INDUSTRIAL CONTROL COMMUNICATIONS, INC.

Instruction Manual

TECO Westinghouse

MA7200-1000
Multiprotocol RS-485 Interface Card for MA7200 Drives

MILLENNIUM SERIES

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ICC #10761

MA7200-1000
User's Manual

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APPLICABLE FIRMWARE

For applicable firmware, please refer to the *XLTR-1000 Instruction Manual*.

Usage Precautions

Operating Environment

- Please use the interface only when the ambient temperature of the environment into which the unit is installed is within the following specified temperature limits:

  Operation: -10 ~ +50°C (+14 ~ +122°F)
  Storage: -40 ~ +85°C (-40 ~ +185°F)
- Avoid installation locations that may be subjected to large shocks or vibrations.
- Avoid installation locations that may be subjected to rapid changes in temperature or humidity.

Installation and Wiring

- Proper ground connections are vital for both safety and signal reliability reasons. Ensure that all electrical equipment is properly grounded.
- Route all communication cables separate from high-voltage or noise-emitting cabling (such as ASD input/output power wiring).

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1. Introduction

Congratulations on your purchase of the ICC MA7200-1000 multiprotocol RS-485 interface card for the Teco-Westinghouse MA7200 adjustable-speed drive family. This interface card allows the MA7200 drive to be directly connected to various RS-485 communication networks, such as BACnet MS/TP and Johnson Controls Metasys N2. In addition to the supported fieldbus protocols, the interface card hosts a USB interface for configuring the card via a PC.

Before using the interface card, please familiarize yourself with the product and be sure to thoroughly read the instructions and precautions contained in this manual. In addition, please make sure that this instruction manual is delivered to the end user of the drive and interface card, and keep this instruction manual in a safe place for future reference or unit inspection.

For the latest information, support software and firmware releases, please visit http://www.iccdesigns.com.

Before continuing, please take a moment to ensure that you have received all materials shipped with your kit. These items are:

- MA7200-1000 interface card
- Documentation CD-ROM
- 3 nylon standoffs

Note that different interface card firmware versions may provide varying levels of support for the various protocols. When using this manual, therefore, always keep in mind that the firmware version indicated on your unit must be listed on page 2 for all documented aspects to apply.

This manual will primarily be concerned with the interface card's hardware specifications, installation, wiring, configuration and operational characteristics.

To maximize the abilities of your new interface card, a working familiarity with this manual will be required. This manual has been prepared for the interface card installer, user, and maintenance personnel. With this in mind, use this manual to develop a system familiarity before attempting to install or operate the interface card and drive system.

Note that because the MA7200-1000 is a derivative product of the ICC XLTR-1000 multiprotocol RS-485 network gateway, this instruction manual will not duplicate the majority of the configuration and operation information already contained in the *XLTR-1000 Instruction Manual*. A proper understanding of the MA7200-1000, therefore, relies in part on a thorough understanding of the contents of the *XLTR-1000 Instruction Manual*.

2. Features

Supported Protocols

The interface card currently provides support for the following fieldbus protocols:

- Modbus RTU Master
- Modbus RTU Slave
- BACnet MS/TP Client
- BACnet MS/TP Server
- Johnson Controls Metasys N2 Slave

Note that any combination of these protocols may be configured on the interface card's "RS-485 A (NETWORK)" and "RS-485 B (INVERTER)" ports. Typically, however, the "RS-485 B (INVERTER)" port will be configured as a Modbus RTU master port (to communicate to the MA7200 drive), while the "RS-485 A (NETWORK)" port will be configured for the building network protocol in use.

A Member of the ICC Millennium Series Family

The interface card is a member of the ICC Millennium Series family of communication products. As such, it is able to take advantage of the ICC Gateway Configuration utility, and uses the same network drivers as the standard ICC XLTR-1000 multiprotocol network gateway.

Both Client and Server Functionality

The interface card provides the ability to act as a traditional slave/server device on the fieldbus network (drive mode). However, it is also possible to configure the card to act as a client/master on certain networks (scanner mode), which allows the card to scan remote I/O on its own (perhaps from various sensors, other drives, etc.). This data can then be scaled if desired and passed on to the attached drive, thereby eliminating the necessity of a separate network master to reside on the network, exchanging information among groups of slaves.

Supported Baud Rates

The interface card currently provides support for the following baud rates:

- 2400
- 4800
- 9600
- 19200
- 38400
- 57600
- 76800
- 115200

Note that not all protocols support every baud rate listed above. Refer to the *XLTR-1000 Instruction Manual* for more information.

Field-Upgradeable

As new firmware becomes available, the interface card can be upgraded in the field by the end-user. Refer to the *XLTR-1000 Instruction Manual* for more information.

USB Interface

The interface card can be connected to a PC via a USB mini type-B cable. This simultaneously supplies power while providing the ability to configure the interface card, monitor data, and update firmware on the device using the ICC Gateway Configuration Utility. Refer to the *XLTR-1000 Instruction Manual* for more information.

3. Interface Card Concepts

The MA7200-1000 is a derivative product of the ICC XLTR-1000 multiprotocol RS-485 network gateway. While the MA7200-1000 has been adapted for specific application to the Teco-Westinghouse MA7200 family of drives, it is still fundamentally a XLTR-1000 gateway device at its core. This means that the MA7200-1000 enumerates itself to the ICC Gateway Configuration Utility as a standard XLTR-1000 gateway, uses all existing XLTR-1000 firmware drivers, and is otherwise configured in an identical manner to the XLTR-1000 gateway.

While ICC provides certain "standard" configuration files for typical MA7200-1000 applications on popular fieldbus networks, these configuration files are still entirely user-configurable, allowing end-users to add/remove/change data items and configuration elements to suit their specific application. For detailed instructions regarding how to modify the network configuration elements, please refer to the *XLTR-1000 Instruction Manual*.

The XLTR-1000 gateway is a 2-port RS-485 device, whose two ports are labeled "RS-485 A" and "RS-485 B". These same two ports exist on the MA7200-1000's terminal block, and are labeled on the adjacent silkscreen to clearly identify which port is being configured: "RS-485 A (NETWORK)" and "RS-485 B (INVERTER)". The only other main distinction between the XLTR-1000 gateway and the MA7200-1000 interface card is that the MA7200-1000's RS-485 ports are both only 2-wire interfaces (instead of the 2- or 4-wire interfaces available on the XLTR-1000).

Configuration of the MA7200-1000 can be performed at a workstation, prior to installation of the card into a drive. In this scenario, the interface card will draw power from an attached USB cable, and therefore requires no additional power supply when attached to a computer's USB port. Of course, it is also possible to configure the interface card after it has been installed into an inverter.

The remainder of this instruction manual will deal with items that are specific to the MA7200-1000 interface card. For all other information that is common to the XLTR-1000 gateway (such as network configuration, explanation of configuration fields, etc.), please refer to the *XLTR-1000 Instruction Manual*.

4. Precautions and Specifications

DANGER!

Rotating shafts and electrical equipment can be hazardous. Installation, operation, and maintenance of the interface card shall be performed by **Qualified Personnel** only.

Qualified Personnel shall be:

- Familiar with the construction and function of the interface card and the drive into which it is installed, the equipment being driven, and the hazards involved.
- Trained and authorized to safely clear faults, ground and tag circuits, energize and de-energize circuits in accordance with established safety practices.
- Trained in the proper care and use of protective equipment in accordance with established safety practices.

Installation of the interface card should conform to all applicable **National Electrical Code** (NEC) *Requirements For Electrical Installation*s, all regulations of the **Occupational Safety and Health Administration**, and any other applicable national, regional, or industry codes and standards.

DO NOT install, operate, perform maintenance, or dispose of this equipment until you have read and understood all of the following product warnings and user directions. Failure to do so may result in equipment damage, operator injury, or death.

4.1 Installation Precautions

DANGER!

- Avoid installation in areas where vibration, heat, humidity, dust, metal particles, or high levels of electrical noise (EMI) are present.
- Do not install the interface card where it may be exposed to flammable chemicals or gasses, water, solvents, or other fluids.
- Follow all warnings and precautions and do not exceed equipment ratings.

4.2 Maintenance Precautions

DANGER!

- **Do Not** attempt to disassemble, modify, or repair the interface card. Contact your ICC or Teco-Westinghouse support representative for repair or service information.
- If the interface card should emit smoke or an unusual odor or sound, turn the power off immediately.
- The system should be inspected periodically for damaged or improperly functioning parts, cleanliness, and to determine that all connectors are tightened securely.

4.3 Inspection

Upon receipt, perform the following checks:

- Inspect the unit for shipping damage.
- Check for loose, broken, damaged or missing parts.

Report any discrepancies to your ICC or Teco-Westinghouse support representative.

4.4 Maintenance and Inspection Procedure

Preventive maintenance and inspection is required to maintain the interface card in its optimal condition, and to ensure a long operational lifetime. Depending on usage and operating conditions, perform a periodic inspection once every three to six months.

Inspection Points

- Check that there are no defects in any attached wire terminal crimp points. Visually check that the crimp points are not scarred by overheating.
- Visually check all wiring and cables for damage. Replace as necessary.
- Clean off any accumulated dust and dirt.
- If use of the interface card is discontinued for extended periods of time, apply power at least once every two years and confirm that the unit still functions properly.
- Do not perform hi-pot tests on the interface card, as they may damage the unit.

Please pay close attention to all periodic inspection points and maintain a good operating environment.

4.5 Storage

- Store the device in a well ventilated location (in its shipping carton, if possible).
- Avoid storage locations with extreme temperatures, high humidity, dust, or metal particles.

4.6 Warranty

This interface card is covered under warranty by ICC, Inc. for a period of 12 months from the date of installation, but not to exceed 18 months from the date of shipment from the factory. For further warranty or service information, please contact Industrial Control Communications, Inc. or your local distributor.

4.7 Disposal

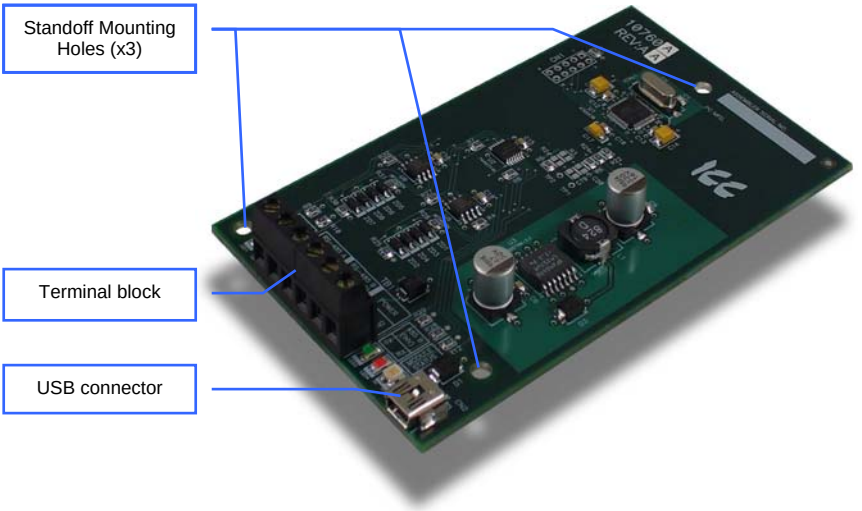
- Contact the local or state environmental agency in your area for details on the proper disposal of electrical components and packaging.
- Do not dispose of the unit via incineration.

4.8 Environmental Specifications

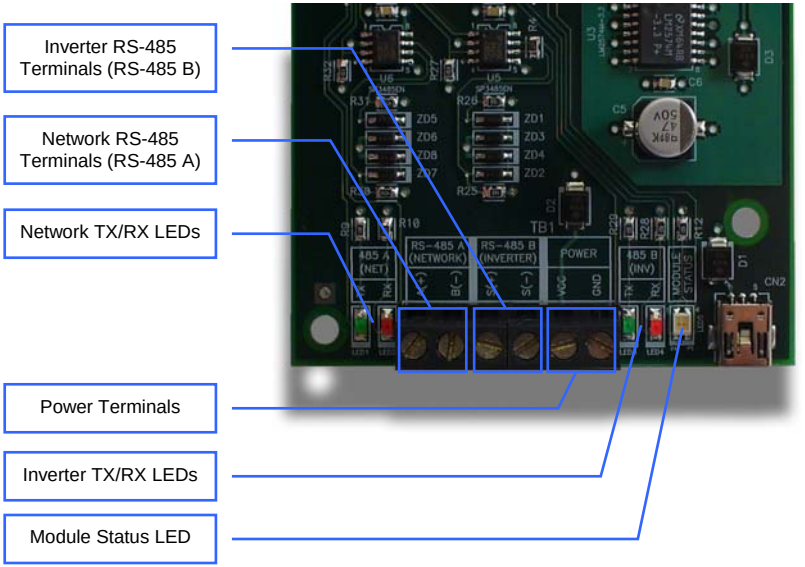
Item	Specification
Operating Environment	Indoors, less than 1000m above sea level, do not expose to direct sunlight or corrosive / explosive gasses
Operating Temperature	-10 ~ +50°C (+14 ~ +122°F)
Storage Temperature	-40 ~ +85°C (-40 ~ +185°F)
Relative Humidity	20% ~ 90% (without condensation)
Vibration	5.9m/s2 {0.6G} or less (10 ~ 55Hz)
Grounding	Non-isolated, referenced to power ground
Cooling Method	Self-cooled

This device is lead-free / RoHS-compliant.

5. Interface Card Overview



Interface Card Overview



Interface Card Details

5.1 Power Supply Electrical Interface

When the interface card is not plugged into a PC via the USB cable, it must be powered by an external power source. Ensure that the power supply adheres to the following specifications:

Voltage rating ..... 5 - 24VDC
Minimum Current rating..... 50mA (@24VDC)

- Typical current consumption of the MA7200-1000 when powered from a 24V supply is approximately 15mA.
- Do not attempt to power the interface card from the drive's "+12V" supply terminal, as this terminal does not provide sufficient current.
- ICC offers an optional 120VAC/12VDC power supply (ICC part number 10755) that can be used to power the interface card from a standard wall outlet.
- The power supply must be connected to terminals "VCC" and "GND"

5.2 RS-485 Port Electrical Interface

In order to ensure appropriate network conditions (signal voltage levels, etc.) when making connections to the interface card's "Network / RS-485 A" port, some knowledge of the network interface circuitry is required. Refer to Figure 1 for a simplified network schematic of the RS-485 interface circuitry. Note that the circuitry for the "Network / RS-485 A" port is not the same as that for the "Inverter / RS-485 B" port, and the connections for these ports are therefore not interchangeable.

The GND terminal should also be used to connect the network ground wire.

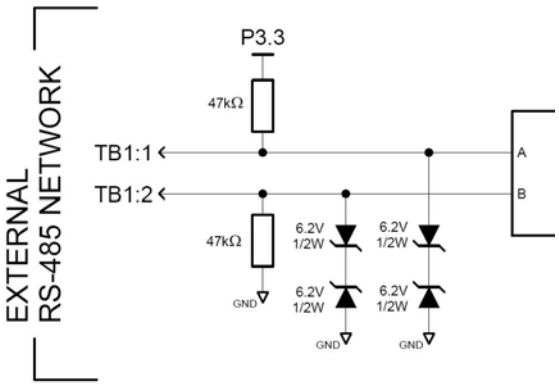


Figure 1: RS-485 Interface Circuitry Schematic

6. Installation

The interface card's installation procedure will vary slightly depending on the size of the drive to which it is to be connected.

- For 3HP and larger MA7200 drives, the interface card mounts directly onto the drive's control board via the three included nylon standoffs.
- For smaller drives, the interface card must be mounted externally (on a panel, etc.)

6.1 Internal Mounting

On 3HP and larger drives, install the three included nylon standoffs into the corresponding holes on the drive's control board, then install the interface card onto the standoffs.

6.2 External Mounting

On drives smaller than 3HP, the interface card must be externally mounted. Refer to Figure 2 for a dimensional drawing of the locations of the standoff holes (4mm diameter) to be drilled into the mounting panel. Use appropriate hardware (not included) to attach the interface card to the mounting panel.

The included nylon standoffs may be used to mount the interface card to the panel if a 4mm drill bit is used, and the thickness of the panel is approximately equivalent to the thickness of a typical PCB (0.0625" / 1.6mm).

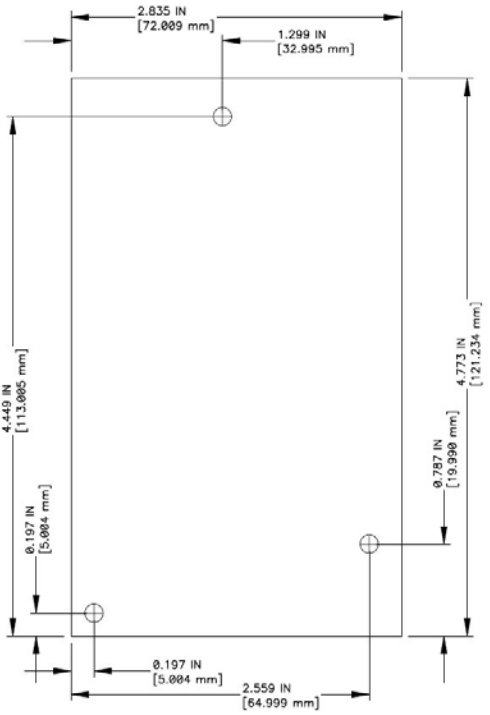


Figure 2: External Mounting Diagram

6.3 Wiring Connections

1. Mount the interface card via the desired method, depending on the drive's capacity (refer to sections 6.1 or 6.2).
2. Connect the RS-485 B (INVERTER) terminals to the indicated "S(+)" and "S(-)" RS-485 terminals on the MA7200 drive.
3. Connect the network wiring to the RS-485 A (NETWORK) terminals. Connect the network GROUND wire to the same GND terminal used by the interface card's power supply.
4. Connect the power supply to the VCC and GND terminals as indicated on the interface card's silkscreen. Pay particular attention to the proper polarity.
5. Take a moment to verify that the power and communication cables have sufficient clearance from electrical noise sources such as motor wiring or power-carrying electrical wiring. Also ensure that all wires are fully seated into their respective terminal blocks, and that they are routed away from any sharp edges or positions where they may be pinched.

6.4 Grounding

Grounding is of particular importance for reliable, stable operation. Communication system characteristics may vary from system to system, depending on the system environment and grounding method used. The interface card has a single GND terminal that serves as the ground reference for both power and RS-485 A (NETWORK) communication signals.

Please be sure to consider the following general points for making proper ground connections:

Grounding method checkpoints

1. Make all ground connections such that no ground current flows through the case or heatsink of a connected electrical device.
2. Do not connect the GND terminal to a drive power ground or any other potential noise-producing ground connection.
3. Do not make connections to unstable grounds (paint-coated screw heads, grounds that are subjected to inductive noise, etc.)

7. LED Indicators

The interface contains several different LED indicators, each of which conveys important information about the status of the unit and connected networks. Each of these indicators is clearly identified by a silkscreened label on the interface card, and their functions are summarized here.

7.1 Module Status

The interface card has one dichromatic LED to indicate the status of the device. On startup, the LED blinks a startup sequence: Green, Red, Green, Red. Always confirm this sequence upon powering the interface card to ensure the device is functioning properly.

Solid green ..... The status LED lights solid green when the interface card has power and is functioning normally.

Flashing green..... The status LED flashes green when the interface card is connected to a PC via a USB cable.

Flashing red..... If a fatal error occurs, the status LED will flash a red error code. The number of sequential blinks (followed by 2 seconds of OFF time) indicates the error code. Contact ICC for further assistance.

7.2 RS-485 Network Status LEDs

The interface has one red and one green LED for each of the two RS-485 ports to indicate the status of that RS-485 network. The “485 A (NET)” LEDs indicate the transfer of data on the RS-485 A (NETWORK) port, and the “485 B (INV)” LEDs indicate the transfer of data between the interface card and the drive.

Green (TX) LED ..... Lights when the interface card is transmitting data on that RS-485 port.

Red (RX) LED ..... Lights when the interface card is receiving data on that RS-485 port. Note that this does not indicate the validity of the data with respect to a particular protocol: only that data exists and is being detected. Also note that the RX LED will always light in conjunction with the corresponding TX LED (as transmitting devices on 2-wire RS-485 networks also receive their own transmissions).

8. Drive Parameter Configuration

The interface card communicates to the drive via its standard RS-485 port with the Modbus RTU protocol. Therefore, certain parameters (baud rate, etc.) on the drive must be configured to match the interface card's settings for communication to be successful. In addition, there are other drive parameters that may or may not be modified depending on, for example, whether or not the drive is to be commanded from the network.

This section will detail some important considerations to make note of when connecting to, and interacting with, the MA7200 drive.

- Although the latest MA7200 Modbus manual (dated 2001/06/05) indicates that the maximum baud rate (set via parameter Sn-37) is 9600 baud, all newer drives actually support 19.2kbaud (Sn-37 = 4). For optimal data throughput, it is recommended to use the fastest baud rate supported on your drive.
- When drive parameter Sn-38 (parity) is set to 0 (no parity), the interface card's RS-485 B (INVERTER) configuration can be set to either "No Parity (1 Stop Bit)" or "No Parity (2 Stop Bits)" (either setting will work).
- Note that the default value of drive parameter Cn-27 (time-out check) is 1.0s. If it is desired to disable communication timeout checking between the interface card and the drive, set parameter Cn-27 to 0.0s.
- If run/stop etc. commands are to come from network, set drive parameter Sn-04 to 2.
- If frequency reference is to come from network, set drive parameter Sn-05 to 2.
- Note that the holding register "address" column provided in the MA7200 Modbus manual contains the Modbus "addressed as" (on-the-wire) values, which are always 1 less than the Modbus "known as" values (which the ICC Gateway Configuration Utility requires). Additionally, this "address" column indicates the holding register numbers in hexadecimal, which is atypical for Modbus decimal-based register assignments. Therefore, to calculate the "register" assignment that must be programmed into the interface card's service object configuration, first convert the documented "address" to a decimal value, and then add 1. For example, the MA7200's "output frequency" register is documented to exist at register 0025H. Converting this number to decimal and adding 1 therefore results in a "known as" register value of 38, which can then be entered in a service object's "Start Reg" configuration field.
- The MA7200 drops Modbus packets frequently when it is in PRG mode, which negatively impacts the overall quality of communications between the interface card and the drive. Therefore, it is recommended to not leave the drive in PRG mode for long periods of time unless absolutely necessary.
- The MA7200 Modbus manual indicates that control data registers (0000H..000FH) are read/write, but reading always returns 0. It is therefore

recommended that service objects targeting these registers have their “read” function disabled.

- All drive parameters may be read at any time, but only An and Bn parameters can be written while the inverter is in DRV mode. The inverter must be in PRG mode to write any other parameters.
- Changes to the drive parameters that configure the RS-485 communication characteristics (baud rate, etc.) do not take effect until the drive is reset.
- Cn parameter changes take effect instantly, while others don't take effect until the inverter is put back into DRV mode or the parameters are saved into EEPROM and the inverter is reset.
- The “write to EEPROM” register (0900H) is write-only. It is therefore recommended that service objects targeting this register have their “read” function disabled.

9. Quick-Start Configuration

This section will detail an example quick-start configuration procedure that loads the predefined BACnet MS/TP configuration file onto the interface card. This configuration procedure can either be done at a workstation (with the card powered via the computer's USB port) prior to installation into the drive, or it can be performed once the card has already been installed in the drive.

Although this procedure will only demonstrate loading one of the predefined configuration files (which map typically-used drive parameters to the fieldbus network), it is perfectly acceptable to modify the predefined configuration files to suit your specific application. For detailed procedures on how to modify protocol object definitions, service objects etc., please refer to the *XLTR-1000 Instruction Manual*.

For overviews of the predefined configuration file contents, refer to section 10.

1. Connect the interface card to the computer via a USB mini type-B cable.
2. Open the ICC Gateway Configuration Utility and select the XLTR-1000 via either explicitly selecting the device (Figure 3) or by clicking on the "Auto Connect" button (Figure 4).

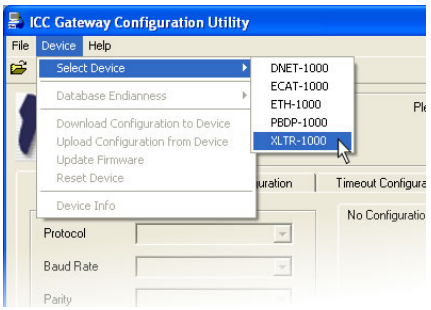


Figure 3: Explicitly Select Device

Figure 4: Auto Connect

3. Confirm that the status should now be "Connected", and the on-board firmware information should be displayed in the "Device" group (Figure 5).

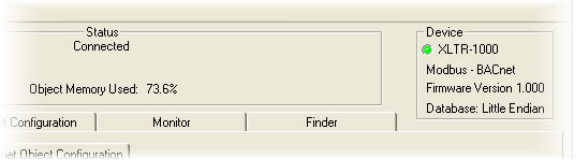


Figure 5: Connected Status

4. Choose “Load Configuration” either via the “File…Load Configuration…” menu (Figure 6), or by clicking on the folder icon in the toolbar (Figure 7). This will load the predefined configuration file from your PC into the Gateway Configuration Utility for manipulation and subsequent download to the interface card.

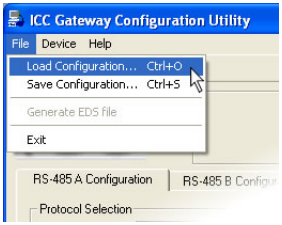


Figure 6: Load Configuration

Figure 7: Load Configuration

5. Select the desired predefined configuration file and then click the “Open” button. In this example, we will be selecting the predefined BACnet MS/TP configuration (Figure 8).

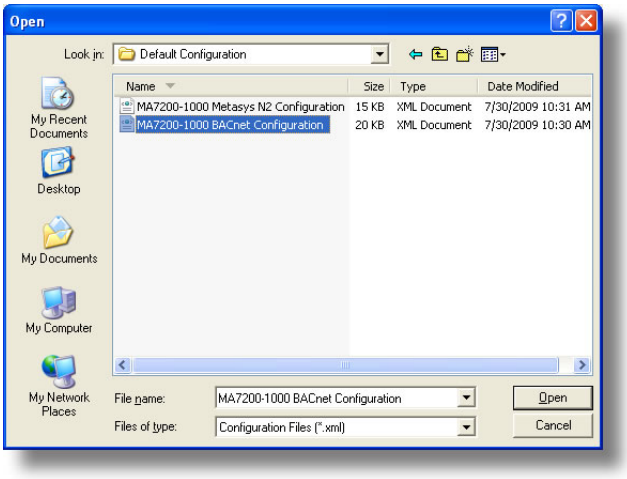


Figure 8: Select Predefined Configuration File

6. The configuration file will be loaded, and the configuration elements will be visible in the “RS-485 A Configuration” and “RS-485 B Configuration” tabs (Figure 9). Remember that the interface card’s “RS-485 A” port communicates to the fieldbus network, and the “RS-485 B” port communicates to the drive.

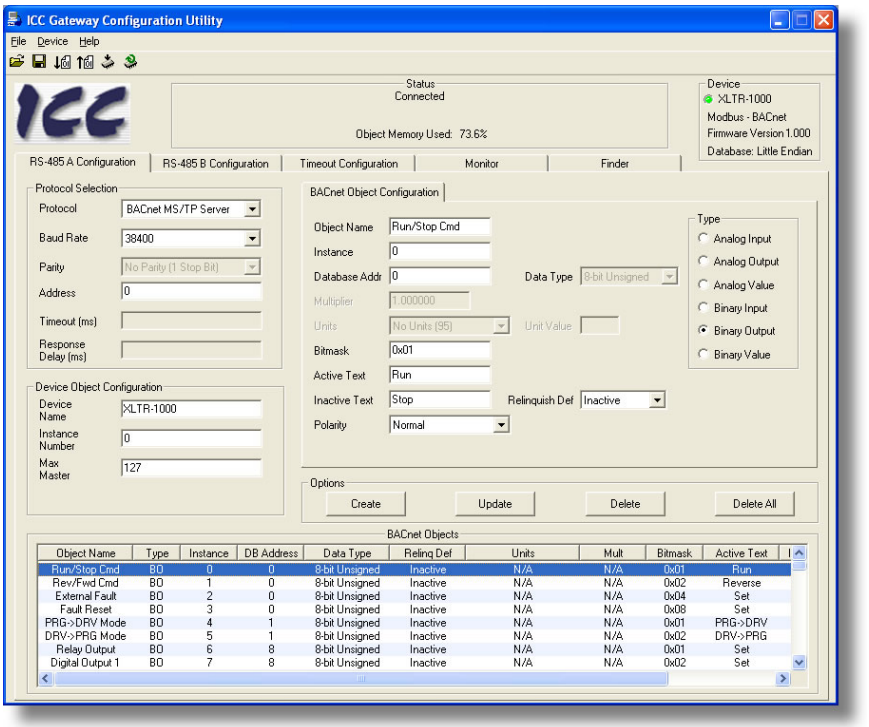


Figure 9: Configuration File Loaded

7. Although a predefined configuration file is being used, some minimal amount of installation-specific configuration will still be required for each card. For example, each drive installed on a BACnet MS/TP network must be configured for the appropriate network baud rate, station address, and device object configuration values. This information is found on the “RS-485 A Configuration” tab (Figure 10). Similarly, it may be necessary to adjust the “RS-485 B Configuration” to match the drive’s parameter settings (or vice-versa). Specifically, the baud rate and parity settings (Figure 11) must match the drive’s settings for Sn-37 and Sn-38, respectively. Each Modbus master service object on the RS-485 B configuration tab is also embedded with a destination address, which is set to “1” in the predefined configuration files. So that every service object does not have to be modified, it is therefore recommended to set the drive’s “node address” parameter (Sn-36) to “1” (default setting).

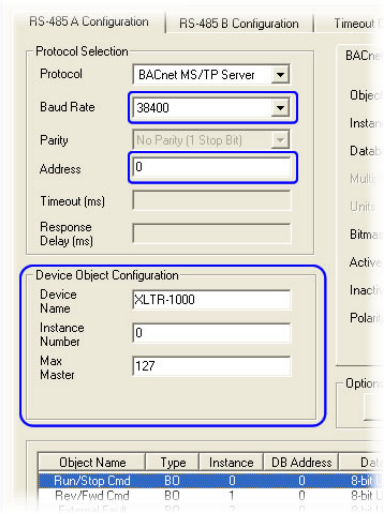


Figure 10: BACnet Configuration

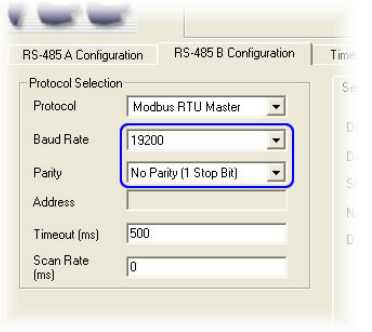


Figure 11: Modbus Configuration

8. Choose “Download Configuration to Device” either via the “Device…Download Configuration to Device” menu (Figure 12), or by clicking on the download icon in the toolbar (Figure 13).

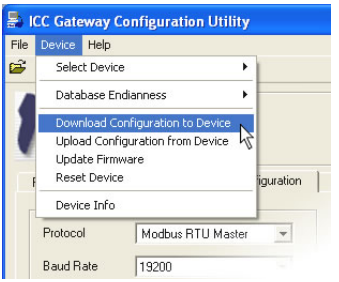


Figure 12: Download Configuration

Figure 13: Download Configuration

9. Click “Yes” to confirm on the dialog box that appears (Figure 14).

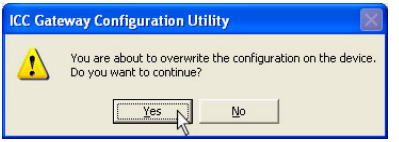


Figure 14: Confirm Download

10. The configuration file will be downloaded to the interface card, which should only require a few seconds to complete. Once completed, the status should indicate that the configuration was updated successfully (Figure 15), and a dialog box will then appear which indicates that the interface card must be reset for the new configuration to take effect (Figure 16). Click “Yes”.

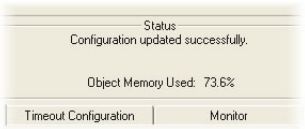


Figure 15: Update Success

Figure 16: Confirm Reset

11. Once the interface card reboots, it will now be communicating with the new configuration. If connected to a drive, confirm that the “485 B (INV)” TX and RX LEDs should be blinking rapidly (dozens of blinks per second). If this is not the case, then recheck the drive and interface card communication parameter settings, as well as the interface card-to-drive wiring.
12. Connect to the interface card via the fieldbus network. If communications cannot be successfully established, recheck the communication settings on the interface card and network equipment, as well as the network wiring. When connected to the interface card via the Configuration Utility, the “Monitor” tab can be a useful tool to observe real-time data flowing to and from the drive and network.
13. Congratulations! Your configuration is complete. You may now disconnect the USB cable from the interface card.

10. Predefined Configuration Files

This section will detail the predefined configuration files that are currently provided. While using these files as-is may be sufficient for most applications, it is possible to modify them in any way necessary to optimize a specific situation. For details regarding this procedure, refer to the *XLTR-1000 Instruction Manual* and the Teco-Westinghouse *MA7200 Modbus Manual*.

Further insight into the specific configuration of each of these objects may also be gained by inspecting their configuration from within the Gateway Configuration Utility.

10.1 BACnet MS/TP Server

Table 1: List of Binary Outputs

Instance ID	Object Name	Description	Active/Inactive Text
BO0	Run/Stop Cmd	Run/Stop Command	Run/Stop
BO1	Rev/Fwd Cmd	Reverse/Forward Command	Reverse/Forward
BO2	External Fault	External Fault	Set/Clear
BO3	Fault Reset	Fault Reset	Set/Clear
BO4	PRG->DRV Mode	Switch to DRV mode from PRG	PRG->DRV/Invalid
BO5	DRV->PRG Mode	Switch to PRG mode from DRV	DRV->PRG/Invalid
BO6	Relay Output	Relay Output Command	Set/Clear
BO7	Digital Output 1	Digital Output 1 Command	Set/Clear
BO8	Digital Output 2	Digital Output 2 Command	Set/Clear

Table 2: List of Analog Outputs

Instance ID	Object Name	Description	Units	Multiplier	Notes
AO0	H.L. Freq Ref	Host Link Frequency Reference	Hertz (27)	0.002000	Multiplier must change if Cn-02 is not set to 60.0 Hz
AO1	Analog Output 1	Analog Output 1 Command	Volts (5)	0.010000	
AO2	Analog Output 2	Analog Output 2 Command	Volts (5)	0.010000	

Table 3: List of Binary Inputs

Instance ID	Object Name	Description	Active/Inactive Text
BI0	Run/Stop Stat	Run/Stop Status	Running/Stopped
BI1	Zero Speed	Indicates drive's speed is 0	Zero/Non-Zero
BI2	Rev/Fwd Stat	Reverse/Forward Status	Reverse/Forward
BI3	Inverter Ready	Inverter Ready	Ready/Unready
BI4	DRV/PRG Mode	The current mode of the drive	DRV/PRG
BI5	Series	The drive is 440V or 220V series	440V/220V
BI6	Inverter Alarm	Indicates an alarm has been triggered	Alarm/No Alarm
BI7	Inverter Fault	Indicates a fault has been triggered	Fault/No Fault
BI8	LCD Digital Oper	LCD Digital Operator	Present/Not Pres
BI9	UV1 Fault	Under Voltage Fault	Fault/No Fault
BI10	OC Fault	Over Current Fault	Fault/No Fault
BI11	OV Fault	Over Voltage Fault	Fault/No Fault
BI12	OH Fault	Over Heat Fault	Fault/No Fault
BI13	OL1 Fault	Motor Over Load Fault	Fault/No Fault
BI14	OL2 Fault	Inverter Over Load Fault	Fault/No Fault
BI15	OL3 Fault	Output Over Torque Fault	Fault/No Fault
BI16	EF3 Fault	External Fault 3	Fault/No Fault
BI17	EF5 Fault	External Fault 5	Fault/No Fault
BI18	EF6 Fault	External Fault 6	Fault/No Fault
BI19	EF7 Fault	External Fault 7	Fault/No Fault
BI20	EF8 Fault	External Fault 8	Fault/No Fault
BI21	CPF04 Fault	EEPROM Fault	Fault/No Fault
BI22	CPF05 Fault	CPU A/D Fault	Fault/No Fault
BI23	GF Fault	Ground Fault	Fault/No Fault
BI24	PG Over Spd Flt	PG Over Speed Fault	Alarm/No Alarm
BI25	UV Alarm	Under Voltage Alarm	Alarm/No Alarm
BI26	OV Alarm	Over Voltage Alarm	Alarm/No Alarm
BI27	OH Alarm	Over Heat Alarm	Alarm/No Alarm
BI28	OL3 Alarm	Over Torque Alarm	Alarm/No Alarm
BI29	EF Alarm	Two Line Terminal 1, 2 External Alarm	Alarm/No Alarm
BI30	BB Alarm	Base Block Alarm	Alarm/No Alarm
BI31	EEPROM Alarm	EEPROM Alarm	Alarm/No Alarm
BI32	EF3 Alarm	External Alarm 3	Alarm/No Alarm
BI33	PG Over Spd Alm	PG Over Speed Alarm	Alarm/No Alarm
BI34	PG Spd Dev Alarm	PG Speed Deviation Alarm	Alarm/No Alarm

Instance ID	Object Name	Description	Active/Inactive Text
BI35	PG Line Alarm	PG Line Alarm	Alarm/No Alarm
BI36	Brake Res Alarm	Braking Resistor Over Heat Alarm	Alarm/No Alarm
BI37	RS-485 Com Alarm	RS-485 Communication Alarm	Alarm/No Alarm
BI38	DI 1 Status	Digital Input 1 Status	Close/Open
BI39	DI 2 Status	Digital Input 2 Status	Close/Open
BI40	DI 3 Status	Digital Input 3 Status	Close/Open
BI41	DI 4 Status	Digital Input 4 Status	Close/Open
BI42	DI 5 Status	Digital Input 5 Status	Close/Open
BI43	DI 6 Status	Digital Input 6 Status	Close/Open
BI44	DI 7 Status	Digital Input 7 Status	Close/Open
BI45	DI 8 Status	Digital Input 8 Status	Close/Open
BI46	RA-RB-RC Status	Relay Output Status	Close/Open
BI47	DO1-DOG Status	Digital Output 1 Status	Close/Open
BI48	DO2-DOG Status	Digital Output 2 Status	Close/Open

Table 4: List of Analog Inputs

Instance ID	Object Name	Description	Units	Multiplier	Notes
AI0	Status Word	Monitor Data Word	No Units (95)	1.000000	Modbus register address 0020H
AI1	Faults	Word containing fault causes	No Units (95)	1.000000	Modbus register address 0021H
AI2	Alarms 1	Word containing alarm causes	No Units (95)	1.000000	Modbus register address 0022H
AI3	Alarms 2	Word containing alarm causes	No Units (95)	1.000000	Modbus register address 0023H
AI4	Frequency Ref	Frequency Reference	Hertz (27)	0.002000	Multiplier must change if Cn-02 is not set to 60.0 Hz
AI5	Output Frequency	Output Frequency	Hertz (27)	0.002000	Multiplier must change if Cn-02 is not set to 60.0 Hz
AI6	PG Speed FB	PG Speed Feedback	Hertz (27)	0.060000	Multiplier must change if Cn-02 is not set to 60.0 Hz
AI7	Output Current	Output Current	Amps (3)	0.100000	
AI8	DC Voltage	DC Voltage	Volts (5)	1.000000	

Instance ID	Object Name	Description	Units	Multiplier	Notes
AI9	Analog Input VIN	Analog Input VIN Value	Volts (5)	0.010000	
AI10	Analog Input AIN	Analog Input AIN Value	Milliamps (2)	0.020000	
AI11	Analog Input AUX	Analog Input AUX Value	Volts (5)	0.010000	
AI12	Digital Inputs	Word containing Digital Input Status 1-8	No Units (95)	1.000000	
AI13	AO1 Value	Analog Output 1 Value	Volts (5)	0.010000	
AI14	AO2 Value	Analog Output 2 Value	Volts (5)	0.010000	
AI15	Digital Outputs	Word containing Relay and Digital Output Status	No Units (95)	1.000000	

10.2 Johnson Controls Metasys N2

Table 5: List of Binary Outputs

Instance ID	Object Name	Description	Active/Inactive Description
BO1	Run/Stop Cmd	Run/Stop Command	Run/Stop
BO2	Rev/Fwd Cmd	Reverse/Forward Command	Reverse/Forward
BO3	External Fault	External Fault	Set/Clear
BO4	Fault Reset	Fault Reset	Set/Clear
BO5	PRG->DRV Mode	Switch to DRV mode from PRG	PRG->DRV/Invalid
BO6	DRV->PRG Mode	Switch to PRG mode from DRV	DRV->PRG/Invalid
BO7	Relay Output	Relay Output Command	Set/Clear
BO8	Digital Output 1	Digital Output 1 Command	Set/Clear
BO9	Digital Output 2	Digital Output 2 Command	Set/Clear

Table 6: List of Analog Outputs

Instance ID	Object Name	Description	Units	Multiplier	Notes
AO1	H.L. Freq Ref	Host Link Frequency Reference	Hertz	0.002000	Multiplier must change if Cn-02 is not set to 60.0 Hz
AO2	Analog Output 1	Analog Output 1 Command	Volts	0.010000	
AO3	Analog Output 2	Analog Output 2 Command	Volts	0.010000	

Table 7: List of Binary Inputs

Instance ID	Object Name	Description	Active/Inactive Description
BI1	Run/Stop Stat	Run/Stop Status	Running/Stopped
BI2	Zero Speed	Indicates drive's speed is 0	Zero/Non-Zero
BI3	Rev/Fwd Stat	Reverse/Forward Status	Reverse/Forward
BI4	Inverter Ready	Inverter Ready	Ready/Unready
BI5	DRV/PRG Mode	The current mode of the drive	DRV/PRG
BI6	Series	The drive is 440V or 220V series	440V/220V
BI7	Inverter Alarm	Indicates an alarm has been triggered	Alarm/No Alarm
BI8	Inverter Fault	Indicates a fault has been triggered	Fault/No Fault
BI9	LCD Digital Oper	LCD Digital Operator	Present/Not Pres
BI10	UV1 Fault	Under Voltage Fault	Fault/No Fault
BI11	OC Fault	Over Current Fault	Fault/No Fault
BI12	OV Fault	Over Voltage Fault	Fault/No Fault
BI13	OH Fault	Over Heat Fault	Fault/No Fault
BI14	OL1 Fault	Motor Over Load Fault	Fault/No Fault
BI15	OL2 Fault	Inverter Over Load Fault	Fault/No Fault
BI16	OL3 Fault	Output Over Torque Fault	Fault/No Fault
BI17	EF3 Fault	External Fault 3	Fault/No Fault
BI18	EF5 Fault	External Fault 5	Fault/No Fault
BI19	EF6 Fault	External Fault 6	Fault/No Fault
BI20	EF7 Fault	External Fault 7	Fault/No Fault
BI21	EF8 Fault	External Fault 8	Fault/No Fault
BI22	CPF04 Fault	EEPROM Fault	Fault/No Fault
BI23	CPF05 Fault	CPU A/D Fault	Fault/No Fault
BI24	GF Fault	Ground Fault	Fault/No Fault
BI25	PG Over Spd Flt	PG Over Speed Fault	Alarm/No Alarm
BI26	UV Alarm	Under Voltage Alarm	Alarm/No Alarm
BI27	OV Alarm	Over Voltage Alarm	Alarm/No Alarm
BI28	OH Alarm	Over Heat Alarm	Alarm/No Alarm
BI29	OL3 Alarm	Over Torque Alarm	Alarm/No Alarm
BI30	EF Alarm	Two Line Terminal 1, 2 External Alarm	Alarm/No Alarm
BI31	BB Alarm	Base Block Alarm	Alarm/No Alarm
BI32	EEPROM Alarm	EEPROM Alarm	Alarm/No Alarm
BI33	EF3 Alarm	External Alarm 3	Alarm/No Alarm
BI34	PG Over Spd Alm	PG Over Speed Alarm	Alarm/No Alarm
BI35	PG Spd Dev Alarm	PG Speed Deviation Alarm	Alarm/No Alarm

Instance ID	Object Name	Description	Active/Inactive Description
BI36	PG Line Alarm	PG Line Alarm	Alarm/No Alarm
BI37	Brake Res Alarm	Braking Resistor Over Heat Alarm	Alarm/No Alarm
BI38	RS-485 Com Alarm	RS-485 Communication Alarm	Alarm/No Alarm
BI39	DI 1 Status	Digital Input 1 Status	Close/Open
BI40	DI 2 Status	Digital Input 2 Status	Close/Open
BI41	DI 3 Status	Digital Input 3 Status	Close/Open
BI42	DI 4 Status	Digital Input 4 Status	Close/Open
BI43	DI 5 Status	Digital Input 5 Status	Close/Open
BI44	DI 6 Status	Digital Input 6 Status	Close/Open
BI45	DI 7 Status	Digital Input 7 Status	Close/Open
BI46	DI 8 Status	Digital Input 8 Status	Close/Open
BI47	RA-RB-RC Status	Relay Output Status	Close/Open
BI48	DO1-DOG Status	Digital Output 1 Status	Close/Open
BI49	DO2-DOG Status	Digital Output 2 Status	Close/Open

Table 8: List of Analog Inputs

Instance ID	Object Name	Description	Units	Multiplier	Notes
AI1	Status Word	Monitor Data Word		1.000000	Modbus register address 0020H
AI2	Faults	Word containing fault causes		1.000000	Modbus register address 0021H
AI3	Alarms 1	Word containing alarm causes		1.000000	Modbus register address 0022H
AI4	Alarms 2	Word containing alarm causes		1.000000	Modbus register address 0023H
AI5	Frequency Ref	Frequency Reference	Hertz	0.002000	Multiplier must change if Cn-02 is not set to 60.0 Hz
AI6	Output Frequency	Output Frequency	Hertz	0.002000	Multiplier must change if Cn-02 is not set to 60.0 Hz
AI7	PG Speed FB	PG Speed Feedback	Hertz	0.060000	Multiplier must change if Cn-02 is not set to 60.0 Hz
AI8	Output Current	Output Current	Amps	0.100000	
AI9	DC Voltage	DC Voltage	Volt	1.000000	

Instance ID	Object Name	Description	Units	Multiplier	Notes
AI10	Analog Input VIN	Analog Input VIN Value	Volts	0.010000	
AI11	Analog Input AIN	Analog Input AIN Value	Milliamps	0.020000	
AI12	Analog Input AUX	Analog Input AUX Value	Volts	0.010000	
AI13	Digital Inputs	Word containing Digital Input Status 1-8		1.000000	
AI14	AO1 Value	Analog Output 1 Value	Volts	0.010000	
AI15	AO2 Value	Analog Output 2 Value	Volts	0.010000	
AI16	Digital Outputs	Word containing Relay and Digital Output Status		1.000000	

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