

## BMG Series

## BACnet MS/TP Gateways for Mega Controls Modbus RTU Networking Devices

**General**

The BMG Series is a BACnet network gateway which routes communication traffic between BACnet MS/TP network and Modbus RTU network.

While the gateway (master) communicates on a RS-485 network at its NET1 communication port using the BACnet MS/TP protocol, it can support up to 32 Mega Controls NT10, NT50, NTAf, NSM, NC24A or NC24T RS-485 networking devices (slaves) on a RS-485 network at its NET2 communication port using Modbus RTU protocol. The gateway spontaneously detects the presence of slaves that go online in its NET 1 network. However, these devices must not be mixed and must be of the same series or

type in NET2 network trunk. NT10 Series and NT50 Series are treated as the same type of devices and can be mixed in the same network trunk.

The gateway has 2 addresses. NET 2 address is always 0 which is the address of the Modbus RTU network. NET 1 address is the MAC address of the BACnet MS/TP network which is set up for a maximum of 32 devices. The NET 1 address is set via DIP switches in the device.

If more than 32 masters are needed in the system, an additional network supervising device is required for the second BACnet MS/TP network.

**Mounting**

It is strongly recommended to



mount the gateway inside a metal cabinet for EMI shielding protection, with 2 or 4 screws or rack-mounted in a DIN rail.

**Ordering**

To order, specify the complete gateway model number with specific communication protocol to suit applicable networking devices.

**Specifications**

|                                    |                    |   |
|------------------------------------|--------------------|---|
| Gateway model numbers              | BMG-1              | Universal BACnet MS/TP gateway for Mega Controls NT10/NT50 Series, NTAf Series, NSM Series, NC24A or NC24T            |
| Power requirements                 | Voltage            | 22-28 V 50/60 Hz or 16-30 VDC   |
|                                    | Current            | Maximum 200 mA  |
| Technology                         | CPU                | 32-bit ARM at 48M clock   |
|                                    | ROM                | 256 kB Flash  |
|                                    | RAM                | 64 kB SRAM  |
|                                    | EEPROM             | 2 kB  |
| NET 1 communication port           | Physical           | RS-485 with opto-coupler Isolation  |
|                                    | Baud rate          | Field selectable 9600, 19200, 38400 or 76,800 bps set via DIP switches (factory set 38,400 bps)                       |
|                                    | Protocol           | BACnet MS/TP  |
|                                    | Indicators         | Red LED for data receiving and green LED for data transmitting  |
|                                    | Device MAC address | Set via DIP switches  |
|                                    | Maximum number     | 32 BMGs in one BACnet MS/TP network   |
|                                    | Service supported  | Whols, ReadProperty, ReadPropertyMultiple, WriteProperty  |
|                                    | Objects supported  | Device, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Multi-State Input, Multi-State Output |
| NET 2 communication port           | Object names       | Static  |
|                                    | Physical           | RS-485 with opto-coupler Isolation  |
|                                    | Baud rate          | Fixed at 19,200 bps   |
|                                    | Protocol           | Modbus RTU  |
|                                    | Indicators         | Red LED for data receiving and green LED for data transmitting  |
|                                    | Device address     | Always 0  |
| Ambient/storage temperature limits | Maximum number     | 32 slaves in one Modbus RTU network   |
|                                    | Wiring class       | Class II for 24 VAC Power Supply  |
|                                    | Connectors         | Removable screw-type terminal connectors  |
| Power wires                        | Wire size          | 1 mm <sup>2</sup> or 18 AWG solid copper recommended  |
| Communication wires                |                    | Balanced 100 to 120 $\Omega$ nominal Impedance twisted shielded pair (TSP) cable                                      |
| Shipping weight                    |                    | 0.25 kg (1 lb)  |
| Dimensions                         |                    | 90 x 116 x 40 mm (W x L x D)  |

*The performance specifications above are nominal and subject to tolerances and application variables of generally acceptable industry standards. The manufacturer shall not be liable for damages resulting from misapplication or misuse of its products.*

## Language, Gateway Instance ID and Communication Protocol Setup Procedure

### System Setting Objects

There are 2 objects for system setup defined as:

| Object Name    | Object          | Value | Unit | Object Type     | Read/Write | Priority Array |
|----------------|-----------------|-------|------|-----------------|------------|----------------|
| *** SYS SELECT | yyyyyy.AV1 (*2) | *1    | None | Analog Variable | R/W        | None           |
| *** SYS VALUE  | yyyyyy.AV2 (*2) | *1    | None | Analog Variable | R          | None           |

**Note:** System setting can be changed by writing value to \*\*\* SYS SELECT.

| Write property value to ***SYS SELECT | Function Description  |
|---------------------------------------|---|
| 2012                                  | <b>Change all descriptions to CHINESE.</b> New setting will take effect after entering a restart command 3003 followed by reloading descriptors at the BMG Manager.   |
| 2014                                  | <b>Change all descriptions to ENGLISH.</b> New setting will take effect after entering a restart command 3003 followed by reloading descriptors at the BMG Manager.   |
| 3003                                  | Restart   |
| 2004                                  | <b>To set device instance ID.</b><br>This is a two-step operation: after writing 2004 to ***SYS SELECT, wait until *** SYS VALUE changes to -1, then write an integer 'n' (where $0 \leq n \leq 12799$ ) to ***SYS SELECT. Assuming the DIP switches' MAC address is set as 'm', the device instance ID is 'n*100 + m'. New setting will take effect after entering a restart command 3003 followed by a discovering new devices at the BACnet workstation. |
| Notes:                                | After all new entries have taken into effect, the new data will be saved to the EEPROM. Power restart will resume all data saved before power failure.  |

### Derived Network Addressing (DNA)

The DNA DIP switch is set by factory default to ON position. This allows the gateway to automatically configure a BACnet instance ID number. This setting should not be changed unless an authorized agent is assigning a BACnet instance ID number through the system setup procedure. The BACnet instance ID number should not be confused with the gateway MAC address DIP switch setting, and each gateway must still have a unique DIP switch MAC address even when using software to define the gateway's instance ID number.

**Example:** If the MAC address of the upstream network router or controller is 8 and the gateway MAC address is set as 13, the gateway's DNA BACnet Instance ID is 80013 ( $8 \times 10000 + 13$ ).

#### Notes:

\*1 When DNA function is turned on (DIP switch set as 1), 2004 function is disabled. When DNA function is turned off (DIP switch set as 0), 2004 function is enabled. Disconnect power supply before changing DNA switch position.

\*2 yyyyyy is the the BACnet instance ID number which can be either the DNA or a number assigned manually through the system setup procedure.

### Gateway MAC Addressing

The DIP switch is a binary switch. Each individual DIP switch represents a unique value, which forms the gateway MAC address when added together. To set the address, simply move the switches that add up to the gateway's desired address to the ON position.

**Example:** If the gateway is to be address 7 on the network, set the switches numbered 1, 2 and 4 (equals 7) to the ON position.

**Note:** Each gateway on the same MS/TP network segment must have a unique DIP switch address.

### Gateway Baud Rate Setting

Make sure that the baud rate of the gateway is set to match the network baud rate.

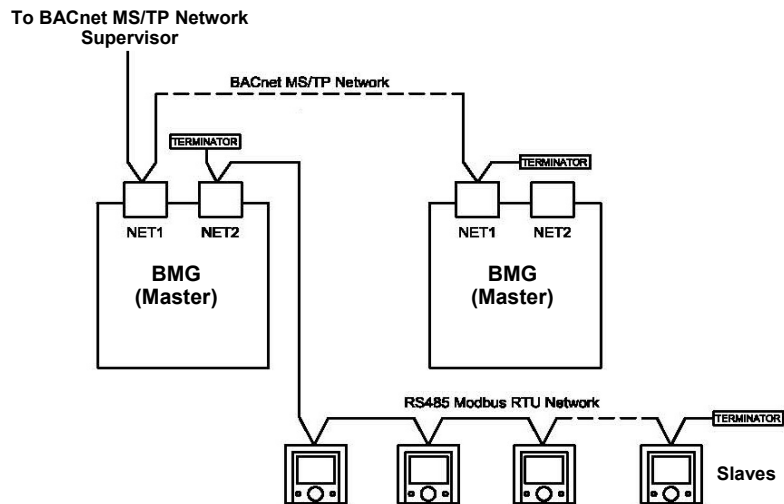
**Example:** If the network baud rate is 38,400 bps, set the DIP switches X2 and X4 to OFF and ON respectively.

### Network, Cabling and Step-down Transformer Requirements

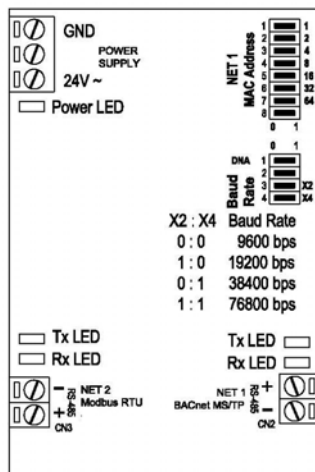
To ensure network stability and reliable communications, particularly at high speeds on a BACnet MS/TP network for a number of devices, it is imperative that the following network and cabling requirements are adhered to:

| Item                  | Description  |
|-----------------------|--|
| Cabling               | It is recommended to use networking cabling that matches the following specifications: <ul style="list-style-type: none"> <li>Balanced 100 to 120 ohms nominal impedance, 22 or 24 AWG Twisted Shielded Pair (TSP) Cable</li> <li>Nominal capacitance of 52 pF/m or lower</li> <li>Nominal velocity of propagation of 66% or higher</li> <li>Terminating the shield to ground at one end only for each isolated segment will prevent ground loops in the shield and drain RF energy to ground. Grounding at the BACnet router or controller is preferred.</li> </ul> |
| Topology              | Ensure both the BACnet MS/TP network cable and Modbus RTU network cable are installed as a daisy chain from one device to the next.  |
| Maximum Nodes         | The maximum number of devices is 32 per BACnet MS/TP or Modbus RTU network.  |
| Terminator            | A terminator of 120-ohm impedance must be installed at each end of each BACnet MS/TP or Modbus RTU network. Ensure that this requirement is not overlooked in laying out the network architecture and when ordering product.   |
| Cable Shielding       | Use a shielded, twisted pair cable for communications. Never directly ground wire in more than one point on the shield. Doing so can induce large currents and result in communication problem.  |
| Trunk Separation      | NET 1 and NET 2 trunks must be physically separated and must not be bundled together in the same cable or conduit.   |
| Repeater              | A repeater is not necessary unless more than 32 nodes is extended beyond 1,000 m.  |
| Step-down Transformer | A separate isolated double-wound transformer is recommended for supplying 24 VAC power to each BMG. If and when the same transformer is shared with other devices, observe the polarities of the power supply of all devices including the BMG.  |

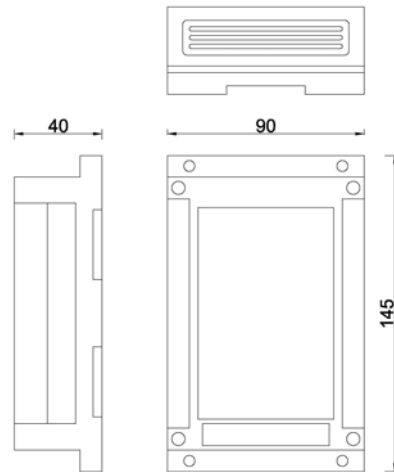
## Network Configuration



## Termination Diagram



## Dimensions in mm



### Dynamic Created Objects

The gateway spontaneously detects the presence of a NT10 ,NT50, NTAF, NSM, NC24A or NC24T slave that goes online in its NET 2 network and automatically creates a number of pre-defined objects associated with this NT10 ,NT50, NTAF, NSM, NC24A or NC24T slave's MAC address. When this NT10 ,NT50, NTAF, NSM, NC24A or NC24T slave goes offline, these objects will be automatically deleted.

### For NT10 and NT50 Modbus RTU Networking Room Thermostats

If the NT10's or NT50's MAC address is xx, its associated objects are:

| Object Name                      | Object           | Value                       | Unit | Type                  | Read/Write | Priority Array |
|----------------------------------|------------------|-----------------------------|------|-----------------------|------------|----------------|
| #xxNT - Temperature Setpoint     | yyyyyy.AOxx1     | (5-35) / (41-95)            | None | Analog Output         | R/W        | 16             |
| #xxNT - Operating Mode           | yyyyyy.BOxx1     | Stop/Run                    | None | Binary Output         | R/W        | 16             |
| #xxNT - Control Mode             | yyyyyy.MOxx1     | Heat/Cool/<br>Fan Only/Auto | None | Multi-State<br>Output | R/W        | 16             |
| #xxNT - Fan Speed Command        | yyyyyy.MOxx2     | High/Medium/<br>Low/Auto    | None | Multi-State<br>Output | R/W        | 16             |
| #xxNT - Ambient Temperature      | yyyyyy.Alxx1     | (5-35) / (41-95)            | None | Analog Input          | R          | None           |
| #xxNT - Valve 1 Output Status    | yyyyyy.Alxx2     | (0-100)                     | %    | Analog Input          | R          | None           |
| #xxNT - Valve 2 Output Status    | yyyyyy.Alxx3     | (0-100)                     | %    | Analog Input          | R          | None           |
| #xxNT - Temperature Eng. Unit    | yyyyyy.Blxx1     | °C/°F                       | None | Binary Input          | R          | None           |
| #xxNT - Unoccupied Mode          | yyyyyy.Blxx2     | Off/On                      | None | Binary Input          | R          | None           |
| #xxNT - Binary Input             | yyyyyy.Blxx3     | Open/Closed                 | None | Binary Input          | R          | None           |
| #xxNT - Window Mode <sup>a</sup> | yyyyyy.Mlxx1     | Off/On/None                 | None | Multi-State<br>Input  | R          | None           |
| #xxNT - Fan Totalizator          | yyyyyy.AVxx1     | 0-999999                    | hr   | Analog variable       | R/W        | None           |
| #xxNT - Cooling Totalizator      | yyyyyy.AVxx2     | 0-999999                    | hr   | Analog variable       | R/W        | None           |
| #xxNT - Heating Totalizator      | yyyyyy.AVxx3     | 0-999999                    | hr   | Analog variable       | R/W        | None           |
| *** SYSTEM SELECT                | yyyyyy.AV1       | *1                          | None | Analog variable       | R/W        | None           |
| *** SYSTEM SELECT                | yyyyyy.AV2       | *1                          | None | Analog variable       | R          | None           |
| BMG_MANAGER_yyyyyy               | yyyyyy.DEVyyyyyy | Operational                 | None | Device                | R          | None           |

<sup>a</sup> The value of this object is displayed as Off/On for NT10 Series or None for NT50 Series thermostats.

### For NTAF Modbus RTU Networking Room Thermostats

If the NT10's or NT50's MAC address is xx, its associated objects are:

| Object Name                   | Object           | Value                       | Unit | Type                  | Read/Write | Priority Array |
|-------------------------------|------------------|-----------------------------|------|-----------------------|------------|----------------|
| #xxNT - Temperature Setpoint  | yyyyyy.AOxx1     | (5-35) / (41-95)            | None | Analog Output         | R/W        | 16             |
| #xxNT - Operating Mode        | yyyyyy.BOxx1     | Stop/Run                    | None | Binary Output         | R/W        | 16             |
| #xxNT - Control Mode          | yyyyyy.MOxx1     | Heat/Cool/<br>Fan Only/Auto | None | Multi-State<br>Output | R/W        | 16             |
| #xxNT - Fan Speed Command     | yyyyyy.MOxx2     | 1/2/3/4/5/6/7/Auto          | None | Multi-State<br>Output | R/W        | 16             |
| #xxNT - Ambient Temperature   | yyyyyy.Alxx1     | (5-35) / (41-95)            | None | Analog Input          | R          | None           |
| #xxNT - Valve 1 Output Status | yyyyyy.Alxx2     | (0-100)                     | %    | Analog Input          | R          | None           |
| #xxNT - Valve 2 Output Status | yyyyyy.Alxx3     | (0-100)                     | %    | Analog Input          | R          | None           |
| #xxNT - Temperature Eng. Unit | yyyyyy.Blxx1     | °C/°F                       | None | Binary Input          | R          | None           |
| #xxNT - Unoccupied Mode       | yyyyyy.Blxx2     | Off/On                      | None | Binary Input          | R          | None           |
| #xxNT - Binary Input          | yyyyyy.Blxx3     | Open/Closed                 | None | Binary Input          | R          | None           |
| #xxNT - Window Mode           | yyyyyy.Mlxx1     | Off/On/None                 | None | Multi-State<br>Input  | R          | None           |
| #xxNT - Fan Totalizator       | yyyyyy.AVxx1     | 0-999999                    | hr   | Analog variable       | R/W        | None           |
| #xxNT - Cooling Totalizator   | yyyyyy.AVxx2     | 0-999999                    | hr   | Analog variable       | R/W        | None           |
| #xxNT - Heating Totalizator   | yyyyyy.AVxx3     | 0-999999                    | hr   | Analog variable       | R/W        | None           |
| *** SYSTEM SELECT             | yyyyyy.AV1       | *1                          | None | Analog variable       | R/W        | None           |
| *** SYSTEM SELECT             | yyyyyy.AV2       | *1                          | None | Analog variable       | R          | None           |
| BMG_MANAGER_yyyyyy            | yyyyyy.DEVyyyyyy | Operational                 | None | Device                | R          | None           |

**For NSM Modbus RTU Networking Setpoint Modules**

If the NSM's MAC address is xx, its associated objects are:

| Object Name                | Object           | Value       | Unit | Type            | Read/Write | Priority Array |
|----------------------------|------------------|-------------|------|-----------------|------------|----------------|
| #xxNS - Module Setpoint    | yyyyyy.AOxx1     | -99 to 999  | None | Analog Output   | R/W        | 16             |
| #xxNS.- Operating Mode     | yyyyyy.BOxx1     | Stop/Run    | None | Binary Output   | R/W        | 16             |
| #xxNS.- Analog Input Type  | yyyyyy.Alxx1     | 0 or 1^     | None | Analog Input    | R          | None           |
| #xxNS - Analog Input Value | yyyyyy.Alxx2     | -99 to 999  | None | Analog Input    | R          | None           |
| #xxNS - Set Display Lower  | yyyyyy.AVxx1     | -99 to 999  | None | Analog Variable | R/W        | None           |
| #xxNS - Set Display Upper  | yyyyyy.AVxx2     | -99 to 999  | None | Analog Variable | R/W        | None           |
| #xxNS - Remote Set Lower   | yyyyyy.AVxx3     | -99 to 999  | None | Analog Variable | R/W        | None           |
| #xxNS - Remote Set Upper   | yyyyyy.AVxx4     | -99 to 999  | %    | Analog Variable | R/W        | None           |
| *** SYSTEM SELECT          | yyyyyy.AV1       | *1          | None | Analog Variable | R/W        | None           |
| *** SYSTEM SELECT          | yyyyyy.AV2       | *1          | None | Analog Variable | R          | None           |
| BMGE_MANAGER_10123         | yyyyyy.DEVyyyyyy | Operational |      | Device          | R          | None           |

**Notes:** ^ 0 denotes 0-10 VDC input and 1 denotes temperature sensor input.

**For NC24A Modbus RTU Networking Controllers**

If the NC24A's MAC address is xx, its associated objects are:

| Object Name                   | Object           | Value               | Unit | Type              | Read/Write | Priority Array |
|-------------------------------|------------------|---------------------|------|-------------------|------------|----------------|
| #xxNC - Controller Setpoint   | yyyyyy.AOxx1     | -99 to 999          | None | Analog Output     | R/W        | 16             |
| #xxNC - X1 Analog Input Value | yyyyyy.Alxx1     | -99 to 999          | None | Analog Input      | R          | None           |
| #xxNC - X2 Analog Input Value | yyyyyy.Alxx2     | -99 to 999          | None | Analog Input      | R          | None           |
| #xxNC - ECO Mode Status       | yyyyyy.Blxx1     | Off/On              | None | Binary Input      | R          | None           |
| #xxNC - Day/Night Mode Status | yyyyyy.Blxx2     | Day/Night           | None | Binary Input      | R          | None           |
| #xxNC - Engineering Unit      | yyyyyy.Mlxx1     | °C/°F/%/None        | None | Multi-State Input | R          | None           |
| #xxNC - Application Number    | yyyyyy.AVxx1     | 1 to 9              | None | Analog Variable   | R          | None           |
| #xxNC - Setpoint Differential | yyyyyy.AVxx2     | (1 to 20)/(1 to 99) | None | Analog Variable   | R          | None           |
| #xxNC - Control Bandwidth     | yyyyyy.AVxx3     | -99 to 99           | None | Analog Variable   | R          | None           |
| #xxNC - Y1 Output Status      | yyyyyy.AVxx4     | 0 to 100            | %    | Analog Variable   | R          | None           |
| #xxNC - Y2 Output Status      | yyyyyy.AVxx5     | 0 to 100            | %    | Analog Variable   | R          | None           |
| #xxNC - Q1 Output Status      | yyyyyy.AVxx6     | 0 to 100            | %    | Analog Variable   | R          | None           |
| #xxNC - Proportional Band     | yyyyyy.AVxx7     | (1 to 20)/(1 to 99) | K    | Analog Variable   | R          | None           |
| #xxNC - Integral Time         | yyyyyy.AVxx8     | 0 to 30             | min  | Analog Variable   | R          | None           |
| *** SYSTEM SELECT             | yyyyyy.AV1       | *1                  | None | Analog Variable   | R/W        | None           |
| *** SYSTEM SELECT             | yyyyyy.AV2       | *1                  | None | Analog Variable   | R          | None           |
| BMG_MANAGER_yyyyyy            | yyyyyy.DEVyyyyyy | Operational         |      | Device            | R          | None           |

**For NC24T Modbus RTU Networking Controllers**

If the NC24T's MAC address is xx, its associated objects are:

| Object Name                     | Object           | Value               | Unit | Type              | Read/Write | Priority Array |
|---------------------------------|------------------|---------------------|------|-------------------|------------|----------------|
| #xxNC - Controller Setpoint     | yyyyyy.AOxx1     | -99 to 999          | None | Analog Output     | R/W        | 16             |
| #xxNC - X1 Analog Input Value   | yyyyyy.Alxx1     | -99 to 999          | None | Analog Input      | R          | None           |
| #xxNC - X2 Analog Input Value   | yyyyyy.Alxx2     | -99 to 999          | None | Analog Input      | R          | None           |
| #xxNC - ECO Mode Status         | yyyyyy.Blxx1     | Off/On              | None | Binary Input      | R          | None           |
| #xxNC - Day/Night Mode Status   | yyyyyy.Blxx2     | Day/Night           | None | Binary Input      | R          | None           |
| #xxNC - Engineering Unit        | yyyyyy.Mlxx1     | °C/°F/%/None        | None | Multi-State Input | R          | None           |
| #xxNC - Application Number      | yyyyyy.AVxx1     | 1 to 12             | None | Analog Variable   | R          | None           |
| #xxNC - Setpoint Differential   | yyyyyy.AVxx2     | (1 to 20)/(1 to 99) | None | Analog Variable   | R          | None           |
| #xxNC - Control Bandwidth       | yyyyyy.AVxx3     | -99 to 99           | None | Analog Variable   | R          | None           |
| #xxNC - Main Output Status      | yyyyyy.AVxx4     | 0 to 100            | %    | Analog Variable   | R          | None           |
| #xxNC - Secondary Output Status | yyyyyy.AVxx5     | 0 to 100            | %    | Analog Variable   | R          | None           |
| #xxNC - Valve Stroke Time       | yyyyyy.AVxx6     | 10 to 240           | sec  | Analog Variable   | R          | None           |
| #xxNC - Proportional Band       | yyyyyy.AVxx7     | (1 to 20)/(1 to 99) | K    | Analog Variable   | R          | None           |
| #xxNC - Integral Time           | yyyyyy.AVxx8     | 0 to 30             | min  | Analog Variable   | R          | None           |
| *** SYSTEM SELECT               | yyyyyy.AV1       | *1                  | None | Analog Variable   | R/W        | None           |
| *** SYSTEM SELECT               | yyyyyy.AV2       | *1                  | None | Analog Variable   | R          | None           |
| BMG_MANAGER_yyyyyy              | yyyyyy.DEVyyyyyy | Operational         |      | Device            | R          | None           |

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