DTS BACnet MSTP Map
Version 3.2U

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7334 S. Alton Way, Suite 14M, Centennial CO 80112
Tel: 877 PQ-SOLNS (777-6567) Fax: 425-799-4780
e-mail: info@measurlogic.com
web: www.measurlogic.com

1 SCOPE

1.1 IDENTIFICATION

This is a universal document that describes the BACnet MSTP Communications Object specification for the Measurlogic family of AC energy sub-meters and transducers. Features are model dependent.

This document applies to models **DTS 305, DTS 307, DTS 310, DTS SMX, DTS SKT**.

ATTENTION
Meter capabilities are model dependant. Some objects may not be applicable to certain meter models, or certain wiring topologies.

1.2 INTRODUCTION

The DTS family of meters is a range of compact DIN-rail, panel, weatherproof or socket mounted energy meters and transducers, with communications and I/O capability. Models are available for single-phase, 3-Phase 2 or 4-Quadrant, and DC measurement applications. Some models are available with optional backlit LCD display.

The remote communications is provided through:

- An RS-485 port using the BACnet MSTP protocol. There cannot be more than one BACnet device on the network with the same Device Object ID.

Unless specified**, the default BACnet Device Object ID will be 100**. This may be viewed and changed using the "Device_ID" object. See section 2.3.4 for details.

Unless specified**, the default BACnet MSTP MAC Address will be 100**. This may be viewed and changed using the "MAC_Address" object. See section 2.3.4 for details.

7334 S. Alton Way, Suite 14M, Centennial CO 80112
Tel: 877 PQ-SOLNS (777-6567) Fax: 425-799-4780
e-mail: info@measurlogic.com
web: www.measurlogic.com

2 BACNET INTERFACE SPECIFICATION

2.1 GENERAL INFORMATION

2.1.1 BACnet Object_Types and Properties

The measured values of the AC and DC energy sub-meters and transducers are exposed using BACnet Objects and Properties.

The following BACnet objects are supported:

- Device
- Analog_Input AI
- Analog_Value AV
- Analog_Output AO
- Digital_Output BO

The Object Number are prefixed with the above abbreviations following tables to indicate the Object Type. The tables show the Object_Name and the Object Instance_Number for each measurement quantity. Object Instance_Numbers are 1-based numbers.

The Object Instance_Number determines the information reported by that object. The value of the Object is contained in the Present_Value property. All Present_Value properties are 32-bit "float" values. As such they are able to represent floating point values, so always represent the appropriate engineering units, and thus no scaling is required. The Object_Name property contains the name of measurement quantity.

The minimum and maximum values for same measurement values are considered separate Object Instances, each with there own Instance_Number. The value is contained in the Present_Value property.

2.1.2 Measurement Object Subsets

Depending on the meter model, and also on the way in which the meter is connected and configured, not all of the available channels may be used, and thus not all of the measurement objects described in this document will be applicable. If only one or two channels are connected, then only objects applicable to those channels will contain measurement information. In addition, objects that contain processed information, such as Total or Average, will also contain valid information.

2.1.3 The Device Object

The ObjectName, VendorIdentifier and VendorName properties of the BACnet Device Object are also available for reading.

7334 S. Alton Way, Suite 14M, Centennial CO 80112
Tel: 877 PQ-SOLNS (777-6567) Fax: 425-799-4780
e-mail: info@measurlogic.com
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2.1.4 Power and Energy Register Resolutions and Roll Over

In order to handle the very wide range of possible Power and Energy values due to the flexibility of the DTS Family, it is necessary to vary the internal register resolution according to the total power levels being measured. The internal register resolutions for the power and the energy registers are the same, therefore a finer resolution provides more significant digits of measured power values, but decreases the total energy accumulation time before the energy registers overflow, and visa versa. The following table shows the ***suggested*** resolutions for various Total Power ranges. These provide 4 or 5 significant digits of power, while still allowing energy to accumulate for over a year before the register overflows:

Total Power			Register Resolution	EnerPowDivider	Energy Roll Over
		< 10 kW	0.1 W	100	99,999.9999 kWh
>= 10 kW	and	< 100 kW	1 W	1,000	999,999.999 kWh
>= 100 kW	and	< 1 MW	10 W	10,000	9,999,999.99 kWh
>= 1 MW	and	< 10 MW	100 W	100,000	99,999,999.9 kWh
>= 10 MW	and	< 100 MW	1 kW	1,000,000	999,999,999 kWh
>= 100 MW	and	< 1 GW	10 kW	10,000,000	9,999,999,990 kWh
>= 1 GW	and	< 10 GW	100 kW	100,000,000	99,999,999,900 kWh

The internal 32-bit energy registers always contain nine significant digits, so will accumulate up to 999,999,999 and then rollover to zero. The rollover point for different energy resolutions is also shown in the table above. ***For example:***

Example Service	Total Power	Register Resolution	EnerPowDivider	Energy Roll Over
Single Phase 3-Wire 120V/240V 200A	48 kW	1 W	1,000	999,999.999 kWh
3-Phase 3/4-Wire 120V/208V 600A	216 kW	10 W	10,000	9,999,999.99 kWh
3-Phase 3-Wire 277V/480V 3000A	2.5 MW	100 W	100,000	99,999,999.9 kWh

The "EnerPowDivider" factor is used to scale the register resolution of the Power and Energy registers values.

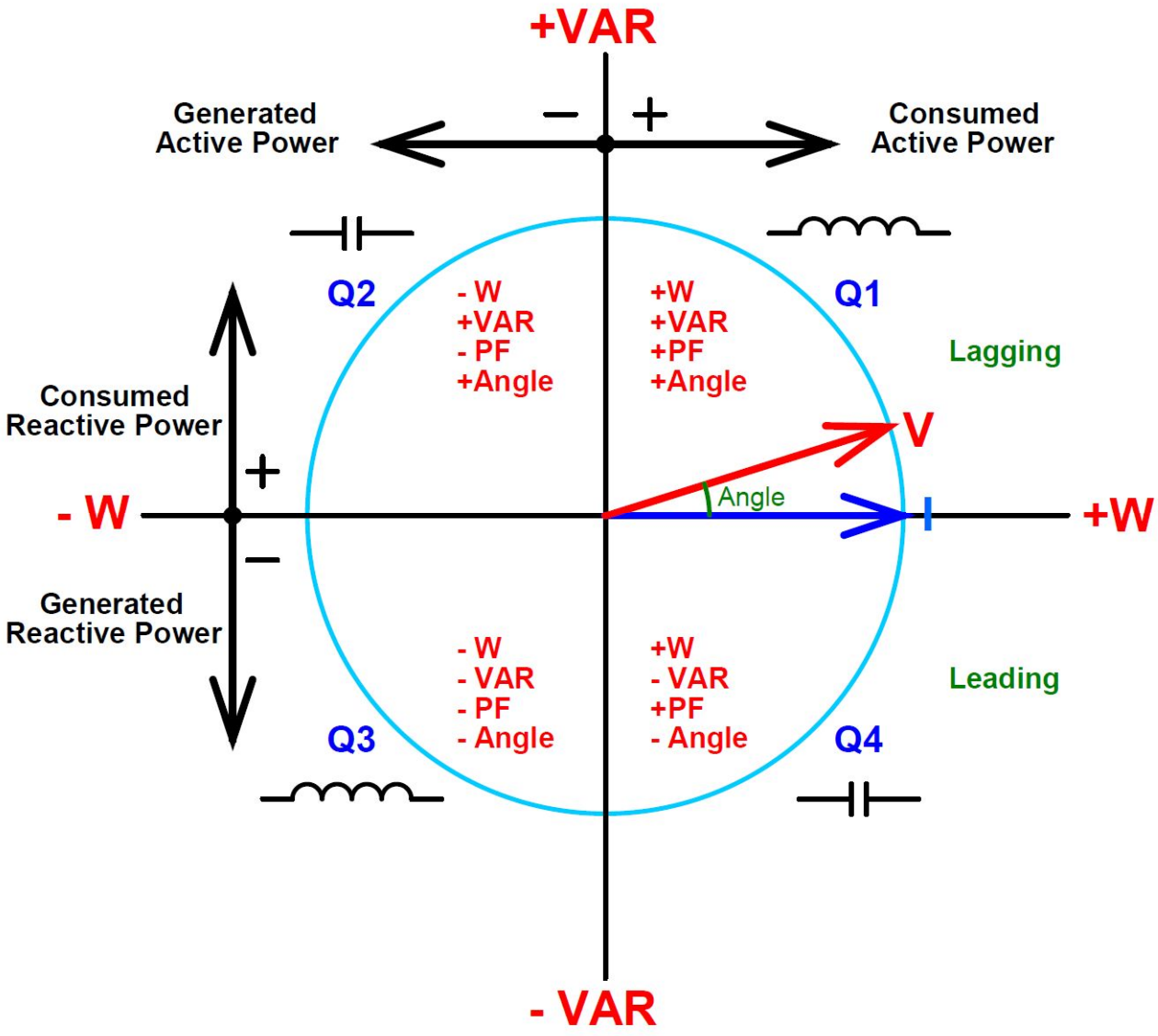
The default value of the "EnerPowDivider" is 10,000, which represents a resolution of 10W. The value of "EnerPowDivider" should always be confirmed by reading object 8023.

The default "EnerPowDivider" value of 10,000 is suitable for most (208V-480V, 50A to 1600A) sub-metering applications, so will not generally need to be changed. If you have a significantly smaller or larger system, you may need to configure your meter with a different "EnerPowDivider" value. **Please consult Measurlogic Inc for advice in this regard.**

BACnet PresentValues are floating point values, and the EnerPowDivider has already been used to scale the value so that is always in the standard "unit" form (e.g. Wh). There will still be a "resolution" in terms of the smallest difference in the numbers as they increment. For example: If the resolution is 10W, then the numbers jump by 0.01kWh, so they will go 0.0, 0.01, 0.02, 0.03 kWh etc. Remember though, that BACnet PresentValue objects are 32-bit floating point values, so there are only about 7 significant digits in the mantissa.

7334 S. Alton Way, Suite 14M, Centennial CO 80112
Tel: 877 PQ-SOLNS (777-6567) Fax: 425-799-4780
e-mail: info@measurlogic.com
web: www.measurlogic.com

2.1.5 Polar Diagram and Sign of Measurement Values



The above polar diagram illustrates the geometric representation of active and reactive powers, and is based on the *"recommended geometric representation"* in accordance with clauses 12 and 14 of IEC 60375, and Annex C of IEC 62053-23.

- The reference of this diagram is the current vector (I) (fixed on right hand line).
- The voltage vector (V) varies its direction according to the phase angle.
- The phase angle between voltage (V) and current (I) is taken to be positive in the mathematical sense (counter clockwise).

7334 S. Alton Way, Suite 14M, Centennial CO 80112
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2.1.6 Measurlogic DTS Power Factor Format

The Power Factor objects in the DTS meters are normalized Power factor values in the range:

[-1.000 … 0 … +1.000].

NOTES

- The **DTS PF** value is **POSITIVE** when the meter is measuring **CONSUMED (+) power**.
- The **DTS PF** value is **NEGATIVE** when the meter is measuring **GENERATED (-) power**.
- The **sign of the PF value does NOT indicate leading or lagging** *(see Section **Error! Reference source not found.** below)*. You MUST use the sign of the values in the PowerQ (VAR) objects (or the ACosPF objects) to determine the VAR hemisphere, and thus leading or lagging.

EXAMPLES

DTS PF Object Value	W Value Sign	VAR Value Sign	ACosPF Value Degrees	Lagging or Leading	Quadrant
+ 0.954	[+]	[+]	+ 17.4	Lagging	Q1
+ 0.954	[+]	[-]	- 17.4	Leading	Q4
- 0.954	[-]	[+]	+ 162.6	Lagging	Q2
- 0.954	[-]	[-]	- 162.6	Leading	Q3

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2.2 AC MEASUREMENT REGISTERS

2.2.1 Measurement Values

Object_Name		Units	Object Number
Volt_LN_1		V	AI-5501
Volt_LN_2		V	AI-5502
Volt_LN_3		V	AI-5503
Volt_LN_Ave		V	AI-5504
Volt_LL_12		V	AI-5505
Volt_LL_23		V	AI-5506
Volt_LL_31		V	AI-5507
Volt_LL_Ave		V	AI-5508
Curr_1		A	AI-5513
Curr_2		A	AI-5514
Curr_3		A	AI-5515
Curr_Ave		A	AI-5516
Curr_Tot		A	AI-5517
Curr_N		A	AI-5518
Freq_1		Hz	AI-5521
Freq_2		Hz	AI-5522
Freq_3		Hz	AI-5523
Freq_Ave		Hz	AI-5524
PowerP_1	(Active)	kW	AI-5525
PowerP_2		kW	AI-5526
PowerP_3		kW	AI-5527
PowerP_Tot		kW	AI-5528
PowerS_1	(Apparent)	kVA	AI-5529
PowerS_2		kVA	AI-5530
PowerS_3		kVA	AI-5531
PowerS_Tot		kVA	AI-5532
PowerQ_1	(Reactive)	kVAR	AI-5533
PowerQ_2		kVAR	AI-5534
PowerQ_3		kVAR	AI-5535
PowerQ_Tot		kVAR	AI-5536
DmdP_Tot	(Active)	kW	AI-5629
DmdP_Tot_Max	(Active)	kW	AI-6229
PF_DTS_1			AI-5551
PF_DTS_2			AI-5552
PF_DTS_3			AI-5553
PF_DTS_All			AI-5554

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2.2.2 Measurement Values (Continued)

Object_Name	Units	Object Number
ACosPF_1	deg	AI-5563
ACosPF_2	deg	AI-5564
ACosPF_3	deg	AI-5565
ACosPF_All	deg	AI-5566
Volt_UB_LN_1	%	AI-5571
Volt_UB_LN_2	%	AI-5572
Volt_UB_LN_3	%	AI-5573
Volt_UB_LN_Worst	%	AI-5574
Volt_UB_LL_12	%	AI-5575
Volt_UB_LL_23	%	AI-5576
Volt_UB_LL_31	%	AI-5577
Volt_UB_LL_Worst	%	AI-5578
Curr_UB_1	%	AI-5579
Curr_UB_2	%	AI-5580
Curr_UB_3	%	AI-5581
Curr_UB_Worst	%	AI-5582

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2.2.3 Measurement Nett Counter Values

These counters contain the **nett** energy values. By convention, imported/consumed energies are positive, and exported/generated energies are negative. Therefore, the values in these counters may be positive or negative.

Object_Name		Units	Object Number
EnergyP_1	(Active)	kWh	AI-7001
EnergyP_2		kWh	AI-7002
EnergyP_3		kWh	AI-7003
EnergyP_Total		kWh	AI-7004
EnergyS_1	(Apparent)	kVAh	AI-7005
EnergyS_2		kVAh	AI-7006
EnergyS_3		kVAh	AI-7007
EnergyS_Total		kVAh	AI-7008
EnergyQ_1	(Reactive)	kVARh	AI-7009
EnergyQ_2		kVARh	AI-7010
EnergyQ_3		kVARh	AI-7011
EnergyQ_Total		kVARh	AI-7012

2.2.4 Measurement Split Counter Values (Advanced use only)

These counters contain the energies that have been accumulated in each operational area, and are therefore always positive values. There are import/consumed and exported/generated counters for both the active and reactive hemispheres. Similarly, each of the four quadrants each have active and reactive counters.

Object_Name	Units	Object Number
EnergyP_Tot_Imp	kWh	AI-7013
EnergyP_Tot_Exp	kWh	AI-7014
EnergyQ_Tot_Imp	kVARh	AI-7015
EnergyQ_Tot_Exp	kVARh	AI-7016
EnergyP_Tot_Q1	kWh	AI-7017
EnergyQ_Tot_Q1	kVARh	AI-7018
EnergyP_Tot_Q2	kWh	AI-7019
EnergyQ_Tot_Q2	kVARh	AI-7020
EnergyP_Tot_Q3	kWh	AI-7021
EnergyQ_Tot_Q3	kVARh	AI-7022
EnergyP_Tot_Q4	kWh	AI-7023
EnergyQ_Tot_Q4	kVARh	AI-7024

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2.3 OTHER REGISTERS

2.3.1 Special Objects

Object_Name	Units	Object Number
DTS_SerialNumber		AI-5002
DTS_FW_Version		AI-5005
DTS_Model_ID		AI-5008

2.3.2 CT Rating Objects

The "CT_Ratings" register contains the CT Current Rating for the CTs use with the meter.

- The CTs that are used with the meter must ALL have the same current rating, and must be sized appropriately for the panel rating. Please contact Measurlogic Inc for advice on CT selection for your application.

Object_Name	Units	Object Number
CT_Ratings	A	AV-8005

2.3.3 Other Configuration Registers (Advanced use only)

The "EnerPowDivider" object and its usage is discussed in detail in this document on Page 4.

Object_Name	Units	Object Number
EnerPowDivider		AV-8023

7334 S. Alton Way, Suite 14M, Centennial CO 80112
Tel: 877 PQ-SOLNS (777-6567) Fax: 425-799-4780
e-mail: info@measurlogic.com
web: www.measurlogic.com

2.3.4 Communications Objects

Object_Name		Units	Object Number	Options	Default
Baud_Rate			AV-8068	9600, 19200, 38400	38400
Device_ID	(Node_ID)		AV-8070	1 - 4194303	100
MAC_Address			AV-8072	1 – 127	100
Max_Master			AV-8073	1 – 127	127

Object_Name		Units	Object Number	Options	Default
Protocol_Reset			BV-8067	1 = Reset Protocol	0
Term_Resistor	(120 ohms)		BV-8069	0=Off & 1=On	0

NOTES

The Baud Rate may be set to 9600, 19200 or 38400. The Device_ID, MAC_Address and Max_Master may be set to parameters that suit the network.

Not all meter models are equipped with an internal 120 ohm terminating resistor, so the Term_Resistor Object may not be present. In this case, external terminating resistors must be used to terminate the RS-485 bus at each physical end of the bus.

Once all the parameters have been set
the protocol must be reset by writing a 1 to the Protocol_Reset PresentValue.

If the meter is equipped with switches, the MAC_Address and the Device_ID will both be set to the value on the swiches. For more flexible control over the network settings, set all the swiches to the ON position, and set the network parameters for each device over the network. Thereafter, do not move the switches.

2.3.5 General Counters

Object_Name	Units	Object Number
GeneralCounter_1		AI-7041
GeneralCounter_2		AI-7042
GeneralCounter_3		AI-7043
GeneralCounter_4		AI-7044

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2.4 DEMAND OBJECTS

Object_Name	Units	Object Instance_Number Instantaneous	
DemandP_Total	kW	AI-5629	Total Active Demand
DemandP_TotMax	kW	AI-6629	Maximum Total Active Demand
DemandP_Total_Max_Date *	Days	AI-7029	
DemandP_Total_Max_Time *	Seconds	AI-7129	

The "DemandP_Tot" value is a **sliding (or windowed) average** of the total active power over a specified time period, called the **Demand Interval** period. The Demand values are updated at a regular period, called the **Demand Update** period.

These values are 15 minutes and 1 minute respectively, so there are 15 sub-intervals in the demand interval period. The following tables give a simple visualization to this concept.

Interval: 5 min
Update: 1 min
■■■■■**:** Demand Window Position

Dmd Tot		2.0kW							
Time	1	2	3	4	5	6	7	8	9
Active P	1kW	1kW	2kW	1kW	4kW	2kW	2kW	3kW	1kW

Dmd Tot			2.2kW						
Time	1	2	3	4	5	6	7	8	9
Active P	1kW	1kW	2kW	1kW	4kW	2kW	2kW	3kW	1kW

Dmd Tot				2.4kW					
Time	1	2	3	4	5	6	7	8	9
Active P	1kW	1kW	2kW	1kW	4kW	2kW	2kW	3kW	1kW

** The Maximum Demand Timestamp requires that the real time clock features be available on the meter. See section **Error! Reference source not found.** for details.*

7334 S. Alton Way, Suite 14M, Centennial CO 80112
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web: www.measurlogic.com

2.4.1 Maximum Demand Time Stamp

The Maximum Demand time stamp is broken up into two objects:

Object_Name	Units	Object Instance_Number Instantaneous
DemandP_Total_Max_Date	Days	AI-7029
DemandP_Total_Max_Time	Seconds	AI-7129

In order to recreate the Maximum Demand UTC time stamp follow the equation below:

DemandP_Total_Max_UTC = (DemandP_Total_Max_Date * 86400) + DemandP_Total_Max_Time

This equation converts the DemandP_Total_Max_Date from Days to Seconds and adds the DemandP_Total_Max_Time value to recreate the full UTC time stamp of the Maximum Demand in the meter. This value will only change if the previous Maximum Demand threshold has changed or if the Maximum Demand is reset.

2.4.2 Resetting the Maximum Demand

The Maximum Demand can be reset by writing the "Reset All Maximum Values" command to the command objects:

Action	Register Description	Object ID	Value (Dec)	Value (Hex)
Reset All Maximum Values	Command	AV-20001	0	0x0000
	Command_Hi	AV-20101	61442	0xF002

NOTE
When a maximum reset is performed, the "DemandP_TotMax" will be reset to the present "DemandP_Tot" value, and the "DemandP_Total_Max_Date/Time" will be reset to the current time.
When issuing these commands write to DTS_COMMAND first, then write to DTS_COMMAND_HI.
The Command Object values will be reset to zero when the specified action is completed. Since this occurs very quickly, the Command Object values will generally read as zero.

7334 S. Alton Way, Suite 14M, Centennial CO 80112
Tel: 877 PQ-SOLNS (777-6567) Fax: 425-799-4780
e-mail: info@measurlogic.com
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2.5 SETTING TIME AND TIME OBJECTS

ATTENTION
The time objects are available in the DTS range of meters with firmware V2.91 and later.
If the meter is fitted with a Real Time Clock (RTC) then time will be maintained while the meter is powered off as long as the backup battery is good. For meters without a RTC the meter will maintain real time while the meter is powered on only. After a power interruption, the RTC will be restored to the time shortly before the meter lost power.
The **DTS 307** meter is NOT fitted with a RTC so will have the reduced time functionality as described above.

The internal format for all *time* registers in the DTS range of meters is the 32-bit UNIX time format, which is the number of seconds since January 1, 1970 00:00:00. This standard time format allows addition and subtraction arithmetic operations to be performed on times. In addition, any of the many available tools and websites can be used to convert to and from the YYYY-MM-DD hh:mm:ss human readable format, such as http://www.epochconverter.com/.

2.5.1 Real Time Clock and Daylight Savings

The Real Time Clock, Daylight Savings, and UTC Offset can all be found inside the Device Object. Time can be set via the BACnet **Time Synchronization** command.

Device Object	Units
Local Date	MM/DD/YYYY
Local Time	HH:MM:SS
Utc Offset	Minutes
Daylight Savings Status	BOOL

2.6 PICS (BACnet Protocol Implementation Conformance Statement)

The DTS range of Serial BACnet meters are BTL listed. For a full list of the PICS please follow this link: http://www.bacnetinternational.net/catalog/index.php?m=200&p=1680

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