRE1	Disturbance Recorder #1 status; write to initiate recorder
RDRE2	Disturbance Recorder #2 status; write to initiate recorder
RSYN1	V1, V2: Phase A Freq, AngDiff, FreqDiff
RSYN2	V1, V2: Phase B Freq, AngDiff, FreqDiff
RSYN3	V1, V2: Phase C Freq, AngDiff, FreqDiff
RWRE1	Waveform Recorder #1 status; write to initiate recorder
RWRE2	Waveform Recorder #2 status; write to initiate recorder

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2.3.4 M872 Two Bus, Two Line IED UCA Object Model

M871	Voltage Bus 1(V1), Voltage Bus 2(V2), Current Line 1(L1), Current Line 1(L2)
DEVID	Information that describes this instance of an M872, e.g. IP address
GLOBE	Clock, GOOSE, Virtual Inputs & Outputs, Health bits, Time sync, Ethernet, Reset
AMXU1	V1,V2,L1,L2: % THD (total, odd, even); RMS Fund. & PhsAng; K factor; DPF; Watt/VAR/VA Fund.
dmdprsAMXU1	V1, V2, L1, L2: % THD Demand
dmdmaxAMXU1	V1, V2, L1, L2: % THD Max Demand since last reset
DIAG1	Internal temperature
GCTL1[1]	Control Outputs from optional Digital I/O Virtual Slot 0
GCTL2[1]	Control Outputs from optional Digital I/O Virtual Slot 1
GCTL3[1]	Control Outputs from optional Digital I/O Virtual Slot 2
GCTL4[1]	Control Outputs from optional Digital I/O Virtual Slot 3
GCTL5[1]	Control Outputs from optional Digital I/O Virtual Slot 4
GCTL6[1]	Control Outputs from optional Digital I/O Virtual Slot 5
GCTL7[1]	Control Outputs from optional Digital I/O Virtual Slot 6
GIND1[1]	Status Inputs from optional Digital I/O Virtual Slot 0
GIND2[1]	Status Inputs from optional Digital I/O Virtual Slot 1
GIND3[1]	Status Inputs from optional Digital I/O Virtual Slot 2
GIND4[1]	Status Inputs from optional Digital I/O Virtual Slot 3
GIND5[1]	Status Inputs from optional Digital I/O Virtual Slot 4
GIND6[1]	Status Inputs from optional Digital I/O Virtual Slot 5
GIND7[1]	Status Inputs from optional Digital I/O Virtual Slot 6
MHAI1	V1, L1: Magnitude & Ang, Fundamental & Individual (to 63Rd) Harmonics
MHAI2	V2, L2: Magnitude & Ang, Fundamental & Individual Harmonics (to 63Rd) Harmonics
MMTR1	V1, L1: Energy counter, Watt/VAR/VA, In&Out/Lead&Lag/Total, Pulse Outputs, Reset counters
MMXU1	V1, L1: RMS Volts, AMPs, Watts, VARs, VA, PF, PhsAng, Frequency, Impedance; Reset
dmdprsMMXU1	V1, L1: RMS Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdmaxMMXU1	V1, L1: Max Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdminMMXU1	V1, L1: RMS Min Demand of Volts, Watts, VARs, VA, PF
MMXU2	V2, L2: RMS Volts, AMPs, Watts, VARs, VA, PF, PhsAng, Frequency, Impedance; Reset
dmdprsMMXU2	V2, L2: RMS Demand of Volts , AMPs, Watts, VARs, VA, PF
dmdmaxMMXU2	V2, L2: RMS Max Demand of Volts, AMPs, Watts, VARs, VA, PF
dmdminMMXU2	V2, L2: RMS Min Demand of Volts, AMPs, Watts, VARs, VA, PF
MMXU3	V2: RMS Volts, Frequency
MSQI1	V1, L1: Positive, Negative, Zero Sequence
MSQI2	V2, L2: Positive, Negative, Zero Sequence
RATO1	V1, L1: Primary/Secondary winding ratios; Phase rotation indication
RATO2	V2, L2: Primary/Secondary winding ratios; Phase rotation indication
RATO3	V2: Primary/Secondary winding ratios
RDRE1	Disturbance Recorder #1 status; write to initiate recorder
RDRE2	Disturbance Recorder #2 status; write to initiate recorder
RSYN1	V1, V2: Phase A Freq, AngDiff, FreqDiff
RSYN2	V1, V2: Phase B Freq, AngDiff, FreqDiff
RSYN3	V1, V2: Phase C Freq, AngDiff, FreqDiff
RWRE1	Waveform Recorder #1 status; write to initiate recorder
RWRE2	Waveform Recorder #2 status; write to initiate recorder

2.4 UCA 2.0 Objects

Section 4 contains the complete references of Objects available, organized by Brick Type.

Section 7 contains a cross reference of Measurement and calculated parameters to the Brick Type.

Each Object presented in Section 4 contains a reference to its functional component and Object Class.

2.5 UCA 2.0 Object Classes

Section 5 presents the Object Classes where the available data elements are presented along with the support service (rwec).

2.6 UCA 2.0 Functional Components

The Objects within a Brick are arranged into functional components to facilitate browsing by the client. This following table provides a description of how they are used:

Functional Component	How used
CF.<name>	Contains the configuration information of the analog value such as scale and units
	Contains the configuration information of the binary value such as pulse on time, pulse off time, etc.
DC.<name>	Contains additional descriptive information of the analog value such as measurement type, reference, etc…
	Contains additional descriptive information of the binary value such as a description string, type of binary value, etc…
MX.<name>	Contains the actual dynamic value(s) of measurements both externally sampled, and, internally computed
RP	Contains a Report Control Block
SP.<name>	Contains set points relating for the measurement value
ST.<name>	Contains the current state of the switch for reading

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3.0 UCA 2.0 Services

3.1 Device Control Model

The 70 Series IED uses the UCA Device Control Model to operate physical output points on the optional Digital Input/Output hardware. The following options are supported:

- Allow or force a select operation to precede a control operation
- Automatically de-select after a definitive timeout period
- Automatically de-select upon a control operation
- Automatically toggle the output after a given period of time (used for pulsed output operation)

The Device Control model is divided into two portions: select-before-operate and pulsed output. These are independent of one another. Each physical output has a separate configuration.

3.1.1 Select-Before Operate

The select-before-operate configuration parameters are:

- **SelTimOut** – sets the time in seconds when the select will automatically time out
- **SBOClass** – determines whether an automatic de-selection will occur upon an operation
- **SBOEna** – determines whether a select is required prior to an operate command.

The attribute (Element) **State** reflects the “selected-ness” of an Object, e.g. “BO1”. Refer to the section on the common class component SBOCF (section 5) for detailed information.

There are three actions that can be performed upon a physical output: select, de-select, and operate.

A **select action** is performed by reading a variable named “SBO”. For example, reading the variable “GCTL1.CO.BO1.SBO” will cause the first output point to become selected. The server returns the variable which is associated with the operate action (in this case, the UCA variable is “GCTL1.CO.BO1.b1”. Upon selection, the point becomes unavailable for selection by other clients until de-selection takes place. Re-selection by the same client merely extends the automatic timeout period. The “selected-ness” of the point can be tested by reading the State attribute. The SBO object differs from all other Server objects in that reads alter the state of the Server; for this reason, reading of the SBO attribute is prohibited unless the Client has write privileges.

A **de-select action** is performed by writing a “FALSE” to the “State” attribute. For example, writing a FALSE to “GCTL1.CF.BO1.State” will cause the State attribute to become FALSE. It is an error to attempt to write TRUE to the State attribute. A point will become de-selected under three conditions:

- An explicit de-select action (described in the above paragraph)
- A time period of SelTimOut seconds elapsed since a selection
- An operate action was performed with SBOClass indicating automatic de-select

An **operate action** is performed by writing to the actual point. For example, writing FALSE to “GCTL1.CO.BO1.b1” will cause the first output to immediately turn off. It also optionally causes de-selection as described above. If the point is configured to require SBO (i.e., if the SBOEna attribute is TRUE), it is an error to perform the operate action on an unselected point.

3.1.2 Pulse Output

The pulsed output portion of the device control model allows a point to automatically toggle after a defined time period. A separate time period, in milliseconds, is defined for turning outputs on (OnDur) and off (OffDur). These attributes are located in the configuration of the binary output. A

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value of zero indicates that the output is to remain in the commanded state until commanded to change. For example, if GCTL1.CF.BO1.OffDur is set to zero and GCTL1.CF.BO1.OnDur is set to 1000, then a write of FALSE to GCTL1.CO.BO1.b1 will cause the output to turn off. If TRUE is written to GCTL1.CO.BO1.b1, the output will be turned on for 1000 milliseconds and then turned off. It is an error to attempt to change an output that is in the process of timing-out for an automatic toggle. It is also an error to attempt to change an output that is controlled by some other process (for example, if the output is configured to monitor the energy pulse state).

3.2 Multicast Service Model –GOOSE (GlobeCORsGOOSE)

The object controls the re-subscription of (UCA) GOOSE messages. The server is configured with a list of the “names” of GOOSE messages which should be received.

For the first minute after startup, the Ethernet interface is temporarily modified to pass all incoming multicast messages. During this time, incoming GOOSE messages are checked for matching names. If a desired GOOSE message is found, the multicast MAC (Media Access Controller) address (i.e. aa.bb.cc.dd.ee.ff) of that GOOSE is saved.

After the minute expires, the Ethernet interface is then returned to a mode where only those specific multicast address packets are allowed to pass. There is one more multicast address which is always allowed to pass, it is the “OSI ES Hello” which informs the server of the OSI router’s MAC address.

This accomplishes the “GOOSE name” to “GOOSE MAC address” lookup. Under two conditions, this will be inadequate:

- If the GOOSE publisher is powered after this subscriber completes the translation step, then the subscriber will not allow reception of that GOOSE message (the MAC filter will keep the firmware from seeing those GOOSE packets.
- If the GOOSE publisher changes its multicast address (this could happen if the publishing IED is swapped out

Under these circumstances, the GOOSE subscription process needs to be repeated. One way would be to cycle power to the server, which would cause the re-subscription to occur as part of the normal power-up process. However, this could cause disruptions to other IED which might depend upon GOOSE signals sent from this server.
An alternative is to write to the “RsGoose” bit which causes the re-enrollment process to be run without otherwise disrupting the communications. The obvious question at this point is “why doesn’t the 70 Series IEDs just accept all GOOSE messages”? The problem is that GOOSE processing incurs a large amount of computational resources. Most of the GOOSE messages will NOT be directed toward any particular M87x device. Therefore, discarding the GOOSE packets in the Ethernet hardware interface allows more processing time for other tasks.

3.3 Time Synchronization

The 70 Series IEDs can accept UCA time sync messages from a UCA time sync Master. Alternatively, a 70 Series IED could be a UCA time sync Master.

The protocol is specified in IEEE TR1550-1999 Part 2: UCA Profiles, Appendix B with corrections from the document named:

ftp://ftp.sisconet.com/epri/uca2.0/sync-p6.doc

The protocol allows a choice of synchronization to either 1 millisecond or 1 microsecond resolution, and the 70 Series IEDs accepts either protocol resolution.

Unlike normal time-sync Slaves, the M871 is capable of modifying both the absolute time error and the rate of time flow. The device uses time-sync requests to drive the internal clock frequency error towards zero. If the time sync messages cease arriving, the clock will free-wheel at the last determined rate. Time rate errors of far below 1 part-per-million are possible depending upon the jitter of the Master and the amount of network congestion. The M871 drives the absolute time error towards zero instead of the classical method of simply noting the error.

The 70 Series IEDs ensures that time always flows forward, even when time-sync messages indicate that the M871 is ahead of the Master. It does this by modifying the clock frequency up to +/- 3% for an appropriate amount of time. This assures that events are always time stamped in the order in which they occurred.

The first time-sync message received after a power-up or a manual change of the clock (by setting ClockTOD) initiates an automatic time set. It is assumed that the time in a sync message is of higher quality than the time sent in the explicit time-set message. After this initial sync message, the 70 Series IED switches to an algorithm that runs a software phase-locked-loop, driving both the time error and rate of time error towards zero. The algorithm validates each sync request by ensuring that the estimated sync latency does not differ greatly from the average of the last several sync requests. The number of sync requests used to compute the average and the maximum difference from this average are both configurable. Refer to the 70 Series Configurator program help files for information on these configuration parameters.

The 70 Series IEDs stores the estimated crystal calibration error in an ".INI" file which is updated every four hours while receiving time sync requests. Additionally, the CMOS time-of-day clock is updated hourly during time sync. This ensures that a power cycle while the time sync Master is disabled produces an internal clock with the best possible accuracy.

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4.0 UCA 2.0 Object Reference by Brick

The following section contains detailed descriptions of each brick, its associated objects and classes, and a description of the object. In describing the class, we will use a convention where some classes are identified as "WW~XX" or "YY+ZZ". In this convention, the first identifies a standard class WW where the (optional) component XX has been removed and the second signifies a standard class YY where a new component ZZ has been added. See section 5.0 for an explanation of the elements that defined the Class.

4.1 AMXU Objects

Polyphase Measurement Unit provides measurements of single phase or polyphase analog values (including neutral) pertaining to a wye or delta connected field device or circuit. Where specified, V1 is from Bus 1 and V2 from Bus 2.
The addition of the prefix dmdprs and dmdmax for a manufacturer extension to this brick, namely, present demand and maximum demand since reset.

4.1.1 AMXU1

AMXU1				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	DispPF	WYE~N	r	Per-Phase Displacement PF (fundamental only)
	TotDispPF	AI	r	Three-Phase DispPF (Arithmetic or Geometric)
	KfA	WYE+R	r	Per-Phase K factor (transformer de-rating factor)
	TDDA	WYE+R	r	Total ampere demand distortion (THD if MaxDmdLoA = 0)
	FundA	WYE+R	r	Fundamental RMS Current
	TDDOddA	WYE~N	r	Total Odd amp demand distortion (THD if MaxDmdLoA = 0)
	TDDEvnA	WYE~N	r	Total Oven amp demand distortion (THD if MaxDmdLoA = 0)
	THDV	WYE~N	r	Total Harmonic Distortion V1 (WYE systems)
	THDPPV	DELTA	r	Total Harmonic Distortion V1 (DELTA systems)
	FundV	WYE~N	r	Fundamental RMS Voltage V1 (WYE systems)
	FundPPV	DELTA	r	Fundamental RMS Voltage V1 (DELTA systems)
	THDOddV	WYE~N	r	[(RMS of harmonic 3+5+7+…)] / FundV Bus 1
	THDEvnV	WYE~N	r	[(RMS of each even harmonic)] / FundV Bus 1
	THDOddPPV	DELTA	r	[(RMS of harmonic 3+5+7+…)] / FundV Bus 1
	THDEvnPPV	DELTA	r	[(RMS of each even harmonic)] / FundV Bus 1
	THDV2	WYE~N	r	Total Harmonic Distortion V2 (WYE systems)
	THDPPV2	DELTA	r	Total Harmonic Distortion V2 (DELTA systems)
	FundV2	WYE~N	r	Fundamental RMS Voltage V2 (WYE systems)
	FundPPV2	DELTA	r	Fundamental RMS Voltage V2 (DELTA systems)
	THDOddV2	WYE~N	r	[(RMS of harmonic 3+5+7+…)] / FundV Bus 2
	THDEvnV2	WYE~N	r	[(RMS of each even harmonic)] / FundV Bus 2
	THDOddPPV2	DELTA	r	[(RMS of harmonic 3+5+7+…)] / FundV Bus 2
	THDEvnPPV2	DELTA	r	[(RMS of each even harmonic)] / FundV Bus 2
	FundW	WYE~N	r	Fundamental Watts in Phases A,B,C (WYE systems)
	FundTotW	WYE~N	r	Fundamental Total Watts in all three phases

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AMXU1				
FC	**Object Name**	**Class**	**rwec**	**Description**
	FundVAr	WYE~N	r	Fundamental VARs in Phases A,B,C (WYE systems)
	FundTotVAr	WYE~N	r	Fundamental Total VARs in all three phases
	FundVA	WYE~N	r	Fundamental Vas in Phases A,B,C (WYE systems)
	FundTotVA	WYE~N	r	Fundamental Total VAs in all three phases
ST	FileCnt	INT32U	r	Total number of files in MMS directory
	WaveTrigd	BO	rw[1]	New waveform file created since last clear
	AnyStr	BO	r	Any waveform/disturbance recorder triggered
	AnyMade	BO	r	Any waveform/disturbance recorder completed
	AnyFull	BO	r	Any waveform/disturbance recorder memory nearly full
ST	StBinFunc[2]	BSTR5	r	Aggregated miscellaneous status bits
CO	WaveTrig	BO	rw[3]	Manual waveform record trigger
	RsDmdH	BO	rw	Reset ALL harmonic demands
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
	MaxDmdLoA	WYE+R~QT	rw	Denominator for Ampere %TDD calculations
	DmdIntH	INT32U	rw	Demand integration time for harmonics in seconds
	LogInt	INT32U	rw	Trend Recorder Logging Interval (seconds)
	CalcTVA[4]	ENUM8	rw	Total VA calculation type
DC	All MX	d	r	Description of ALL measurements included in this brick
	All ST	d	r	Description of ALL status included in this brick
	All SP	d	r	Description of ALL set-points included in this brick
	All CO	d	r	Description of ALL controls included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control
	brcbST	BasRCB	Rw	Status Report Control

[1] WaveTrigd allows only writes of zero, writing one is disallowed
[2] StBinFunc bits are:
Bit0=+WattHour pulse, Bit1=-WattHour Pulse,Bit2=+VArHour Pulse, Bit3=-VArHour Pulse
Bit4=Copy of ST.AnyStr.b1, Bit5=Copy of ST.AnyMade.b1, Bit6=Copy of ST.AnyFull.b1
[3] Writing to this point does not require write privilege
[4] CalcTVA Argument:

1=arithmetic, 2=geometric(vector), 3=line-to-neutral-equivalent, 4=line-to-line-equivalent method

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4.1.2 AMXU2 – M572 and M872 Only

AMXU1 (Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	DispPF	WYE~N	r	Per-Phase Displacement PF (fundamental only)
	TotDispPF	AI	r	Three-Phase DispPF (Arithmetic or Geometric)
	DispPF2	WYE~N	r	Per-Phase Displacement PF (fundamental only) bus 2
	TotDispPF2	AI	r	Three-Phase DispPF (Arithmetic or Geometric) bus 2
	KfA	WYE~N+R	r	Per-Phase K factor (transformer de-rating factor)
	TDDA	WYE~N+R	r	Total ampere demand distortion (THD if MaxDmdLoA = 0)
	FundA	WYE~N+R	r	Fundamental RMS Current
	TDDOddA	WYE~N	r	Total Odd amp demand distortion (THD if MaxDmdLoA = 0)
	TDDEvnA	WYE~N	r	Total Oven amp demand distortion (THD if MaxDmdLoA = 0)
	KfA2	WYE~N+R	r	Per-Phase K factor (transformer de-rating factor)
	TDDA2	WYE~N+R	r	Total ampere demand distortion (THD if MaxDmdLoA = 0)
	FundA2	WYE~N+R	r	Fundamental RMS Current
	TDDOddA2	WYE~N	r	Total Odd amp demand distortion (THD if MaxDmdLoA = 0)
	TDDEvnA2	WYE~N	r	Total Oven amp demand distortion (THD if MaxDmdLoA = 0)
	THDV	WYE~N	r	Total Harmonic Distortion V1 (WYE systems)
	THDPPV	DELTA	r	Total Harmonic Distortion V1 (DELTA systems)
	FundV	WYE~N	r	Fundamental RMS Voltage V1 (WYE systems)
	FundPPV	DELTA	r	Fundamental RMS Voltage V1 (DELTA systems)
	THDOddV	WYE~N	r	[(RMS of harmonic 3+5+7+…)] / FundV Bus 1
	THDEvnV	WYE~N	r	[(RMS of each even harmonic)] / FundV Bus 1
	THDOddPPV	DELTA	r	[(RMS of harmonic 3+5+7+…)] / FundV Bus 1
	THDEvnPPV	DELTA	r	[(RMS of each even harmonic)] / FundV Bus 1
	THDV2	WYE~N	r	Total Harmonic Distortion V2 (WYE systems)
	THDPPV2	DELTA	r	Total Harmonic Distortion V2 (DELTA systems)
	FundV2	WYE~N	r	Fundamental RMS Voltage V2 (WYE systems)
	FundPPV2	DELTA	r	Fundamental RMS Voltage V2 (DELTA systems)
	THDOddV2	WYE~N	r	[(RMS of harmonic 3+5+7+…)] / FundV Bus 2
	THDEvnV2	WYE~N	r	[(RMS of each even harmonic)] / FundV Bus 2
	THDOddPPV2	DELTA	r	[(RMS of harmonic 3+5+7+…)] / FundV Bus 2
	THDEvnPPV2	DELTA	r	[(RMS of each even harmonic)] / FundV Bus 2
	FundW	WYE~N	r	Fundamental Watts in Phases A,B,C (WYE systems)
	FundTotW	WYE~N	r	Fundamental Total Watts in all three phases
	FundVAr	WYE~N	r	Fundamental VARs in Phases A,B,C (WYE systems)
	FundTotVAr	WYE~N	r	Fundamental Total VARs in all three phases
	FundVA	WYE~N	r	Fundamental Vas in Phases A,B,C (WYE systems)
	FundTotVA	WYE~N	r	Fundamental Total VAs in all three phases
	FundW2	WYE~N	r	Fundamental Watts in Phases A,B,C (WYE systems) Bus 2
	FundTotW2	WYE~N	r	Fundamental Total Watts in all three phases Bus 2

AMXU1 (Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
	FundVAr2	WYE~N	r	Fundamental VARs in Phases A,B,C (WYE systems) Bus 2
	FundTotVAr2	WYE~N	r	Fundamental Total VARs in all three phases Bus 2
	FundVA2	WYE~N	r	Fundamental Vas in Phases A,B,C (WYE systems) Bus 2
	FundTotVA2	WYE~N	r	Fundamental Total VAs in all three phases Bus 2
ST	FileCnt	INT32U	r	Total number of files in MMS directory
	WaveTrigd	BO	rw[1]	New waveform file created since last clear
	AnyStr	BO	r	Any waveform/disturbance recorder triggered
	AnyMade	BO	r	Any waveform/disturbance recorder completed
	AnyFull	BO	r	Any waveform/disturbance recorder memory nearly full
ST	StBinFunc[2]	BSTR5	r	Aggregated miscellaneous status bits
CO	WaveTrig	BO	rw[3]	Manual waveform record trigger
	RsDmdH	BO	rw	Reset ALL harmonic demands
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
	MaxDmdLoA	WYE+R~QT	rw	Denominator for Ampere %TDD calculations
	DmdIntH	INT32U	rw	Demand integration time for harmonics in seconds
	LogInt	INT32U	rw	Trend Recorder Logging Interval (seconds)
	CalcTVA[4]	ENUM8	rw	Total VA calculation type
DC	All MX	d	r	Description of ALL measurements included in this brick
	All ST	d	r	Description of ALL status included in this brick
	All SP	d	r	Description of ALL set-points included in this brick
	All CO	d	r	Description of ALL controls included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control
	brcbST	BasRCB	Rw	Status Report Control

[1] WaveTrigd allows only writes of zero, writing one is disallowed
[2] StBinFunc bits are:
Bit0=+WattHour pulse, Bit1=-WattHour Pulse,Bit2=+VArHour Pulse, Bit3=-VArHour Pulse
Bit4=Copy of ST.AnyStr.b1, Bit5=Copy of ST.AnyMade.b1, Bit6=Copy of ST.AnyFull.b1
[3] Writing to this point does not require write privilege
[4] CalcTVA Argument:
1=arithmetic, **2**=geometric(vector), **3**=line-to-neutral-equivalent, **4**=line-to-line-equivalent method

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4.1.3 dmdprsAMXU1

dmdprsAMXU1				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	TDDA	WYE+R	r	Total ampere demand distortion
	FundA	WYE+R	r	Fundamental RMS Current
	THDV	WYE~N	r	Total Harmonic Distortion V1 (WYE systems)
	THDPPV	DELTA	r	Total Harmonic Distortion V1 (DELTA systems)
	THDV2	WYE~N	r	Total Harmonic Distortion V2 (WYE systems)
	THDPPV2	DELTA	r	Total Harmonic Distortion V2 (DELTA systems)
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick

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4.1.4 dmdprsAMXU2 - M572 and M872 Only

dmdprsAMXU1 (Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	TDDA	WYE~N+R	r	Total ampere demand distortion
	FundA	WYE~N+R	r	Fundamental RMS Current
	TDDA2	WYE~N+R	r	Total ampere demand distortion bus 2
	FundA2	WYE~N+R	r	Fundamental RMS Current bus 2
	THDV	WYE~N	r	Total Harmonic Distortion V1 (WYE systems)
	THDPPV	DELTA	r	Total Harmonic Distortion V1 (DELTA systems)
	THDV2	WYE~N	r	Total Harmonic Distortion V2 (WYE systems)
	THDPPV2	DELTA	r	Total Harmonic Distortion V2 (DELTA systems)
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick

4.1.5 dmdMaxAMXU1

dmdmaxAMXU1				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	TDDA	WYE+R_MT	r	Total ampere demand distortion
	FundA	WYE+R_MT	r	Fundamental RMS Current
	THDV	WYE~N_MT	r	Total Harmonic Distortion V1 (WYE systems)
	THDPPV	DELTA_MT	r	Total Harmonic Distortion V1 (DELTA systems)
	THDV2	WYE~N_MT	r	Total Harmonic Distortion V2 (WYE systems)
	THDPPV2	DELTA_MT	r	Total Harmonic Distortion V2 (DELTA systems)
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick

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4.1.6 dmdprsAMXU2 - M572 and M872 Only

dmdmaxAMXU1 (Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	TDDA	WYE~N+R_MT	r	Total ampere demand distortion
	FundA	WYE~N+R_MT	r	Fundamental RMS Current
	TDDA2	WYE~N+R_MT	r	Total ampere demand distortion bus 2
	FundA2	WYE~N+R_MT	r	Fundamental RMS Current bus 2
	THDV	WYE~N_MT	r	Total Harmonic Distortion V1 (WYE systems)
	THDPPV	DELTA_MT	r	Total Harmonic Distortion V1 (DELTA systems)
	THDV2	WYE~N_MT	r	Total Harmonic Distortion V2 (WYE systems)
	THDPPV2	DELTA_MT	r	Total Harmonic Distortion V2 (DELTA systems)
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick

4.2 DEVID Objects

Device Identification contains the name, address, description, and location information of the M871.

4.2.1 DEVID

DEVID				
FC	**Object Name**	**Class**	**rwec**	**Description**
DC	Name	VSTR32	rw	Name of the device
	Class	VSTR32	r	Device Class (eg, Emeter for electricity meter)
	d	VSTR32	rw	Text description of the device
	Own	VSTR32	rw	Name of the company owning the device
	Loc	VSTR128	rw	Device location
	VndID	VndID	r	Vendor Identity, manufacturer information
	NsapAdr	VSTR59	rw	OSI Server Address (ex:49 00 01 42 49 09 01 01)
	IpAdr	VSTR15	rw	Internet Protocol Server Address (ex:192.168.0.254)
	SnAdr	VSTR15	rw	Internet Protocol Subnet Mask (ex:255.255.255.0)
	RouterIp	VSTR15	rw	Internet Protocol Gateway Addr (ex:192.168.0.1)
	IEEEAdr	VSTR17	r	Server's MAC (Media Access Controller) address

4.3 DIAG Objects

4.3.1 DIAG1

The Diagnostic Brick provides measurement of the internal operating temperature of the M871.

DIAG1				
FC	**Name**	**Class**	**rwec**	**Description**
MX	T	AI	r	Temperature
CF	All MX	ACF	rw	Configuration for all measurements included in this brick
DC	All MX	d	r	Description for all measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

4.4 GCTL Objects

Generic Control represents outputs of the Digital Input/Output board. The brick suffix (e.g. the 1 in GCTL1) value is one more than the virtual slot number assigned to the hardware group. For example, the card in virtual slot 0 would be represented by GCTL1. Status (ST) values are the last commanded state (NOT the present state of the relay output). Control (CO) values alter the output points. Reading Control returns the same value as the status points. The timestamp of each point indicates the time of last output transition.

4.4.1 GCTL1 – M571 and M572 only

GCTL1 - M571 and M572				
FC	**Object Name**	**Class**	**rwec**	**Description**
ST	BO1	SI	r	Binary Output Status point 1
	BO2	SI	r	Binary Output Status point 2
	BO3	SI	r	Binary Output Status point 3
	BO4	SI	r	Binary Output Status point 4
CO	BO1	BOSBO	rw[1]	Binary Output Status point 1
	BO2	BOSBO	rw[1]	Binary Output Status point 2
	BO3	BOSBO	rw[1]	Binary Output Status point 3
	BO4	BOSBO	rw[1]	Binary Output Status point 4
CF	All CO	CCF	rw	Pulse width (Off and On) configuration
	BO1SBO	SBOCF	rw	Select-before-Operate configuration
	BO2SBO	SBOCF	rw	Select-before-Operate configuration
	BO3SBO	SBOCF	rw	Select-before-Operate configuration
	BO4SBO	SBOCF	rw	Select-before-Operate configuration
DC	All ST	d	r	Description of ALL status included in this brick
	All CO	d	r	Description of ALL controls included in this brick
RP	brcbSOE	BasRCB	rw	Control Report Control

[1] The attribute CO.BOx.SBO can only be read if the Client has “write” privilege

4.4.2 GCTL1 to 7 – M871 to M872 only

GCTL1 to 7 M871 and M872				
FC	**Object Name**	**Class**	**rwec**	**Description**
ST	BO1	SI	r	Binary Output Status point 1
	BO2	SI	r	Binary Output Status point 2
	BO3	SI	r	Binary Output Status point 3
	BO4	SI	r	Binary Output Status point 4
CO	BO1	BOSBO	rw[1]	Binary Output Status point 1
	BO2	BOSBO	rw[1]	Binary Output Status point 2
	BO3	BOSBO	rw[1]	Binary Output Status point 3
	BO4	BOSBO	rw[1]	Binary Output Status point 4
CF	All CO	CCF	rw	Pulse width (Off and On) configuration
	BO1SBO	SBOCF	rw	Select-before-Operate configuration
	BO2SBO	SBOCF	rw	Select-before-Operate configuration
	BO3SBO	SBOCF	rw	Select-before-Operate configuration
	BO4SBO	SBOCF	rw	Select-before-Operate configuration
DC	All ST	d	r	Description of ALL status included in this brick
	All CO	d	r	Description of ALL controls included in this brick
RP	brcbSOE	BasRCB	rw	Control Report Control

[1] The attribute CO.BOx.SBO can only be read if the Client has “write” privilege

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4.5 GIND Objects

Generic Indication represents a group of digital (binary) inputs. Each input group contains 4 or 8 or 16 inputs depending upon the hardware characteristics. The brick suffix (e.g. the 1 in GIND1) value is one more than the virtual slot number assigned to the hardware group. For example, the card in virtual slot 0 would be represented by GIND1. SI1 through SI(n) represent individual debounced bits. SIG1 represents the group of debounced bits. The first (leftmost) bit of SIG1 is SI1, the second bit is SI2, etc. Each timestamp indicates the time of last transition on the input. For SIG1, the timestamp denotes the time any bit made a transition. Debounce sets the input debounce filter on that input. An input transition is not recognized until the input remains in the new state for a time longer than the debounce timer. Values between 60 ns (60.0E-9) and 2 minutes (240.0E+0) are acceptable.

4.5.1 GIND1 to 7 – M871 and M872 only

GIND1 to 7 – M871 and M872				
FC	**Object Name**	**Class**	**Rwec**	**Description**
ST	SI1	SI	r	Binary Input point 1
	SI2	SI	r	Binary Input point 2
	SI3	SI	r	Binary Input point 3
	SI4	SI	r	Binary Input point 4
	SI5	SI	r	Binary Input point 5 (Note : not present in all bricks)
	SI6	SI	r	Binary Input point 6 (Note : not present in all bricks)
	SI7	SI	r	Binary Input point 7 (Note : not present in all bricks)
	SI8	SI	r	Binary Input point 8 (Note : not present in all bricks)
	SI9	SI	r	Binary Input point 9 (Note : not present in all bricks)
	SI10	SI	r	Binary Input point 10 (Note : not present in all bricks)
	SI11	SI	r	Binary Input point 11 (Note : not present in all bricks)
	SI12	SI	r	Binary Input point 12 (Note : not present in all bricks)
	SI13	SI	r	Binary Input point 13 (Note : not present in all bricks)
	SI14	SI	r	Binary Input point 14 (Note : not present in all bricks)
	SI15	SI	r	Binary Input point 15 (Note : not present in all bricks)
	SI16	SI	r	Binary Input point 16 (Note : not present in all bricks)
	SIG1	SIG	r	All Binary Inputs on card (bit0=SI1)
CF	Debounce	FLT32	rw	Input Debounce timer in seconds
DC	All ST	d	r	Description of ALL status included in this brick
RP	brcbST	BasRCB	rw	Status Report Control

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4.5.2 GIND1 to 7 – M571 and M572 only

GIND1 to 7 – M571 and M572				
FC	**Object Name**	**Class**	**Rwec**	**Description**
ST	SI1	SI	r	Binary Input point 1
	SI2	SI	r	Binary Input point 2
	SI3	SI	r	Binary Input point 3
	SI4	SI	r	Binary Input point 4
	SIG1	SIG	r	All Binary Inputs on card (bit0=SI1)
CF	Debounce	FLT32	rw	Input Debounce timer in seconds
DC	All ST	d	r	Description of ALL status included in this brick
RP	brcbST	BasRCB	rw	Status Report Control

4.6 GLOBE Objects

4.6.1 GLOBE

GLOBE is a Server or Logical Device level building block that is used to model attributes that are global to the Server or the Logical Device. The table in section 6.0 describes the Health bit properties returned by the M871 self-tests. Bit 0 of the self-test bits is the left-most bit in the Health bit-string. MaxFilPdu controls the maximum amount of file information transferred before non-file traffic can proceed. Smaller values of MaxFilPdu increase SCADA responsiveness at the expense of slightly slower MMS file transfers.

GLOBE				
FC	**Object Name**	**Class**	**rwec**	**Description**
ST	ModeDS	SIT	r	Device is: in test, off-line, available, or unhealthy
	LocRemDS	SIT	r	The mode of control, local or remote (DevST)
	Health	BSTR32	r	Device Health bits
	PctCpuLod	INT16	r	Percent processor capacity utilized (100=busy)
	DspSftRev	INT32U	r	Signal processor firmware revision number
	AuxIn1	BSTR16	r	Virtual Inputs 1-16 from GOOSE
	AuxIn2	BSTR16	r	Virtual Inputs 17-32 from GOOSE
	TimSet	TimeChange	r	Number of microseconds of error at most recent time sync
CO	RsServer	BO	rw[1]	Force server to execute cold restart
	AuxOut1	BOOL[16]	rw	Virtual Outputs 1-16 to GOOSE
	AuxOut2	BOOL[16]	rw	Virtual Outputs 17-32 to GOOSE
	RsGoose	BO	rw[2]	Write 1 to begin GOOSE RX reset. Clears after enrollment
CF	ClockTOD	BTIME6	rw	Global Date and Time
	Ether	Ether	r(w)	Ethernet information
	NomSysHz	FLT32	r	Nominal System Frequency
	MaxFilPdu	INT16U	rw	Maximum size of MMS file fragment size
DC	EqRtg	EqRtg	r	Equipment Rating
	ConCkt	ConCkt	rw	Connected Circuit
	All ST	d	r	Description of ALL included GLOBE status
	All CO	d	r	Description of ALL included GLOBE controls
RP	GOOSE	PACT	r	GOOSE Output Block

[1] Special write privilege required. Consult factory for details
[2] Writing to this point does not require write privilege

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4.7 MHAI Objects

The Harmonic Input brick provides measurements of individual harmonic magnitudes and angles for polyphase analog values.

4.7.1 MHAI1

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MHAI1				
FC	**Name**	**Class**	**rwec**	**Description**
MX	HaV	HIWYE~N	r	Magnitudes and Angles for Voltages A-N,B-N,C-N up to 63rd
	HaPPV	HIDELTA	r	Magnitudes and Angles for Voltages A-B,B-C,C-A up to 63rd
	HaA	HIWYE	r	Magnitudes and Angles for Currents A,B,C,N up to 63rd
DC	All MX	d	r	Description for all measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.7.2 MHAI2 – M571 and M871 Only

MHAI2 (Mx71)				
FC	**Name**	**Class**	**rwec**	**Description**
MX	HaV	HIWYE~N	r	Magnitudes and Angles for Voltages A-N,B-N,C-N up to 63rd
	HaPPV	HIDELTA	r	Magnitudes and Angles for Voltages A-B,B-C,C-A up to 63rd
DC	All MX	d	r	Description for all measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

4.7.3 MHAI2 – M572 and M872 Only

MHAI2 (Mx72)				
FC	**Name**	**Class**	**rwec**	**Description**
MX	HaV	HIWYE~N	r	Magnitudes and Angles for Voltages A-N,B-N,C-N up to 63rd
	HaPPV	HIDELTA	r	Magnitudes and Angles for Voltages A-B,B-C,C-A up to 63rd
	HaA	HIWYE~N	r	Magnitudes and Angles for Currents A,B,C up to 63rd harmonic
DC	All MX	d	r	Description for all measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.8 MMTR Objects

Polyphase Meter provides for acquiring of single phase or polyphase metering values pertaining to a field device or circuit. Note that objects of class ACCI always indicate in units of kilo-XX units (for example kilo-Watts). This is modeled by having read-only scale factors of 1000.0 for each these objects.

4.8.1 MMTR1

MMTR1				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	TotPosiWHr	AI	r	3-Phase Source-to-Load Watt-Hr accumulated
	TotNegWHr	AI	r	3-Phase Load-to-Source Watt-Hr accumulated
	TotLgVArHr	AI	r	3-Phase Lagging VAR-Hr accumulated
	TotLdVArHr	AI	r	3-Phase Leading VAR-Hr accumulated
	TotVAHr	AI	r	3-Phase VA-Hr accumulated
	AccTPkWHr	ACCI	r	3-Phase Total Source-to-Load kiloWatt-Hours
	AccTNkWHr	ACCI	r	3-Phase Total Load-to-Source kiloWatt-Hours
	AccTLgkVArHr	ACCI	r	3-Phase Total Lagging kiloVAR-Hours
	AccTLdkVArHr	ACCI	r	3-Phase Total Leading kiloVAR-Hours
	AccTkVAHr	ACCI	r	3-Phase Total Leading kiloVA-Hours
ST	PlsWHrP	BO	r	Pulse Output for Source-to-Load Watt-Hr
	PlsWHrN	BO	r	Pulse Output for Load-to-Source Watt-Hr
	PlsVArHrLg	BO	r	Pulse Output for Lagging VAR-Hr
	PlsVArHrLd	BO	r	Pulse Output for Leading VAR-Hr
CO	RsEnergy	BO	rw	Set ALL energy values to zero
CF	All AI MX	ACF	rw	Float-to-int scale factor for AI
	All ACCI MX	ACF	r	Scale factor for ACCI (quantity of Whr per count fixed at 1000)
	PlsQuan	FLT32	rw	Energy per pulse cycle in units of Watt-Hr (or VAR-HR)
DC	All MX	d	r	Description of ALL measurements included in this brick
	All ST	d	r	Description of ALL status included in this brick
	All CO	d	r	Description of ALL controls included in this brick

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4.8.2 MMTR2 – M572 and M872 only

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MMTR2 (Mx72 only)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	TotPosiWHr	AI	r	3-Phase Source-to-Load Watt-Hr accumulated
	TotNegWHr	AI	r	3-Phase Load-to-Source Watt-Hr accumulated
	TotLgVArHr	AI	r	3-Phase Lagging VAR-Hr accumulated
	TotLdVArHr	AI	r	3-Phase Leading VAR-Hr accumulated
	TotVAHr	AI	r	3-Phase VA-Hr accumulated
	AccTPkWHr	ACCI	r	3-Phase Total Source-to-Load kiloWatt-Hours
	AccTNkWHr	ACCI	r	3-Phase Total Load-to-Source kiloWatt-Hours
	AccTLgkVArHr	ACCI	r	3-Phase Total Lagging kiloVAR-Hours
	AccTLdkVArHr	ACCI	r	3-Phase Total Leading kiloVAR-Hours
	AccTkVAHr	ACCI	r	3-Phase Total Leading kiloVA-Hours
ST	PlsWHrP	BO	r	Pulse Output for Source-to-Load Watt-Hr
	PlsWHrN	BO	r	Pulse Output for Load-to-Source Watt-Hr
	PlsVArHrLg	BO	r	Pulse Output for Lagging VAR-Hr
	PlsVArHrLd	BO	r	Pulse Output for Leading VAR-Hr
CO	RsEnergy	BO	rw	Set ALL energy values to zero
CF	All AI MX	ACF	rw	Float-to-int scale factor for AI
	All ACCI MX	ACF	r	Scale factor for ACCI (quantity of Whr per count fixed at 1000)
	PlsQuan	FLT32	rw	Energy per pulse cycle in units of Watt-Hr (or VAR-HR)
DC	All MX	d	r	Description of ALL measurements included in this brick
	All ST	d	r	Description of ALL status included in this brick
	All CO	d	r	Description of ALL controls included in this brick

4.9 MMXU Objects

Polyphase Measurement Unit provides measurements of single phase or polyphase analog values (including neutral) pertaining to a wye or delta connected field device or circuit.

The addition of the prefix dmdprs, dmdmax, and dmdmin for a manufacturer extension to this brick, namely, present demand and maximum demand, minimum demand since reset.

4.9.1 MMXU1

MMXU1 (Bus 1)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA	r	Voltage AB, BC, CA
	A	WYE+R	r	Current in phases A, B, C, N, and R
	W	WYE~N	r	Watts in phases A, B, C
	TotW	AI	r	Total Watts in all 3 phases
	VAr	WYE~N	r	VARs in phases A, B, C
	TotVAr	AI	r	Total VARs in all 3 phases
	VA	WYE~N	r	VA in phases A, B, C
	TotVA	AI	r	Total VA in all 3 phases
	PF	WYE~N	r	Power Factor for phases A, B, C
	TotPF	AI	r	Overall Power Factor of 3 phases
	Ang	WYE~N	r	Angle between phase voltage and current
	Hz	AI	r	Power system frequency
	Z	WYE~N	r	Impedance A, B, C
	Res	WYE~N	r	Resistance A, B, C
	React	WYE~N	r	Reactance A, B, C
CO	RsDmdA	BO	rw	Reset ALL ampere demands
	RsDmdV	BO	rw	Reset ALL voltage demands
	RsDmdP	BO	rw	Reset ALL power demands
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
	DmdIntA	INT32U	rw	Demand integration time for amperes in seconds
	DmdIntV	INT32U	rw	Demand integration time for voltage in seconds
	DmdIntP	INT32U	rw	Demand integration time for power in seconds
DC	All MX	d	r	Description of ALL measurements included in this brick
	All CO	d	r	Description of ALL controls included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.9.2 MMXU2 – M571 and M871 only

MMXU2 (Bus 2 - Mx71)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA	r	Voltage AB, BC, CA
	Hz	AI	r	Power system frequency
CO	RsDmdV	BO	rw	Reset ALL voltage demands
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
	DmdIntV	INT32U	rw	Demand integration time for voltage in seconds
DC	All MX	d	r	Description of ALL measurements included in this brick
	All CO	d	r	Description of ALL controls included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.9.3 MMXU2 – M572 and M872 only

MMXU2 (Bus 2 - Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA	r	Voltage AB, BC, CA
	A	WYE+R	r	Current in phases A, B, C, N, and R
	W	WYE~N	r	Watts in phases A, B, C
	TotW	AI	r	Total Watts in all 3 phases
	VAr	WYE~N	r	VARs in phases A, B, C
	TotVAr	AI	r	Total VARs in all 3 phases
	VA	WYE~N	r	VA in phases A, B, C
	TotVA	AI	r	Total VA in all 3 phases
	PF	WYE~N	r	Power Factor for phases A, B, C
	TotPF	AI	r	Overall Power Factor of 3 phases
	Ang	WYE~N	r	Angle between phase voltage and current
	Hz	AI	r	Power system frequency
	Z	WYE~N	r	Impedance A, B, C
	Res	WYE~N	r	Resistance A, B, C
	React	WYE~N	r	Reactance A, B, C
CO	RsDmdA	BO	rw	Reset ALL ampere demands
	RsDmdV	BO	rw	Reset ALL voltage demands
	RsDmdP	BO	rw	Reset ALL power demands
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
	DmdIntA	INT32U	rw	Demand integration time for amperes in seconds
	DmdIntV	INT32U	rw	Demand integration time for voltage in seconds
	DmdIntP	INT32U	rw	Demand integration time for power in seconds
DC	All MX	d	r	Description of ALL measurements included in this brick
	All CO	d	r	Description of ALL controls included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.9.4 MMXU3 – M871 only

MMXU3 (Aux – M871)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	VAux1	AI	r	Aux 1 AC/DC input voltage
	VAux2	AI	r	Aux 2 AC/DC input voltage
	VAuxDiff	AI	r	Aux AC/DC differential input voltage
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

4.9.5 MMXU3 – M572 and M872 only

MMXU3 (Vref – Mx72 Dual Feeder)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	VRef1	AI	r	Reference Voltage 1
	Vref2	AI	r	Reference Voltage 2
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

4.9.6 dmdprsMMXU1

dmdprsMMXU1 (Bus 1)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA	r	Voltage AB, BC, CA
	A	WYE+R	r	Current in phases A, B, C, N, and R
	TotW	AI	r	Total Watts in all 3 phases.
	TotVAr	AI	r	Total VARs in all 3 phases.
	TotVA	AI	r	Total VA in all 3 phases.
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick

4.9.7 dmdprsMMXU2 –M571 and M871 only

dmdprsMMXU2 (Bus 2 – Mx71)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA	r	Voltage AB, BC, CA
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick

4.9.8 dmdprsMMXU2 – M572 and M872 only

dmdprsMMXU2 (Bus 2 – Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA	r	Voltage AB, BC, CA
	A	WYE+R	r	Current in phases A, B, C, N, and R
	TotW	AI	r	Total Watts in all 3 phases.
	TotVAr	AI	r	Total VARs in all 3 phases.
	TotVA	AI	r	Total VA in all 3 phases.
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick

4.9.9 dmdmaxMMXU1

dmdmaxMMXU1 (Bus 1)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE_MT	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA_MT	r	Voltage AB, BC, CA
	A	WYE+R_MT	r	Current in phases A, B, C, N, and R
	TotW	AI	r	Total Watts in all 3 phases.
	TotVAr	AI	r	Total VARs in all 3 phases.
	TotVA	AI	r	Total VA in all 3 phases.
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	D	r	Description of ALL measurements included in this brick

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4.9.10 dmdmaxMMXU2 – M571 and M871

dmdmaxMMXU2 (Bus 2 – Mx71)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE_MT	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA_MT	r	Voltage AB, BC, CA
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	D	r	Description of ALL measurements included in this brick

4.9.11 dmdmaxMMXU2 - M572 and M872

dmdmaxMMXU2 (Bus 2 – Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE_MT	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA_MT	r	Voltage AB, BC, CA
	A	WYE+R_M_T	r	Current in phases A, B, C, N, and R
	TotW	AI	r	Total Watts in all 3 phases.
	TotVAr	AI	r	Total VARs in all 3 phases.
	TotVA	AI	r	Total VA in all 3 phases.
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	D	r	Description of ALL measurements included in this brick

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4.9.12 dmdminMMXU1

dmdminMMXU1 (Bus 1)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE_MT	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA_MT	r	Voltage AB, BC, CA
	TotW	AI	r	Total Watts in all 3 phases
	TotVAr	AI	r	Total VARs in all 3 phases
	TotVA	AI	r	Total VA in all 3 phases
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	D	r	Description of ALL measurements included in this brick

4.9.13 dmdminMMXU1 – M571 and M871 only

dmdminMMXU2 (Bus 2 – Mx71)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE_MT	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA_MT	r	Voltage AB, BC, CA
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	D	r	Description of ALL measurements included in this brick

4.9.14 dmdminMMXU2 – M572 and M872 only

Minimum Demand Polyphase Measurement Unit provides for measurement of single phase or polyphase analog values (including neutral) pertaining to a wye or delta connected field device or circuit.

dmdminMMXU2 (Bus 2 – Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	V	WYE_MT	r	Voltage on A-N, B-N, C-N, Neutral-Ground
	PPV	DELTA_MT	r	Voltage AB, BC, CA
	TotW	AI	r	Total Watts in all 3 phases
	TotVAr	AI	r	Total VARs in all 3 phases
	TotVA	AI	r	Total VA in all 3 phases
CF	All MX	ACF	rw	Configuration of ALL measurements included in this brick
DC	All MX	D	r	Description of ALL measurements included in this brick

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4.10 MSQI Objects

MSQI provides for measurement of polyphase analog values representing sequence components

4.10.1 MSQI1

MSQI1				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	SeqA	Seq	r	Positive, Negative, and Zero sequence current
	SeqV	Seq	r	Positive, Negative, and Zero sequence voltage
CF	All AI MX	SEQCF	rw	Configuration of ALL measurements in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.10.2 MSQI2 – M571 and M871 Only

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MSQI2				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	SeqV	Seq	r	Positive, Negative, and Zero sequence voltage
CF	All AI MX	SEQCF	rw	Configuration of ALL measurements in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.10.3 MSQI2 – M572 and M872 Only

MSQI2 (Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	SeqA	Seq	r	Positive, Negative, and Zero sequence current
	SeqV	Seq	r	Positive, Negative, and Zero sequence voltage
CF	All AI MX	SEQCF	rw	Configuration of ALL measurements in this brick
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

4.11 RATO Objects

Contains Primary and secondary winding ratios for measurements.

4.11.1 RATO1

RATO1 (Bus 1)				
FC	**Object Name**	**Class**	**rwec**	**Description**
CO	RsScaling	BO	rw	Reset all scale factors using VT/CT ratios
CF	APhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	BPhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	CPhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	NeutVRat	RATIO	rw	Primary/Secondary VT Neutral-to-ground winding ratio
	APhsARat	RATIO	rw	Primary/Secondary CT Phase winding ratio
	BPhsARat	RATIO	rw	Primary/Secondary CT Phase winding ratio
	CPhsARat	RATIO	rw	Primary/Secondary CT Phase winding ratio
	NeutARat	RATIO	rw	Primary/Secondary CT Phase winding ratio
	InvSeq	BOOL	rw	TRUE if phase rotation sequence is CBA (FALSE for ABC)
DC	All CO	d	r	Description of ALL included RATO controls

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4.11.2 RATO2 – M571 and M871 only

RATO2 (Bus 2 – Mx71)				
FC	**Object Name**	**Class**	**rwec**	**Description**
CO	RsScaling	BO	rw	Reset all scale factors using VT ratios
CF	APhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	BPhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	CPhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	NeutVRat	RATIO	rw	Primary/Secondary VT Neutral-to-ground winding ratio
	InvSeq	BOOL	rw	TRUE if phase rotation sequence is CBA (FALSE for ABC)
DC	All CO	d	r	Description of ALL included RATO controls

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4.11.3 RATO2 – M572 and M872 only

RATO2 (Bus 2 – Mx72)				
FC	**Object Name**	**Class**	**rwec**	**Description**
CO	RsScaling	BO	rw	Reset all scale factors using VT/CT ratios
CF	APhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	BPhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	CPhsVRat	RATIO	rw	Primary/Secondary VT Phase-to-Neutral winding ratio
	NeutVRat	RATIO	rw	Primary/Secondary VT Neutral-to-ground winding ratio
	APhsARat	RATIO	rw	Primary/Secondary CT Phase winding ratio
	BPhsARat	RATIO	rw	Primary/Secondary CT Phase winding ratio
	CPhsARat	RATIO	rw	Primary/Secondary CT Phase winding ratio
	InvSeq	BOOL	rw	TRUE if phase rotation sequence is CBA (FALSE for ABC)
DC	All CO	d	r	Description of ALL included RATO controls

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4.11.4 RATO3 –M871 only

.

RATO3 (Aux Voltage Inputs – M871)				
FC	**Object Name**	**Class**	**rwec**	**Description**
CO	RsScaling	BO	rw	Reset all scale factors using VT ratios
CF	VAux1Rat	RATIO	rw	Primary/Secondary VT Aux1 winding ratio
	VAux2Rat	RATIO	rw	Primary/Secondary VT Aux2 winding ratio
	VAuxDRat	RATIO	rw	Primary/Secondary VT Aux differential winding ratio
DC	All CO	d	r	Description of ALL included RATO controls

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4.11.5 RATO3 – M572 and M872 only

RATO3 (Ref Voltage Inputs – Mx72 Dual Feeder)				
FC	**Object Name**	**Class**	**rwec**	**Description**
CO	RsScaling	BO	rw	Reset all scale factors using VT ratios
CF	VAux1Rat	RATIO	rw	Primary/Secondary VT Aux1 winding ratio
	VAux2Rat	RATIO	rw	Primary/Secondary VT Aux2 winding ratio
	VAuxDRat	RATIO	rw	Primary/Secondary VT Aux differential winding ratio
DC	All CO	d	r	Description of ALL included RATO controls

4.12 RDRE Objects

The Disturbance Recorder contains status, control, and configuration information used to capture periodic measurements.

4.12.1 RDRE1

RDRE1				
FC	**Object Name**	**Class**	**rwec**	**Description**
ST	RcdMade	BO	rw[1]	TRUE if recording started and completed
	FltNum	INT16U	r	Most recent recording identifier (Comtrade file suffix)
	RcdStr	BO	rw[1]	TRUE if recording started (but not necessarily completed)
	MemUsed	INT16U	r	Percent of allocated recording space used
	FullSt	BO	r	TRUE if MemUsed exceeeds CF.MemFull
SP	PreTmms	INT32U	r	Pre-trigger time in milliseconds
	PstTmms	INT32U	r	Post-trigger time in milliseconds
	OpMod	ENUM8	r	Buffer usage upon full: 1=overwrite oldest , 2=stop recording
CO	RcdTrg	BO	rw[2]	1=initiate recording immediately (self-clears)
CF	MemFull	INT8U	r	Percent of memory used as threshhold in FullSt determination
DC	All ST	d	r	Description of ALL status included in this brick
	All SP	d	r	Description of ALL setpoints included in this brick
	All CO	d	r	Description of ALL controls included in this brick
	All CF	d	r	Description of ALL configurations included in this brick
RP	brcbST	BasRCB	rw	Status Report Control

[1] Writing FALSE clears this indication. Writing TRUE is disallowed
[2] Writing to this point does not require write privilege

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4.12.2 RDRE2

RDRE2				
FC	**Object Name**	**Class**	**rwec**	**Description**
ST	RcdMade	BO	rw[1]	TRUE if recording started and completed
	FltNum	INT16U	r	Most recent recording identifier (Comtrade file suffix)
	RcdStr	BO	rw[1]	TRUE if recording started (but not necessarily completed)
	MemUsed	INT16U	r	Percent of allocated recording space used
	FullSt	BO	r	TRUE if MemUsed exceeeds CF.MemFull
SP	PreTmms	INT32U	r	Pre-trigger time in milliseconds
	PstTmms	INT32U	r	Post-trigger time in milliseconds
	OpMod	ENUM8	r	Buffer usage upon full: 1=overwrite oldest , 2=stop recording
CO	RcdTrg	BO	rw[2]	1=initiate recording immediately (self-clears)
CF	MemFull	INT8U	r	Percent of memory used as threshhold in FullSt determination
DC	All ST	d	r	Description of ALL status included in this brick
	All SP	d	r	Description of ALL setpoints included in this brick
	All CO	d	r	Description of ALL controls included in this brick
	All CF	d	r	Description of ALL configurations included in this brick
RP	brcbST	BasRCB	rw	Status Report Control

[1] Writing FALSE clears this indication. Writing TRUE is disallowed
[2] Writing to this point does not require write privilege

4.13 RSYN Objects

RSYN compares various voltages to ascertain the degree to which they are synchronized with each other. A typical use is supervision of breakers, switches, and reclosers. One RSYN brick exists for each phase. RSYN1, RSYN4 for Phase A, RSYN2, RSYN5 for Phase B, and RSYN3, RSYN6 for Phase C. RunV is V1 (Bus 1), InV is V2 (Bus 2) or Vref1 or Vref2

4.13.1 RSYN1

.

RSYN1 (PHASE A)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	Hz	AI	r	Frequency of RunV (V1)
	RunV	AI	r	The reference V for synchronism check logic
	InV	AI	r	V compared with RunV by the sync check logic
	AngDiff	AI	r	Diff in Phs Ang between the RunV and the InV
	SyncHz	AI	r	Diff Freq between RunV and InV
	InVHz	AI	r	Frequency of InV (V2)
CF	All MX	ACF	rw	ALL included RSYN.MX
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.13.2 RSYN2

RSYN2 (PHASE B)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	Hz	AI	r	Frequency of RunV (V1)
	RunV	AI	r	The reference V for synchronism check logic
	InV	AI	r	V compared with RunV by the sync check logic
	AngDiff	AI	r	Diff in Phs Ang between the RunV and the InV
	SyncHz	AI	r	Diff Freq between RunV and InV
	InVHz	AI	r	Frequency of InV (V2)
CF	All MX	ACF	rw	ALL included RSYN.MX
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.13.3 RSYN3

RSYN3 (PHASE C)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	Hz	AI	r	Frequency of RunV (V1)
	RunV	AI	r	The reference V for synchronism check logic
	InV	AI	r	V compared with RunV by the sync check logic
	AngDiff	AI	r	Diff in Phs Ang between the RunV and the InV
	SyncHz	AI	r	Diff Freq between RunV and InV
	InVHz	AI	r	Frequency of InV (V2)
CF	All MX	ACF	rw	ALL included RSYN.MX
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.13.4 RSYN4 – M572 and M872 only

RSYN4 (PHASE A, Mx72 Dual Feeder)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	Hz	AI	r	Frequency of RunV (V1)
	RunV	AI	r	The reference V for synchronism check logic
	InV	AI	r	V compared with RunV by the sync check logic
	AngDiff	AI	r	Diff in Phs Ang between the RunV and the InV
	SyncHz	AI	r	Diff Freq between RunV and InV
	InVHz	AI	r	Frequency of InV (V2)
CF	All MX	ACF	rw	ALL included RSYN.MX
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

4.13.5 RSYN5 – M572 and M872 only

RSYN5 (PHASE B, Mx72 Dual Feeder)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	Hz	AI	r	Frequency of RunV (V1)
	RunV	AI	r	The reference V for synchronism check logic
	InV	AI	r	V compared with RunV by the sync check logic
	AngDiff	AI	r	Diff in Phs Ang between the RunV and the InV
	SyncHz	AI	r	Diff Freq between RunV and InV
	InVHz	AI	r	Frequency of InV (V2)
CF	All MX	ACF	rw	ALL included RSYN.MX
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

4.13.6 RSYN6 – M572 and M872 only

RSYN6 (PHASE C, Mx72 Dual Feeder)				
FC	**Object Name**	**Class**	**rwec**	**Description**
MX	Hz	AI	r	Frequency of RunV (V1)
	RunV	AI	r	The reference V for synchronism check logic
	InV	AI	r	V compared with RunV by the sync check logic
	AngDiff	AI	r	Diff in Phs Ang between the RunV and the InV
	SyncHz	AI	r	Diff Freq between RunV and InV
	InVHz	AI	r	Frequency of InV (V2)
CF	All MX	ACF	rw	ALL included RSYN.MX
DC	All MX	d	r	Description of ALL measurements included in this brick
RP	brcbMX	BasRCB	rw	Measurement Report Control

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4.14 RWRE Objects

The Waveform Recorder contains status, control, and configuration information used to capture sub-cycle waveform samples.

4.14.1 RWRE1

RWRE1				
FC	**Object Name**	**Class**	**rwec**	**Description**
ST	RcdMade	BO	rw[1]	TRUE if recording started and completed
	FltNum	INT16U	r	Most recent recording identifier
	RcdStr	BO	rw[1]	TRUE if recording started (but not necessarily completed)
	MemUsed	INT8U	r	Percent of allocated recording space used
	FullSt	BO	r	TRUE if MemUsed exceeeds CF.MemFull
SP	PreTmms	INT32U	r	Pre-trigger time in milliseconds
	PstTmms	INT32U	r	Post-trigger time in milliseconds
	OpMod	ENUM8	r	Buffer usage upon full: 1=overwrite oldest , 2=stop recording
CO	RcdTrg	BO	rw[2]	1=initiate recording immediately (self-clears)
CF	MemFull	INT8U	r	Percent of memory used as threshold in FullSt determination
DC	All ST	d	r	Description of ALL status included in this brick
	All SP	d	r	Description of ALL setpoints included in this brick
	All CO	d	r	Description of ALL controls included in this brick
	All CF	d	r	Description of ALL configurations included in this brick
RP	brcbST	BasRCB	rw	Status Report Control

[1] Writing FALSE clears this indication. Writing TRUE is disallowed. Writing to this control does not require write privilege.
[2] Writing to this point does not require write privilege.

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4.14.2 RWRE2

RWRE2				
FC	Object Name	Class	rwec	Description
ST	RcdMade	BO	rw[1]	TRUE if recording started and completed
	FltNum	INT16U	r	Most recent recording identifier
	RcdStr	BO	rw[1]	TRUE if recording started (but not necessarily completed)
	MemUsed	INT8U	r	Percent of allocated recording space used
	FullSt	BO	r	TRUE if MemUsed exceeeds CF.MemFull
SP	PreTmms	INT32U	r	Pre-trigger time in milliseconds
	PstTmms	INT32U	r	Post-trigger time in milliseconds
	OpMod	ENUM8	r	Buffer usage upon full: 1=overwrite oldest , 2=stop recording
CO	RcdTrg	BO	rw[2]	1=initiate recording immediately (self-clears)
CF	MemFull	INT8U	r	Percent of memory used as threshold in FullSt determination
DC	All ST	d	r	Description of ALL status included in this brick
	All SP	d	r	Description of ALL setpoints included in this brick
	All CO	d	r	Description of ALL controls included in this brick
	All CF	d	r	Description of ALL configurations included in this brick
RP	brcbST	BasRCB	rw	Status Report Control

[1] Writing FALSE clears this indication. Writing TRUE is disallowed. Writing to this control does not require write privilege.
[2] Writing to this point does not require write privilege.

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5.0 UCA 2.0 Object Class Reference

5.1 ACCI Class

Accumulator Input represents an unsigned input parameter that always increases unless it rolls over to zero. Unlike Analog Input, the full range of an Accumulator Input is always used; "r" is the running value of the accumulator.

Common Class: ACCI Accumulator Input		
Name	Type	rwec
r	INT32U	r
q	BSTR16	r

5.2 ACF Class

Analog Configuration represents the configuration parameters for Analog Inputs and Outputs.

Common Class: ACF Analog Configuration		
Name	Type	rwec
s	FLT32	rw

5.3 AI Class – Analog Input

Analog Input represents a continuous input parameter that varies with time. Analog Input is used to model values involved in object interaction within IEDs, or among field devices. Note that the default is RMS values for AC quantities.

Common Class: AI Analog Input		
Name	Type	rwec
i	INT16S	r
f	FLT32	r
q	BSTR16	r
t	BTIME6	r

5.4 AISP Class

Analog Input Set Points represents a collection of low and high operating limits applicable to an individual MX point. The limits can be used to trigger other actions such as waveform recording. Setting either the integer or floating-point version of a value causes the other version to be set to the corresponding value. These conversions between floating point and integer use the same scale factors as the underlying value. Elements ll/llf set the lower limit threshold and hl/hlf the high limit thresholds.

Common Class: AISP Analog Input SP		
Name	Type	rwec
hl	INT16S	rw
ll	INT16S	rw
hlf	FLT32	rw
llf	FLT32	rw

5.5 BO Class

There are three forms of Binary Control: momentary, pulsed and latched. Note that many binary output values automatically reset themselves to "FALSE" when operation is done.

Common Class: BO Binary Output		
Name	Type	rwec
b1	BSTR1	rw

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5.6 BOSBO Class

Binary Output SBO represents a control for a physical output point with select-before-operate capability. If configured for SBO operation, the point must be selected by reading the SBO component. The server indicates selection by returning the name of the point. Operation by writing to the point is then allowed. If the point is configured not to require SBO, the operation may be initiated without prior selection

Common Class: BO Binary Output		
Name	Type	rwec
b1	BSTR1	rw
SBO	VSTR65	r

5.7 CCF Class

Control Configuration represents the configuration for the Binary Outputs. OnDur defines the amount of time in milliseconds, during which the output will remain in the operating (“one”) state after issuance of the control. OffDur indicates the time during which the output will remain off after issuance of the “off” command (i.e. after a zero is written to the control).

Common Class: CCF Control Configuration		
Name	Type	rwec
OnDur	IN32U	rw
OffDur	INT32U	rw

5.8 ConCkt Class

Connected Circuit identifies the circuit to which the field equipment is connected.

Common Class : ConCkt Connected Circuit		
Name	Type	rwec
CktID	VSTR32	rw
CktPhs	ENUM8	rw

5.9 d Class

Description is a text string that represents the description parameters for MX, ST, SP and CO components.

Common Class: d Description		
Name	Type	rwec
d	VSTR32	r

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5.10 DELTA Class

Delta is a collection of measurements of continuous, time-varying input parameters that represent a Delta connected electric circuit. Delta is used to model values involved in object interaction within IEDs, or among field devices. Note that the default is RMS for AC quantities.

Common Class: DELTA Delta		
Name	Type	rwec
PhsABi	INT16S	r
PhsABf	FLT32	r
PhsBCi	INT16S	r
PhsBCf	FLT32	r
PhsCAi	INT16S	r
PhsCAf	FLT32	r
q	BSTR16	r
t	BTIME6	r

5.11 DELTA_MT Class

Delta with multiple timestamps is used to model phase-to-phase measurements with individual timestamps. The most common usage is to store the individual phase minimum and maximum times. The class includes the traditional "t" component from DELTA class, which contains a copy of the AB phase timestamp. Inclusion of the "t" component enhances interoperability.

Common Class: DELTA_MT Delta		
Name	Type	rwec
PhsABi	INT16S	r
PhsABf	FLT32	r
PhsBCi	INT16S	r
PhsBCf	FLT32	r
PhsCAi	INT16S	r
PhsCAf	FLT32	r
q	BSTR16	r
t	BTIME6	r
PhsABt	BTIME6	r
PhsBCt	BTIME6	r
PhsCAt	BTIME6	r

5.12 EqRtg Class

Equipment Rating identifies the rating of the field equipment represented.

Common Class: EqRtg Equipment Rating		
Name	Type	rwec
VTPhs	ENUM8	r
CTPhs	ENUM8	r

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5.13 Ether Class

Ethernet Configuration represents the state of the communication interface. FrameRx indicates the total number of incoming data packets addressed to this device. It includes all broadcast and accepted multicast packets. FrameTx indicates the total number of frames sent by this device. CommSt indicates an encoded link state of the interface. Duplex allows selection of the half/full-duplex parameter when the server is not able to identify the duplex capabilities of the end device. If bit 0 (the leftmost bit) is TRUE (1), full-duplex will be used when a 10 Mb link cannot determine the duplex parameters. If bit 1 (the rightmost bit) is TRUE (1), full-duplex will be used when a 100 Mb link cannot determine the duplex parameters. The array Stats contains various statistics captures by the software driver. Stats[0] contains the number of receive statistics and Stats[1] the number of transmit statistics. The most useful receive statistics are Stats[2]=Octets received, Stats[3]=Frames received, Stats[5]=Multicast frames count, Stats[7]=Broadcast frames count, and Stats[8..14] which indicate errors. The most useful Transmit statistics are Stats[Stats[1]+0]=octets transmitted, Stats[Stats[1]+1]=frames transmitted, Stats[Stats[1]+2]=number of frames deferred due to other network traffic, Stats[Stats[1]+4]=frames encountering one collision, Stats[Stats[1]+5]=frames encountering between 1 and 16 collisions, and transmit Stats at offset 3 and 6 and 7 and 8 (transmit errors). RsStats is used to reset all statistic counters to zero.

Common Class: Ether Ethernet Configuration		
Name	**Type**	**rwec**
FrameRx	INT32U	r
FrameTx	INT32U	r
CommSt	INT32U	r
Duplex	BSTR2	rw
Stats	INT32U[24]	r
RsStats	BOOL	rw

5.14 HIDELTA Class

Harmonic Delta represents the harmonic content of phase-to-phase quantities. Both magnitudes and phase angles are represented as arrays of floating point quantities. The first index (index=0) of each array represents the DC component and index=N represents the component at $FREQ = N * f$, where "f" is the fundamental frequency.

Common Class: HIDELTA Harmonic DELTA		
Name	**Type**	**rwec**
HaMagAB	FLT32[64]	r
HaAngAB	FLT32[64]	r
HaMagBC	FLT32[64]	r
HaAngBC	FLT32[64]	r
HaMagCA	FLT32[64]	r
HaAngCA	FLT32[64]	r
q	BSTR16	r
t	BTIME6	r

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5.15 HIWYE Class

Harmonic Wye represents the harmonic content of phase-to-neutral and neutral-to-ground quantities. Both magnitudes and phase angles are represented as arrays of floating point quantities. The first index (index=0) of each array represents the DC component and index=N represents the component at $FREQ = N * f$, where "f" is the fundamental frequency.

Common Class: HIWYE Harmonic WYE		
Name	**Type**	**rwec**
HaMagA	FLT32[64]	r
HaAngA	FLT32[64]	r
HaMagB	FLT32[64]	r
HaAngB	FLT32[64]	r
HaMagC	FLT32[64]	r
HaAngC	FLT32[64]	r
HaMagN	FLT32[64]	r
HaAngN	FLT32[64]	r
q	BSTR16	r
t	BTIME6	r

5.16 HIWYE~N Class

Harmonic Wye without Neutral represents the harmonic content of phase-to-neutral quantities. Both magnitudes and phase angles are represented as arrays of floating point quantities. the first index (index=0) of each array represents the DC component and index=N represents the component at $FREQ = N * f$, where "f" is the fundamental frequency.

Common Class: HIWYE~N Harmonic WYE without Neutral		
Name	**Type**	**rwec**
HaMagA	FLT32[64]	r
HaAngA	FLT32[64]	r
HaMagB	FLT32[64]	r
HaAngB	FLT32[64]	r
HaMagC	FLT32[64]	r
HaAngC	FLT32[64]	r
q	BSTR16	r
t	BTIME6	r

5.17 RATO Class

Ratio Configuration represents the ratio between primary and secondary windings for the referenced measurements. Ratiof is the external instrument ratio (commonly called the CT or VT ratio). Refer to the User Manual for information on reversing the phase of inputs, or substituting for missing inputs. MagCorr is the small correction factor applied to the magnitude of the input signal and is usually within a few percent of unity. For example, a MagCorr of 1.01 would increase the effective ratio by 1%. AngCorr is the small phase correction applied to the input signal (in degrees) and is typically near zero degrees.

Common Class: RATIO Ratio Configuration		
Name	**Type**	**rwec**
Ratiof	FLT32	rw
MagCorr	FLT32	rw
AngCorr	FLT32	rw

5.18 SACF Class

Sequence analog Configuration allows for setting of the float-to-integer scale factors for sequence component information. Attribute "s" scales the magnitude quantities and attribute "Angs" scales the angle quantities.

Common Class: SACF Sequence Configuration		
Name	Type	rwec
s	FLT32	rw
Angs	FLT32	rw

5.19 SBOCF Class

SBO Configuration represents the configuration parameters for select-before-operate. State represents the selection state of the point. "TRUE" indicates that the point is selected. SelTimOut is the time (in seconds), during which the point will remain selected after the CO.SBO object is read. SBOClass controls whether the point will become de-selected after an operation (1=de-select after operation, 2=leave point selected after an operation). SBOEna controls whether a selection is required prior to an operate. A FALSE indicates that no prior selection is required, a TRUE indicates that operations will fail unless a prior selection is made. A selection can be aborted via the de-selection operation; this involves writing a FALSE to the State object. If this client had not executed a valid prior select, the write operation would fail.

Common Class: SBOCF Select-before-operate Configuration		
Name	Type	rwec
State	BOOL	rw*
SelTimOut	INT8U	rw
SBOClasss	ENUM8	rw
SBOEna	BOOL	rw
* State can only be written with FALSE to de-select the SBO point. Selection is accomplished by reading the SBO component of the control.		

5.20 SEQ Class

Sequence represents a collection of symmetrical components for a three phase system. Magnitudes and angles are included in this class.

Common Class: SEQ Sequence		
Name	Type	rwec
Posii	INT16S	r
Posif	FLT32	r
Negi	INT16S	r
Negf	FLT32	r
Zeroi	INT16S	r
Zerof	FLT32	r
q	BSTR16	r
t	BTIME6	r
PosiAngi	INT16S	r
PosiAngf	FLT32	r
NegAngi	INT16S	r
NegAngf	FLT32	r
ZeroAngi	INT16S	r
ZeroAngf	FLT32	r

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5.21 SI Class

Status Input Single Bit represents the single bit state of "inputs". These "inputs" can be real inputs or binary output status values.

Common Class: SI Status Input Single Bit		
Name	Type	rwec
b1	BSTR1	r
q	BSTR16	r
t	BTIME6	r

5.22 SIG Class

Status Input Group represents a group of two or more bit states of inputs.

Common Class: SIG Status Input Group		
Name	Type	rwec
b16	BSTR16	r
q	BSTR16	r
t	BTIME6	r

5.23 SIT Class

Status Input Double Bit represents the two bit states of inputs. Common use of SIT is defined by the common component DevST.

Common Class: SIT Status Input Double Bit		
Name	Type	rwec
b2	BSTR2	r
q	BSTR16	r
t	BTIME6	r

5.24 VndID Class

Vendor Identity describes the components associated with the vendor or manufacturer of the device. BiosRev indicates the version number of the main processor board boot firmware. SftOpt indicates the licensed software capabilities of the hardware unit.

Common Class: VndID Vendor Identity		
Name	Type	rwec
Vnd	VSTR32	r
Mdl	VSTR32	r
DevMdls	VSTR128	r
SerNum	VSTR32	r
HwRev	VSTR8	r
SftRev	VSTR8	r
BiosRev	VSTR5	r
SftOpt	VSTR8	r
ProRev	VSTR8	r
DspId	VSTR5	r
CtVtId	VSTR5	r

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5.25 WYE Class

WYE is a collection of measurements of continuous time-varying input parameters that represent a wye connected electric circuit. WYE is used to model values involved in object interaction within IEDs, or among field devices. Note that the default is RMS for AC quantities

Common Class: WYE Wye		
Name	Type	rwec
PhsAi	INT16S	r
PhsAf	FLT32	r
PhsBi	INT16S	r
PhsBf	FLT32	r
PhsCi	INT16S	r
PhsCf	FLT32	r
Neuti	INT16S	r
Neutf	FLT32	r
q	BSTR16	r
t	BTIME6	r

5.26 WYE+R Class

Wye with Residual is a collection of measurements of continuous time-varying input parameters that represent a wye connected electric circuit and includes measurements of residuals (instantaneous sums of phases A, B, and C). WYE+R is used to model values involved in object interaction within IEDs, or among field devices. Note that the default is RMS for AC quantities. Note that WYE+R is NOT a new class but is simply class WYE with new components added.

Common Class: WYE+R Wye with Residual		
Name	Type	rwec
PhsAi	INT16S	r
PhsAf	FLT32	r
PhsBi	INT16S	r
PhsBf	FLT32	r
PhsCi	INT16S	r
PhsCf	FLT32	r
Neuti	INT16S	r
Neutf	FLT32	r
q	BSTR16	r
t	BTIME6	r
PhsRi	INT16S	r
PhsRf	FLT32	r

5.27 WYE~N Class

Wye without Neutral is a collection of measurements of continuous time-varying input parameters that represent a wye connected electric circuit which do not require a fourth (neutral) measurement. WYE~N is used to model values involved in object interaction within IEDs, or among field devices. Note that the default is RMS for AC quantities. Note that WYE~N is NOT a new class but is simply class WYE with some optional components removed.

Common Class: WYE~N Wye without neutral measurment		
Name	Type	rwec
PhsAi	INT16S	r
PhsAf	FLT32	r
PhsBi	INT16S	r
PhsBf	FLT32	r
PhsCi	INT16S	r
PhsCf	FLT32	r
q	BSTR16	r
t	BTIME6	r

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5.28 WYE~N+R Class

Wye without Neutral is a collection of measurements of continuous time-varying input parameters that represent a wye connected electric circuit which do not require a fourth (neutral) measurement but does include measurements of residuals (instantaneous sums of phases A, B, and C). WYE~N+R is used to model values involved in object interaction within IEDs, or among field devices. Note that the default is RMS for AC quantities. Note that WYE~N+R is NOT a new class but is simply class WYE with some optional components removed and some new components added

Common Class: WYE~N+R Wye without neutral with Residual		
Name	**Type**	**rwec**
PhsAi	INT16S	r
PhsAf	FLT32	r
PhsBi	INT16S	r
PhsBf	FLT32	r
PhsCi	INT16S	r
PhsCf	FLT32	r
q	BSTR16	r
t	BTIME6	r
PhsRi	INT16S	r
PhsRf	FLT32	r

5.29 WYE+R~QT Class

Wye with residual but without quality/time represents the configuration parameters for three-phase parameters including residual. Note that this is NOT a new class but is simply class WYE with some optional components removed and some components added.

Common Class: WYE+R~QT WYE with residual but without quality/time		
Name	**Type**	**rwec**
PhsAi	INT16S	rw
PhsAf	FLT32	rw
PhsBi	INT16S	rw
PhsBf	FLT32	rw
PhsCi	INT16S	rw
PhsCf	FLT32	rw
Neuti	INT16S	rw
Neutf	FLT32	rw
PhsRi	INT16S	rw
PhsRf	FLT32	rw

5.30 WYE_MT Class

Wye with multiple timestamps is used to model WYE values with individual phase timestamps. The most common usage is to store the individual phase minimum and maximum times. The class includes the traditional "t" component from WYE which contains a copy of the A phase timestamp. Inclusion of the "t" component enhances interoperability.

Common Class: WYE_MT WYE with multiple timestamps		
Name	**Type**	**rwec**
PhsAi	INT16S	r
PhsAf	FLT32	r
PhsBi	INT16S	r
PhsBf	FLT32	r
PhsCi	INT16S	r
PhsCf	FLT32	r
Neuti	INT16S	r
Neutf	FLT32	r
q	BSTR16	r
t	BTIME6	r
PhsAt	BTIME6	r
PhsBt	BTIME6	r
PhsCt	BTIME6	r

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5.31 WYE+R_MT Class

Wye with residual and multiple timestamps is used to model WYE values with an added residual component and individual timestamps for all 5 phases. The most common use is to store the individual phase minimum and maximum times. The class includes the traditional "t" component from WYE which contains a copy of the A phase timestamp. Inclusion of the "t" component enhances interoperability.

Common Class: WYE+R_MT WYE with residual and multiple timestamps		
Name	**Type**	**rwec**
PhsAi	INT16S	r
PhsAf	FLT32	r
PhsBi	INT16S	r
PhsBf	FLT32	r
PhsCi	INT16S	r
PhsCf	FLT32	r
Neuti	INT16S	r
Neutf	FLT32	r
q	BSTR16	r
t	BTIME6	r
PhsRi	INT16S	r
PhsRf	FLT32	r
PhsAt	BTIME6	r
PhsBt	BTIME6	r
PhsCt	BTIME6	r
Neutt	BTIME6	r
PhsRt	BTIME6	r

5.32 WYE~N_MT Class

Wye without neutral with multiple timestamps is used to model WYE values without a neutral component but with individual phase timestamps. The most common usage is to store the individual phase minimum and maximum times. The class includes the traditional "t" component from WYE which contains a copy of the A phase timestamp. Inclusion of the "t" component enhances interoperability.

Common Class: WYE~N_MT WYE with multiple timestamps		
Name	**Type**	**rwec**
PhsAi	INT16S	r
PhsAf	FLT32	r
PhsBi	INT16S	r
PhsBf	FLT32	r
PhsCi	INT16S	r
PhsCf	FLT32	r
q	BSTR16	r
t	BTIME6	r
PhsAt	BTIME6	r
PhsBt	BTIME6	r
PhsCt	BTIME6	r

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5.33 WYE~N+R_MT Class

Wye without neutral with residual with multiple timestamps is used to model WYE values without a neutral component but with an added residual component and with individual phase timestamps. The most common usage is to store the individual phase minimum and maximum times. The class includes the traditional "t" component from WYE which contains a copy of the A phase timestamp. Inclusion of the "t" component enhances interoperability.

Common Class: WYE~N+R_MT WYE with multiple timestamps		
Name	Type	rwec
PhsAi	INT16S	r
PhsAf	FLT32	r
PhsBi	INT16S	r
PhsBf	FLT32	r
PhsCi	INT16S	r
PhsCf	FLT32	r
PhsRi	INT16S	r
PhsRf	FLT32	r
q	BSTR16	r
t	BTIME6	r
PhsAt	BTIME6	r
PhsBt	BTIME6	r
PhsCt	BTIME6	r

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6.0 UCA 2.0 Common Component Reference

6.1 (q) Component

Quality is used to indicate if an object value is valid, and if not, the reason for being invalid. Each Quality indication is represented as a bit within the Quality component. Note that bit 0 is the first (leftmost) bit in the bit string.

Common Component: q Description		
Name	Type	rwec
q	BSTR16	r

Definition of Quality Bits			
Bit Number	Quality	Status	Definition
0	Reserved	No	
1	Invalid	Yes	If set (1), the reported value of this point may not be correct.
2	Comm Fail	No	
3	Forced	No	
4	Over Range	No	
5	Bad Reference	Yes	If set (1), this bit indicates that the value may be inaccurate. For example, if the volts or amps are near zero, the Power-Factor measurement becomes noisy (inaccurate).
6-15	Unassigned (future)	No	

6.2 TimeChange Component

Time change is used to indicate a signed value in microseconds and a timestamp indicating when the value was most recently created

Common Component: TimeChange Description		
Name	Type	rwec
Usec	INT32S	r
t	BTIME6	r

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Revision	Date	Changes	By
A	01/30/2009	Update Bitronics Name, Logo	E. DeMicco
B	05/01/09	Updated logos and cover page	MarCom
C	9/22/09	Updated note regarding firmware revision	E. DeMicco

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