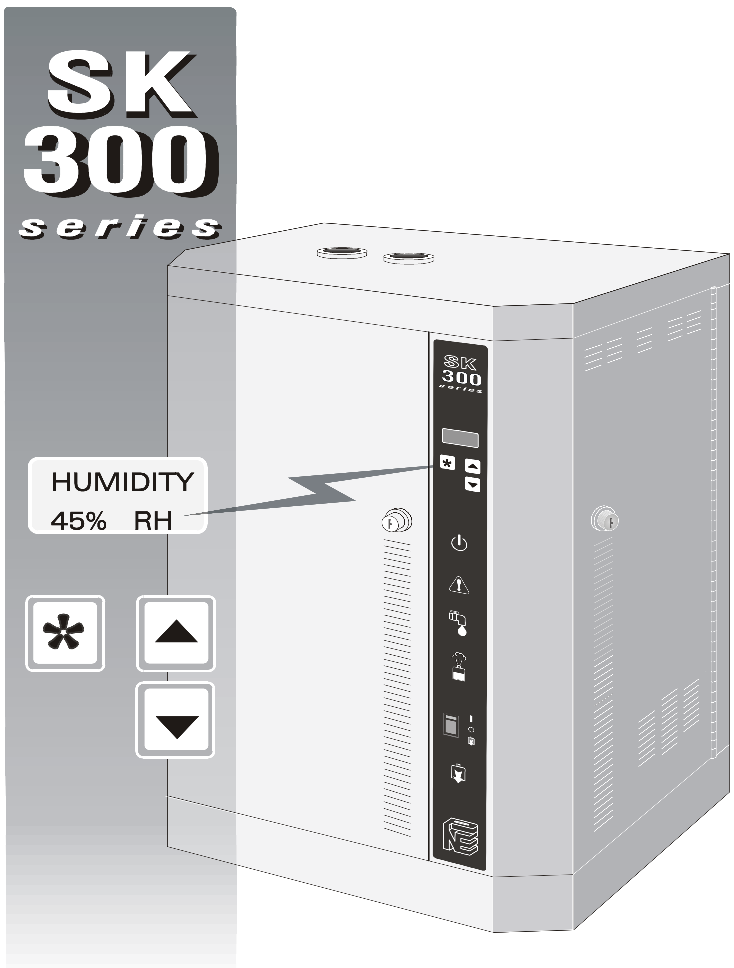
neptronic®

SK300 Series Steam Humidifier

BACnet® Communication Module User Guide



SK300-BACNET – Rev.: 060606

Other related documents:

1. Installation instructions
2. Wiring diagram

Introduction

This document provides a Users Guide for using the NEP PIC Communications Module (NEPIC). This product provides a BACnet® network interface between BACnet® client devices and NEP Humidifier Series devices, specifically for SK300 model. NEPIC uses the BACnet® Master Slave/Token Passing (MS/TP) protocol at the BACnet® MAC layer.

This document assumes you're familiar with BACnet® and BACnet® terminology.

BACnet® Requirements

Performance

The NEPIC uses a synchronous implementation for BACnet® messages. Each BACnet® confirmed service request is answered as quickly as possible without using Reply Postponed. In particular, MS/TP implementation performs within Tusage_delay of 15ms in order to assure Tusage_timeout values within 20ms.

Support for MS/TP

The NEPIC supports a Full Master Node state machine for MS/TP. Max_Master and the MS/TP MAC address shall be configurable through WriteProperty service to the device object. A default MAC address of 254 shall be recognized when a configuration dip switch is set to configure mode. Two other dip switches shall determine MS/TP baud rate 9600, 19200, 38400, and 76800. When in the configure mode WriteProperty service requests may be directed to MAC address 254 using the wildcard Device instance (4194303 decimal/0x3FFFFF hex) as a means of configuring all other parameters for the device. Also, when in the configuration mode the MS/TP MAC address and the Device Instance shall be configurable through the Unit's Keypad.

BIBB Support

The NEPIC generally behaves as a B-ASC type profile server. The following specific BIBBs are supported per their relevant definitions in Annex K to BACnet®:

DS-RP-B, DS-WP-B, DM-DDB-B, DM-DOB-B, DM-DCC-B

Object Support (in general)

The NEPIC supports a table-based fixed list of BACnet®-visible values which appear as Present_Values of various BACnet® standard object types, in addition to a Device object.

Alarms

Although the NEPIC supports the ability to indicate various alarm conditions through value changes in properties of several of its objects, it **does not** generate BACnet® Event Notifications.

Device Object

The following table lists all the BACnet® properties supported for the device object. W? indicates if the property is writable using the BACnet® WriteProperty service.

Device

property	*value*	*W?*
Object_Identifier	*programmable where the instance part of the Object_Identifier is in the range of 0-4194302*. The device instance must be unique system-wide. The default value for the device instance=153000 (Vendor_Identifier*1000)	W
Object_Name	*programmable up to 32 characters.* The device name must be unique system-wide. The default value= "NEP Humidifier 153000" where 153000 is the Vendor_Identifier*1000	W
Object_Type	8	
System_Status	always *operational*	
Vendor_Identifier	always 153	
Vendor_Name	always “National Environmental Products Ltd	
Model_Name	“SK300” for example	
Status_Flags	If the *fault* bit is set, it indicates that the Present_Value is unavailable and is unreliable	
Firmware_Revision	currently “1.00”	
Application_Software_Version	currently “1.00”	
Protocol_Version	always 1	
Protocol_Revision	always 2	
Max_APDU_Length_Accepted	always 107	
Segmentation_Supported	always *none*	
APDU_Timeout	always 0	
Number_of_APDU_Retries	always 0	
Protocol_Services_Supported	aways 0x00 0x09 0x40 0x00 0xE0 (i.e. a *bitstring* in BACnet® order	
Protocol_Object_Types_Supported	aways 0xB4 0x84 0x10 0x00 (i.e. a *bitstring* in BACnet® order	
Object_List	*per the standard*. Because of restrictions on the size of the transmit buffers, the entire Object_List cannot be returned at once, rather the Object_List must be read, one-at-a-time	
Local_Time	*per the standard*, if the unit supports a RTC	
Local_Date	*per the standard*, if the unit supports a RTC	
Device_Address_Binding	always *empty*	
Max_Master	*programmable in the range of 0-127.* Default value=127	W
Max_Info_Frames	always 1	
Proprietary property #1000	*programmable.* This proprietary property represents the MS/TP MAC address in the range of (0-254). Values 128 to 254 represent MS/TP non-token-passing slave devices. Default value=0	W

Objects

A complete list of all BACnet® objects for the NEPIC are listed in the following section. There are a total of 84 BACnet® objects per NEPIC consisting of the following types:

- 1 Device
- 7 Analog Inputs (AI)
- 25 Analog Values (AV)
- 15 Binary Inputs (BI)
- 30 Binary Values (BV)
- 6 Multistate Values (MSV)

The Device Object has already been described. The following tables list all the BACnet® properties supported for each object type. Most of the properties are locked in. The exceptions are Present_Values, which represent the dynamic operating values of the device, and the Status_Flags, Event_States and Reliabilitys which reflect the availability of the Present_Values. Unless otherwise specified, properties are not changeable.

Analog Inputs

property	*value*	*W?*
Object_Identifier	*see Object Table*	
Object_Name	*see Object Table*	
Object_Type	0	
Present_Value	*see Object Table*	
Max_Present_Value	*see Object Table*	
Min_Present_Value	*see Object Table*	
Description	*see Object Table*	
Status_Flags	If the *fault* bit is set, it indicates that the Present_Value is unavailable and is unreliable	
Event_State	If the *fault* bit of the Status_Flags is set, this property's value is *fault*, otherwise it's *normal*	
Reliability	If the *fault* bit of the Status_Flags is set, this property's value is *unreliable_other*, otherwise it's *no_fault_detected*	
Out_of_Service	Always *false*	
Units	*see Object Table*	

Analog Values

property	*value*	*W?*
Object_Identifier	*see Object Table*	
Object_Name	*see Object Table*	
Object_Type	2	
Present_Value	*see Object Table*	W
Max_Present_Value	*see Object Table*	
Min_Present_Value	*see Object Table*	
Description	*see Object Table*	
Status_Flags	If the *fault* bit is set, it indicates that the Present_Value is unavailable and is unreliable	
Event_State	If the *fault* bit of the Status_Flags is set, this property's value is *fault*, otherwise it's *normal*	
Reliability	If the *fault* bit of the Status_Flags is set, this property's value is *unreliable_other*, otherwise it's *no_fault_detected*	
Out_of_Service	Always *false*	
Units	*see Object Table*	

Binary Inputs

property	*value*	*W?*
Object_Identifier	*see Object Table*	
Object_Name	*see Object Table*	
Object_Type	3	
Present_Value	*see Object Table*	
Description	*see Object Table*	
Status_Flags	If the *fault* bit is set, it indicates that the Present_Value is unavailable and is unreliable	
Event_State	If the *fault* bit of the Status_Flags is set, this property's value is *fault*, otherwise it's *normal*	
Reliability	If the *fault* bit of the Status_Flags is set, this property's value is *unreliable_other*, otherwise it's *no_fault_detected*	
Out_of_Service	Always *normal*	
Polarity	*see Object Table*	
Active_Text	*see Object Table*	
Inactive_Text	*see Object Table*	

Binary Values

property	*value*	*W?*
Object_Identifier	*see Object Table*	
Object_Name	*see Object Table*	
Object_Type	5	
Present_Value	*see Object Table*	W
Description	*see Object Table*	
Status_Flags	If the *fault* bit is set, it indicates that the Present_Value is unavailable and is unreliable	
Event_State	If the *fault* bit of the Status_Flags is set, this property's value is *fault*, otherwise it's *normal*	
Reliability	If the *fault* bit of the Status_Flags is set, this property's value is *unreliable_other*, otherwise it's *no_fault_detected*	
Out_of_Service	Always *normal*	
Polarity	*see Object Table*	
Active_Text	*see Object Table*	
Inactive_Text	*see Object Table*	

Multistate Values

property	*value*	*W?*
Object_Identifier	*see Object Table*	
Object_Name	*see Object Table*	
Object_Type	19	
Present_Value	*see Object Table*	W
Description	*see Object Table*	
Status_Flags	If the *fault* bit is set, it indicates that the Present_Value is unavailable and is unreliable	
Event_State	If the *fault* bit of the Status_Flags is set, this property's value is *fault*, otherwise it's *normal*	
Reliability	If the *fault* bit of the Status_Flags is set, this property's value is *unreliable_other*, otherwise it's *no_fault_detected*	
Out_of_Service	Always *normal*	
Number_of_States	*see Object Table*	

SK300 Humidifier Object Table

The SK300 humidifier series of controllers use the following BACnet® object table. The *type* is the BACnet® Object type, the *instance* is the BACnet® Object. *W?* indicates whether the Present_Value property is writable. Together the *type* and *instance* form the BACnet® Object_Identifier for an object according to the following C-language algorithm:

- object_identifier=(unsigned long)((unsigned long)*type*<<22)+*instance*

Analog Input

type	*inst*	*Object_Name*	*Description*	*range of Present_Value*	*W?*
AI	1	Humidity_Out	Humidity Output	0-100 %RH	
AI	2	Water_Level	Water level	0-120%	
AI	3	Delay_to_Drain	Delay until Drain	0-100Hrs	
AI	4	Water_Temp	Water Temperature	0-260 °C or 32-500 °F	
AI	5	Chimney_Temp	Chimney Temperature	0-260 °C or 32-500 °F	
AI	6	SSR_Temp	Solid State Relay Temperature	0-260 °C or 32-500 °F	
AI	7	Op_Delay	Operation Delay	0-5000Hrs	

Analog Values

type	*inst*	*Object_Name*	*Description*	*range of Present_Value*	*W?*
AV	1	Humidity_Demand	Humidity Demand	0-100 %RH	W
AV	2	Room_Humidity	Room Humidity	0-100 %RH	W
AV	3	Duct_Humidity	Duct Humidity	0-100 %RH	W
AV	4	Drain_Delay	Drain Delay	1-100Hrs	W
AV	5	Svc_Delay	Service Delay	1-5000Hrs	W
AV	6	EOS_Delay	End of season delay	1-250Hrs	W
AV	7	PID_Loop_KP	PID Loop gain KP	0-255	W
AV	8	PID_Loop_KI	PID Loop gain KI	0-255	W
AV	9	PID_Loop_KD	PID Loop gain KD	0-255	W
AV	10	Ctl_Band	Control band	0-20.0%	W
AV	11	Ctl_SP	Control set point	0-100%RH	W
AV	12	Extern_SP_Min	External set point minimum	0-100%RH	W
AV	13	Extern_SP_Max	External set point maximum	0-100%RH	W
AV	14	Duct_Hum_HL_SP	Duct hum. high limit set point	50-100%RH	W
AV	15	Fan_Min_On_Time	Minimum ON time for fan	2-20 minutes	W
AV	16	Min_Water_Temp	Min water temp. in On mode	10-90 °C or 50-194 °F (0 -> Mode is Off)	W
AV	17	Antifreeze_Temp	Anti-freeze mode temp	4-10 °C or 39-50°F (0 -> Mode is Off)	W
AV	18	Room_Hum_Offset	Room Humidity offset	±0-20 %RH	W
AV	19	Duct_Hum_Offset	Duct Humidity offset	±0-20 %RH	W
AV	20	Water_Temp_Offset	Water Temperature offset	±0-20 °C or ±0-40 °F	W
AV	21	Water_Lvl_Offset	Water Level offset	±0-20%	W
AV	22	SSR_Temp_Offset	SSR Temperature offset	±0-20 °C or ±0-40 °F	W
AV	23	Lock_On_Cap	Lock On capacity	10-100%	W
AV	24	Max_Out_Limit	Maximum output limit	10-100%	W
AV	25	Outside_Temp	Outside Temperature	-40 - 40 °C or -40 - 104 °F	W

Binary input

type	*inst*	*Object_Name*	*Description*	*range of Present_Value*	*W?*
--	--	--	Actual Operating Status:		
BI	1	Power_Status	Power Status	0=OFF, 1=ON	
BI	2	Demand	Demand	0=NO, 1=YES	
BI	3	Auto_Drain	Auto Drain	0=NO, 1=YES	
BI	4	Manual_Drain	Manual Drain	0=NO, 1=YES	
BI	5	Alrm_Not_Critical	Alarm not critical (unit running)	0=NO, 1=YES	
BI	6	Alarm_Critical	Alarm critical (unit not running)	0=NO, 1=YES	
BI	7	EOS_Delay_Status	End of Season Delay	0=NO, 1=YES	
--	-		Misc. input Status:		
BI	8	Fan_Proof	Fan proof Status	0=OFF, 1=ON	
BI	9	Hi_Lim_Status	Hi-Limit Status	0=OFF, 1=ON	
BI	10	Interlock	Interlock	0=OFF, 1=ON	
BI	11	Power_Fuse	Power Fuse (24VAC)	0=OFF, 1=ON	
BI	12	Klixxon	Klixxon	0=OFF, 1=ON	
BI	13	Ext_Therm_Fuse	Thermal fuse (external 24VAC)	0=OFF, 1=ON	
BI	14	Int_Therm_Fuse	Thermal fuse (internal 24VDC)	0=OFF, 1=ON	
BI	15	Foam_Probe	Foam Probe	0=OFF, 1=ON	

Binary Values

type	*inst*	*Object_Name*	*Description*	*range of Present_Value*	*W?*
--	--	--	Alarm Indications:		
BV	1	Over_Temp_ON	Over temperature contact ON	0=Normal, 1=Alarm	W
BV	2	Pwr_Fuse_Open	Power fuse (24VAC) open	0=Normal, 1=Alarm	W
BV	3	Ext_Th_Fuse_Open	Thermal Fuse open (24VAC)	0=Normal, 1=Alarm	W
BV	4	Int_Th_Fuse_Open	Thermal Fuse open (24VDC)	0=Normal, 1=Alarm	W
BV	5	Hi_Duct_Hum	High humidity level in the duct	0=Normal, 1=Alarm	W
BV	6	Low_Input_Volt	Input voltage too low	0=Normal, 1=Alarm	W
BV	7	Bad_Tank_Sensor	Tank sensor defective	0=Normal, 1=Alarm	W
BV	8	Bad_SSR_Sensor	SSR sensor defective	0=Normal, 1=Alarm	W
BV	9	Bad_Water_Sensor	Water level probe defect	0=Normal, 1=Alarm	W
BV	10	Foam_Sensor_ON	Foam Sensor ON	0=Normal, 1=Alarm	W
BV	11	Low_Tank_Temp	Tank temperature too low (freeze)	0=Normal, 1=Alarm	W
BV	12	Hi_Tank_Temp	Tank temperature too high	0=Normal, 1=Alarm	W
BV	13	Hi_SSR_Temp	SSR temperature too high	0=Normal, 1=Alarm	W
BV	14	Bad_Fill_Tank	Defective filling tank	0=Normal, 1=Alarm	W
BV	15	Bad_Refill_Tank	Defective refill tank (too long)	0=Normal, 1=Alarm	W
BV	16	Bad_Drain_Tank	Defective draining tank	0=Normal, 1=Alarm	W
BV	17	Duct_Hi_Lim_CO	Duct Hi limit cut-out	0=Normal, 1=Alarm	W
BV	18	Interlock_In_Open	Interlock Input Open	0=Normal, 1=Alarm	W
BV	19	Hum_Clean_Time	Humidifier started cleaning period	0=Normal, 1=Alarm	W
BV	20	Hum_Svc_Time	Humidifier exceeded service time	0=Normal, 1=Alarm	W
BV	21	Demand_SP_Type	Demand-Set point type	0=Voltage, 1=Current	W
BV	22	Demand_SP_Span	Demand-Set point span	0=2-10VDC, 1=0-10VDC	W
BV	23	Humidity_In_Type	Humidity input type	0=Voltage, 1=Current	W
BV	24	Humidity_In_Span	Humidity input span	0=2-10VDC, 1=0-10VDC	W
BV	25	Hi_Lim_In_Type	Hi-limit humidity input type	0=Voltage, 1=Current	W
BV	26	Hi_Lim_In_Span	Hi-limit humidity input span	0=2-10VDC, 1=0-10VDC	W
--	--	--	System Option		
BV	27	Temp_Units	Temperature Units	0=Celsius, 1=Fahrenheit	W
BV	28	Outside_Temp_Comp	Outside Temperature Compensation	0=OFF, 1=ON	W
BV	29	Alarm_Beep	Alarm Beep	0=OFF, 1=ON	W
BV	30	Reload_Factory	Reload Factory default value	0=NO, 1=YES	W

SK300 Humidifier Object Table

Multistate Values

type	*inst*	*Object_Name*	*Description*	*range of Present_Value*	*W?*
MSV	1	Ctl_Mode	Control Mode	1=Local Demand from Analog Input 1 2=Internal PID calculation 3=Demand from remote communication port (e.g. BACnet®)	W
MSV	2	Operation_Mode	Operation Mode	1=Set unit Off 2=Set unit On 3=Set unit in drain mode	W
MSV	3	Unit_Display_Lang	Unit Display Language	1=English (Default) 2=French 3=Spanish	W
MSV	4	SP_Source	Set point Source	1=Local analog input 1 2=Local Internal digital value 3=Remote from communication port (e.g. BACnet®)	W
MSV	5	Room_Hum_Source	Room Humidity source	1=Local analog input 2 2=Remote from communication port (e.g. BACnet®)	W
MSV	6	Duct_Hum_Source	Duct Humidity source	1=Not used 2=Local analog input 3 3=Remote from communication port (e.g. BACnet®)	W

Mode

Normally the NEPIC is in the operational mode. The NEPIC can be placed in the configuration mode at any time by throwing a single dip switch.

mode	*Switch 1*
operational	OFF
configuration	ON

The difference between configuration mode and operational mode is explained in detail later in this section. The NEPIC can be put into and out of the configuration mode at any time. When the unit detects a change in the position of switch 1, it automatically restarts itself in the appropriate mode.

Baud Rate

The baud rate for the BACnet® MS/TP is configurable through a pair of dip switches. The following table identifies the baud rates used according to the switch settings:

baud rate	*Switch 2*	*Switch 3*
9600	OFF	OFF
19200	ON	OFF
38400	OFF	ON
76800	ON	ON

Please note, that you ***must*** restart the unit in order for a change of baud rate to take effect.

Configurable BACnet® Properties

The following four BACnet® properties are configurable and in fact most likely will need to be changed to guarantee uniqueness of each device in a BACnet® system:

- Device Object.Object_Identifier *
- Device Object.Object_Name
- Device Object.Max_Master
- Device Object.*proprietary property #1000* (which will be called *MSTP_MACaddress* for the remainder of this section)

* Note: Because the Device's Object_Identifier is a combination of the Device Object_Type (8) and the Device_Instance (0-4194302) it's decimal or hexadecimal representation tends to be incomprehensible. Even the simple/easy-to-understand Device_Instance=1000 has an equivalent Object_Identifier of 0x020003E8 hexadecimal or 33555432 decimal. So, while it's the device's Object_Identifier property that can be changed using a BACnet® WriteProperty service, this document will talk mostly about Device_Instances.

Getting Started

The four configurable BACnet® Device Object properties have two sets of “default” settings, the factory setting and the configuration mode setting and are identified in the following table:

property	*factory value*	*configuration mode value*
Device_Instance	153000*	153000*
Object_Name	“NEP Humidifier 4000”	“NEP Humidifier 4000”
Max_Master	127	127
MSTP_MACaddress	0	254

* Note: These values are NEP’s BACnet® Vendor_Identifier*1000.

Prior to the first time the NEPIC is powered on, you’ll have to know two things:

1. What’s the baud rate of the MS/TP network?
2. Is there already an MS/TP unit on that network with the MAC address=0 and the Device Instance=153000?

Once the answer to Question 1 is known, the dip switches 2 and 3 must be set up accordingly.

If the answer to Question 2 is *no* (there is no MS/TP MAC address 0), then you can start up the NEPIC with the dip switch 1 in the OFF (operational) position. In this mode, the factory settings are in effect and the NEPIC will be MS/TP token-passing master with a MAC address=0 and Device Instance=153000.

If the answer to Question 2 is *yes* (there already is an MS/TP MAC address 0 and/or there already is a Device Instance 153000), then you will need to start up the NEPIC with the dip switch 1 in the ON (configuration) position. In this mode, the configuration mode settings are in effect and the NEPIC will be MS/TP non-token-passing slave with a MAC address 254.

Configuring in the Operational Mode

The NEPIC can be configured from a BACnet® client device using the BACnet® WriteProperty service at any time, while in the operational mode. In other words, the Device_Instance, Object_Name, Max_Master and *MSTP_MACaddress* can be changed “hot” with the changes taking effect immediately and without having to restart the NEPIC.

Configuring in the Configuration Mode

If the NEPIC is put into the configuration mode while it is "hot", the NEPIC will be automatically reset with the Device_Instance, Object_Name, Max_Master and *MSTP_MACaddress* all containing the *configuration mode values*. In this mode, the NEPIC will **not** act as an MS/TP token-passer and will be silent until it is addressed by a BACnet® client. As a side effect, it will also not be able to respond to BACnet® WhoIs services with Iam services, so BACnet® clients will not be able to find out its Device_Instance automatically. In the configuration mode, any of the above properties can be changed by using either the default Device_Instance or the wild card Device_Instance (4194303 decimal or 0x3FFFFF hex). Use of the wild card Device_Instance obviates the need to know the NEPIC's real Device_Instance in case it conflicts with another Device in the system. While in the configuration mode, only the Device Object is available to BACnet® clients through the ReadProperty and Write Property services. All other objects (i.e. AI's, etc) are not available.

As an alternative to using the BACnet® WriteProperty service to change the Device_Instance and/or the *MSTP_MACaddress*, the SK300's keypad can be used to change those two properties, but only while in the configuration mode.

Changes to the Device Object, whether made by using the WriteProperty of the keypad, do not take effect until the NEPIC is restarted in the operational mode.

Selecting the MS/TP MAC address and Max_Master

Some care must be taken in setting the MS/TP MAC address and Max_Master property.

First, the MAC address must be unique on the entire MS/TP network. However, having a unique MAC address and a high baud rate does not guarantee efficient operation of the NEPIC (or other MS/TP units for that matter) on the MS/TP network. Some MAC address and Max_Master combinations are more efficient than others. BACnet® requires token-passing units to occasionally "poll" for other masters based on the value of MAC address and Max_Master. So, a "poor" combination of MAC addresses and Max_Masters can lead to slow networks in which there's a lot of wasted time polling for masters that are not present and never will be. In fact, unless there are 126 other units on the MS/TP network, the default Max-Master=127 is most likely a poor choice for the NEPIC. Having said that, Max-Master=127 has been chosen as the default to insure that any master, specifically a BACnet® client, can be found when the NEPIC is first started.

So, considering the following simple two-unit examples:

Example 1:

- MAC=0. Max_Master=127
- MAC=1, Max_Master=127

This example is slow and inefficient because both Max_Master=127. Everytime either unit is required to find another master units it has to poll 126 units until it finds the right one to pass the token to.

Example 2:

- MAC=0. Max_Master=5
- MAC=5, Max_Master=5

This example is better but is still slower than it could be. The Max_Master is set to the most efficient value, however because of the gap between the two MAC addresses, each unit must poll 4 units until it finds the right one to pass the token to.

Example 3:

- MAC=0. Max_Master=1
- MAC=2, Max_Master=2

This example is actually an incorrect configuration, in that MAC=0 will never find MAC=2 because it will never poll for the master MAC address=2.

Example 4:

- MAC=0. Max_Master=1
- MAC=1, Max_Master=1

This example is the most efficient, since each unit must poll only 1 other unit until it finds the right one to pass the token to.

As a general guideline, the most efficient set up for an MS/TP network is one in which the units are consecutively numbered starting at MAC address 0 and all have Max_Master=the maximum MAC address in the system. If consecutive numbering is not possible, then the next most efficient set up is one in which all units have have Max_Master=the maximum MAC address in the system.

Personal notes

Personal notes

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