IS1001™ Multiplexing Transceiver System

User Manual

Initial Release

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Document History

Release Date	Doc Version	Firmware Version	Comments
October, 2012	Initial		Initial customer release of this manual.

READ THROUGH THIS ENTIRE MANUAL BEFORE INSTALLING AND OPERATING YOUR IS1001-MTS. FOLLOW ALL STEPS EXACTLY. USING THE IS1001-MTS IN A MANNER FOR WHICH IT WAS NOT DESIGNED MAY IMPAIR THE SAFETY FEATURES BUILT IN BY THE MANUFACTURER.

Safety Symbols

|	
⚠	Indicates care should be taken to avoid physical harm. Only qualified service personnel should access the internal components of the IS1001-MTS.

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Product Description

The IS1001™ Multiplexing Transceiver System (MTS) is a high performance RFID detection system that is specifically designed for applications that require low power consumption, a large detection area, and high adaptability to environmental changes. The IS1001-MTS consists of one Master Controller and multiple IS1001 readers.
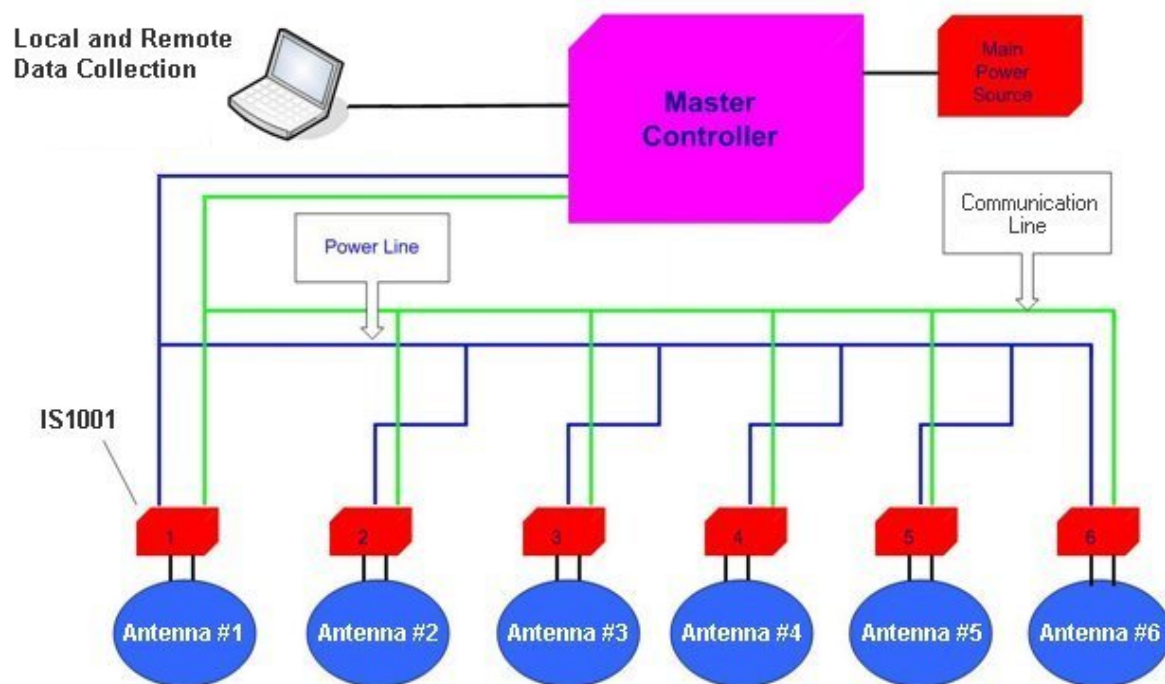
Each IS1001 reader incorporates hardware and software to support not only PIT tag detection but also data communication to the Master Controller. Each IS1001's antenna exciter circuitry is designed to operate a large antenna (possibly as large as 4 feet by 20 feet) with low coil inductance to provide a large detection area that is tolerant of environmental changes. In addition, each IS1001 can carry out independent automatic dynamic antenna tuning while providing ample power to its antenna for optimal tag activation and detection. Each IS1001 can be activated automatically according to a user-selected timing sequence established in the Master Controller. The activated IS1001 makes any necessary tuning adjustments due to environmental changes and looks for the presence of a PIT tag. The IS1001 will remain scanning until the allotted scanning time expires (see page 28 for an explanation of the scanning times). The detected tag data is transmitted to the Master Controller and is processed according to user-selected settings. No tag data is stored locally on the IS1001 when it is part of the Multiplexing Transceiver System.

The Master Controller polls the IS1001s in a user-selectable sequence and is able to activate one or two IS1001s at a time. The Master Controller saves tag data and each IS1001's system information in its internal memory. It can also save the information on a removable memory device or communicate the data in real time via various paths to a host computer or a data logger.

Product Description

Communication between the Master Controller and the IS1001s is achieved using the Controller Area Network (CAN) protocol , providing a robust communication path of up to 1000 feet in length. An IS1001 acquires minimal basic status information of its operation and provides that information and captured tag ID data to the Master Controller whenever requested. The Master Controller also has the capability to synchronize with other Master Controllers.

With its Master Controller(s) and support for multiple IS1001s, the IS1001-MTS provides a highly adaptive and effective RFID detection system for various environmental, industrial and commercial applications. The IS1001-MTS system incorporates the following features:

- Support for up to 12 antennas
- Dynamic antenna auto-tuning
- Adjustable antenna output power
- Detection of ISO-compliant FDX-B and HDX PIT tags
- Automatic system performance diagnostics using a virtual tag test
- Flexible and configurable to support a wide array of system applications
- LCD graphical display with an easy to navigate menu
- Configurable non-volatile setup parameters
- Non-volatile internal memory for storing up to 16MB of real-time information such as tag IDs, alarms, messages, and reports
- USB port for data logging to an external flash drive
- USB port for local operation
- Ethernet and fiber optic ports for remote operation
- Synchronization capability for multiple Master Controllers
- DC power input
- Field upgradeable firmware

IS1001 Specifications

Item	Description
Input Voltage	18-28 V DC
Input Fuse	3 A, Resettable
Reverse Polarity Protection	Yes
Undervoltage Protection	Yes
Overvoltage Protection	Yes
In-rush Current Limiting	Yes
Antenna Exciter Voltage	12-20 V DC, Electronically Adjustable, 5-Steps
Antenna Exciter Configuration	Full Bridge
Antenna Current Limit	11.0 Ap-p, Firmware Enforced
Antenna Tuning	10 Capacitors, Electronically Switched
Operating Frequency	134.2 KHz
Synchronization Capability (IS1001 Standalone Operation)	Antenna Exciter Clock Synchronization Network Configuration Hardwired Twisted-Pair Interface
Tag Technologies Decoding	ISO FDX-B, ISO HDX
Virtual Tag Test	Detection Self-Diagnostic, Electronically Adjustable Level
Internal Data Storage (IS1001 Standalone Operation)	10009 Tag IDs, 199 Status Reports
External Data Storage (IS1001 Standalone Operation with Optional Accessory Board)	Up to 32Gb of real-time information on USB flash drive
Power Port	Terminal Block Connector (3 Positions Receptacle)
CAN Bus Port	Terminal Block Connector (3 Positions Receptacle)
Antenna Port	Terminal Block Connector (4 Positions Receptacle)
Communication Ports	USB (Mini-B); ASCII Protocol
External Status LEDs (With optional Accessory Board)	- Power (Green) - Tuned (Red) - Scan (Yellow) - Tag (White)
Buzzer (With optional Accessory Board)	Piezo Indicator, 4 KHz, 70 dB (Optional)
Operating Temperature Range	-4˚F to 158˚F (-20˚C to 70˚C)
Operating Humidity Range	10% to 90%, Non-Condensing
Weight	1.0 lbs. (0.45 kg) (w/o enclosure)
Dimensions	12.25"L x 3.75"W x 2.00"H (31cm x 9.5cm x 5cm) (w/o enclosure)
Agency Approvals	No

Master Controller Specifications

Item	Description
Input Voltage	20-28 V DC
Input Fuse	4 A, Resettable
Reverse Polarity Protection	Yes
Undervoltage Protection	Yes
Overvoltage Protection	Yes
In-rush Current Limiting	Yes
Synchronization Capability	IS1001 Activation Synchronization
	Chain Configuration
	Hardwired Twisted-Pair Interface
Tag Technologies Decoding	ISO FDX-B, ISO HDX
Virtual Tag Test	Detection Self-Diagnostic, Electronically Adjustable Level
Internal Data Storage	16MB of real-time information
External Data Storage	Up to 32GB of real-time information on USB flash drive
IS1001 Ports	Two, supporting up to 12 nodes
Communication Ports	USB (Mini-B); ASCII Protocol
	Ethernet (RJ45); ASCII Protocol
	Fiber Optics (ST); ASCII Protocol
External Status LEDs	Power On (Green)
	System Ready (Yellow)
	Tag Detected (Red)
Buzzer	Piezo Indicator, 4 KHz, 70 dB
Display	Graphical LCD, Backlit
Keypad	9 Keys, Content-Sensitive
Operating Temperature Range	-4˚F to 158˚F (-20˚C to 70˚C)
Operating Humidity Range	10% to 90%, Non-Condensing
Enclosure	NEMA 4x, IP66 Rated Steel Box
Weight	16.6 lbs. (7.5 kg)
Dimensions	21.0" L x 8.0" W x 6.0" H (53.5 cm x 20.5 cm x 15.5 cm)
Agency Approvals	No

IS1001 Major Internal Hardware Components

Shown as supplied by Biomark.
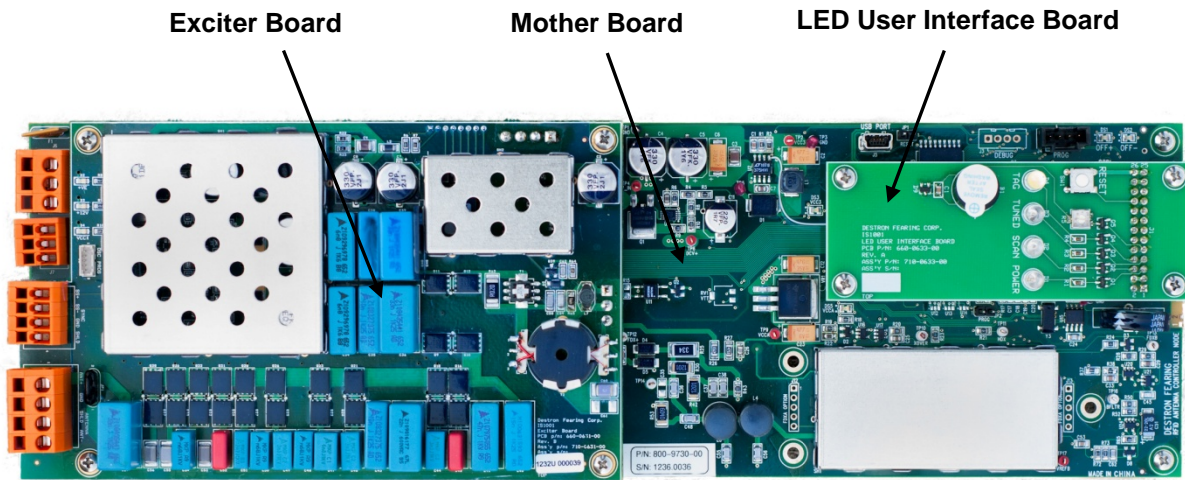
Shown with sample user-supplied enclosure containing pass-through openings for required cables.
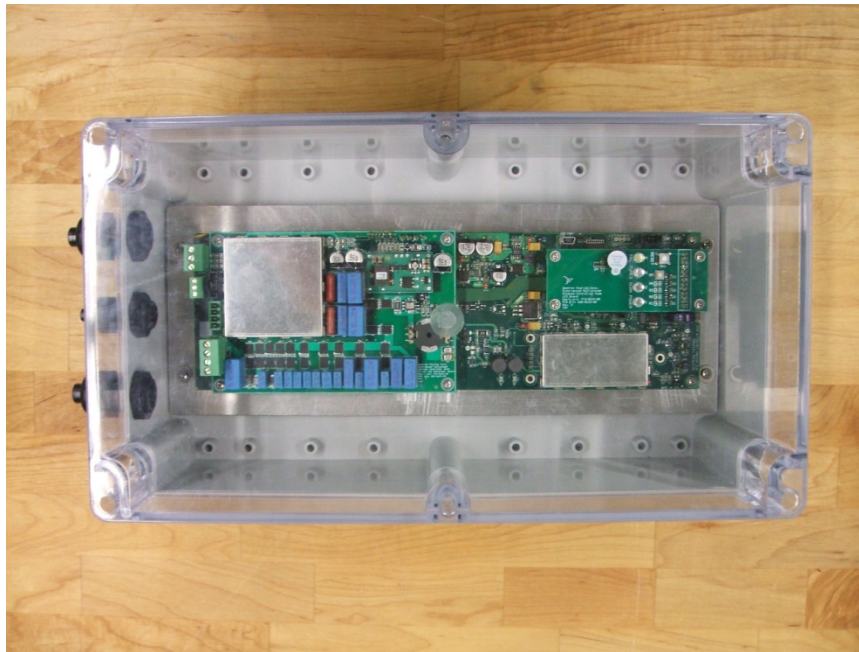
Close-up View of LED User Interface Board (optional) and Mother Board

3V Power LED   USB Port   User Interface LEDs   Antenna Out of Tune LEDs

5V Power LED   FDX-B Filter Output Test Point   Beeper Potentiometer
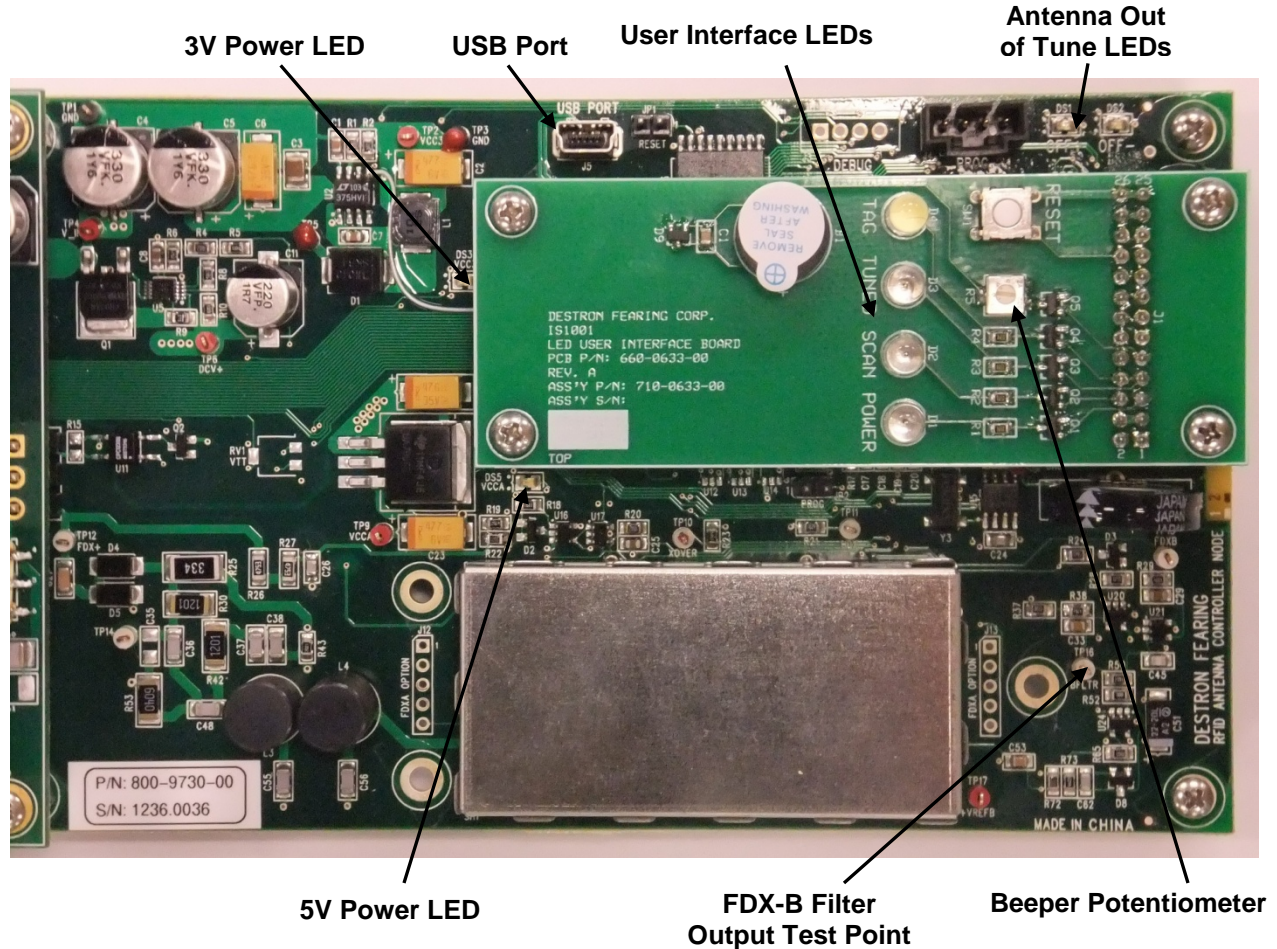
The Mother Board incorporates the following: input power monitoring, CPU, CAN Bus interface, internal memory (IS1001 standalone operation mode only), optional accessory boards interface, and FDX-B tag and HDX tag signal decoding filters. This board also contains two yellow antenna tuning status LEDs (OFF+ and OFF-) that indicate if the antenna is out of tune and if the tuning capacitance needs to be increased (OFF+) or reduced (OFF-).

The LED User Interface Board (an optional accessory board) incorporates the following: IS1001 status LEDs, a buzzer with a potentiometer to adjust its volume, and an IS1001 reset button.

This board contains four status LEDs that indicate the following:

- Green "POWER" LED indicates that power has been applied to the IS1001
- Yellow "SCAN" LED indicates that the IS1001 is in scanning mode
- Red "TUNED" LED indicates that the antenna is properly tuned to the set target phase
- White "TAG" LED indicates that a tag ID was successfully decoded

Close-up View of Exciter Board and Mother Board

Power Connector   CAN Bus Connector   Exciter Board Power LEDs

Antenna Connector   Clock Sync Connector   Capacitor Jumper
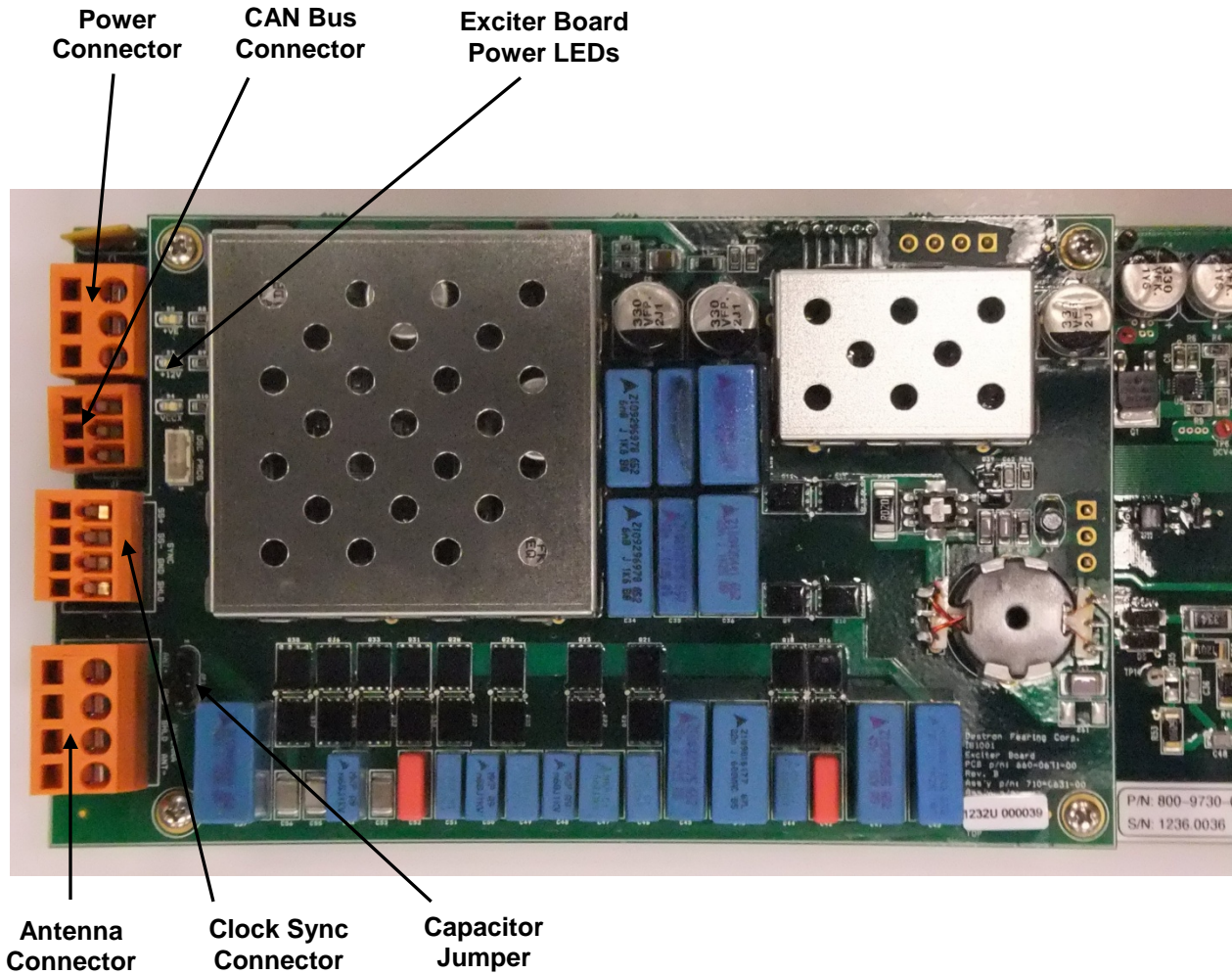
The Exciter Board incorporates the following: the antenna exciter with adjustable power output, dynamic tuning capacitors, the IS1001 synchronization interface (IS1001 standalone operation mode only), VTT, and FDX-B tag and HDX tag signal detectors.

Master Controller Component Identification
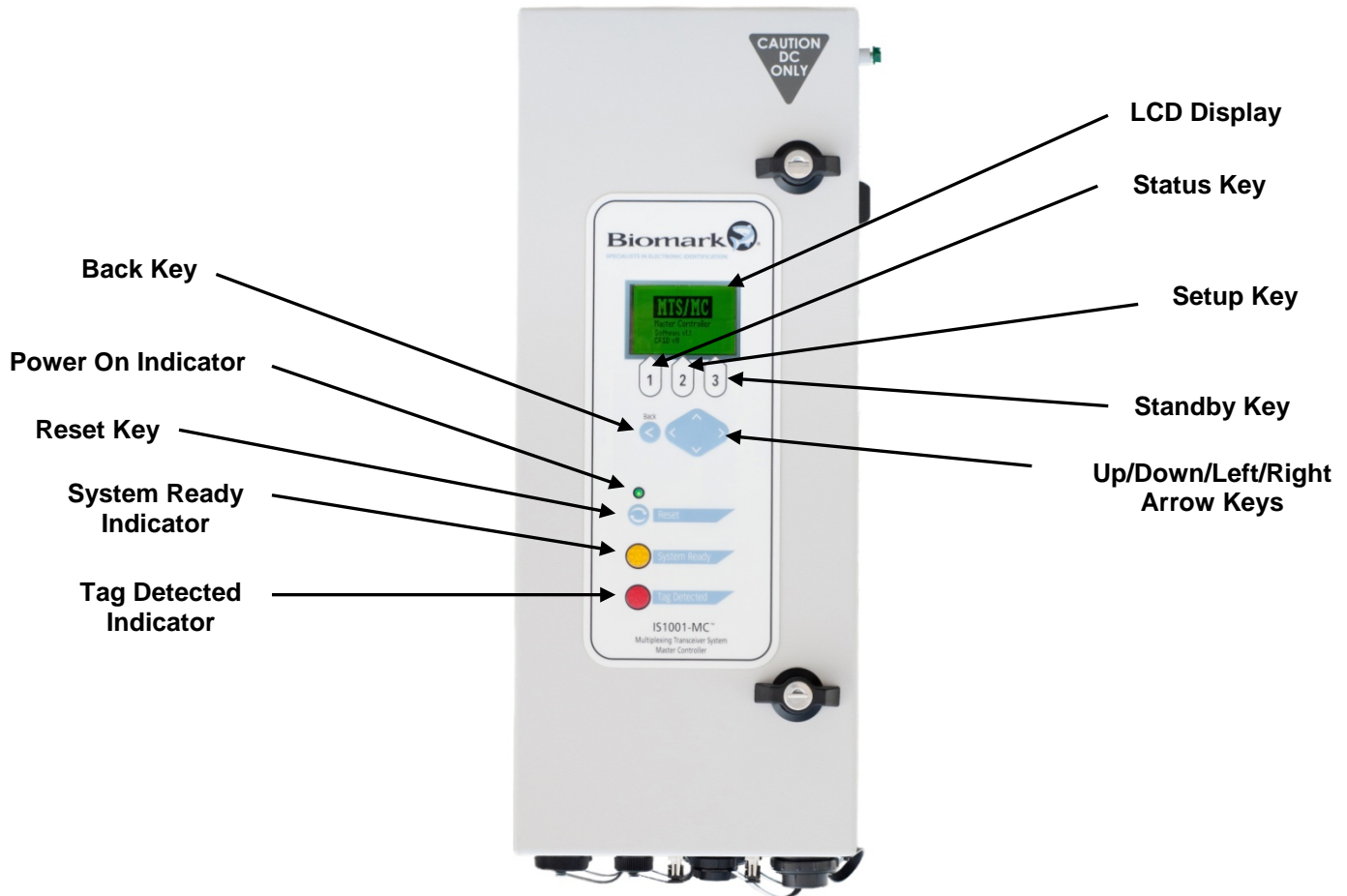
Front View of the Master Controller

1. **Display:** LCD graphical display.

2. **Status Key:** Used to check the current status of the Master Controller and IS1001 parameter settings.

3. **Setup Key:** Used to change the Master Controller and IS1001 parameter settings.

4. **Standby Key:** Places the MTS into standby mode.

5. **Up/Down/Left/Right Arrow Keys:** Used to navigate through the Master Controller menus.

6. **Back Key:** Moves the display to the previous menu.

7. **Power On Indicator:** This green LED glows solid when power is turned on to the MTS.

8. **Reset Button:** Resets the MTS.

9. **System Ready Indicator:** This yellow LED indicator slowly flashes as the system powers up, and then glows solid when the MTS is in scan mode.

10. **Tag Detected Indicator:** This red LED indicator flashes each time a tag ID is successfully decoded.

Master Controller Port Identification

Bottom View of the IS1001-MC Master Controller

CAN BUS Ports I & II: Used to connect the Master Controller to the IS1001s under its control. The ports can be used interchangeably or simultaneously. Both ports are used if you choose to connect your IS1001s using two different branches.

Pin assignments:

- Pin 1 – Power +
- Pin 3 – CAN Bus High
- Pin 4 – Power -
- Pin 5 – Shield
- Pin 6 – CAN Bus Low
- Pin 7 – Power Shield
- Pin 9 – CAN Bus Shield/Reference

Sync In Port: Used to synchronize with another Master Controller by receiving the other unit's IS1001 activation signal.

Pin assignments:

- Pin 1 – Reference (0V)
- Pin 3 – RX +
- Pin 4 – Shield
- Pin 6 – RX -

Sync Out Port: Used to synchronize the Master Controller with another unit by feeding the Master Controller's IS1001 activation signal to the other unit's Sync In port.

Pin assignments:

- Pin 4 – Shield
- Pin 5 – TX +
- Pin 7 – Reference (0V)
- Pin 8 – TX -

Fiber Optic Transmit Port (remote communication port): Used to transmit data to a remote device through a fiber optic network using the RS-232 communications standard.

Fiber Optic Receive Port (remote communication port): Used to receive data from a remote device through a fiber optic network using the RS-232 communications standard.

Ethernet Port (remote communication port): Used to monitor and operate the Master Controller from a remote location through a local area network (LAN).

USB Comm Port (local communication port): Used to monitor and operate the Master Controller from a local device such as a laptop computer.

USB Storage Port: Used to connect a USB flash drive for real-time storage.

Auxiliary Port: Used for triggering a site-specific action (such as moving a gate within a flume or enabling an external speaker) whenever a tag is detected. This port operation depends on the Detection Unique Mode setting and is similar to the Master Controller buzzer operation, except it is not triggered by VTT detection. Each time a tag ID is detected and satisfies the Detection Unique Mode criteria, the internal semiconductor switch is closed for 15 milliseconds.

Pin assignments:

- Pin 1 – Switch +
- Pin 2 – Switch -
- Pin 4 – Shield

Master Controller Major Internal Hardware Components
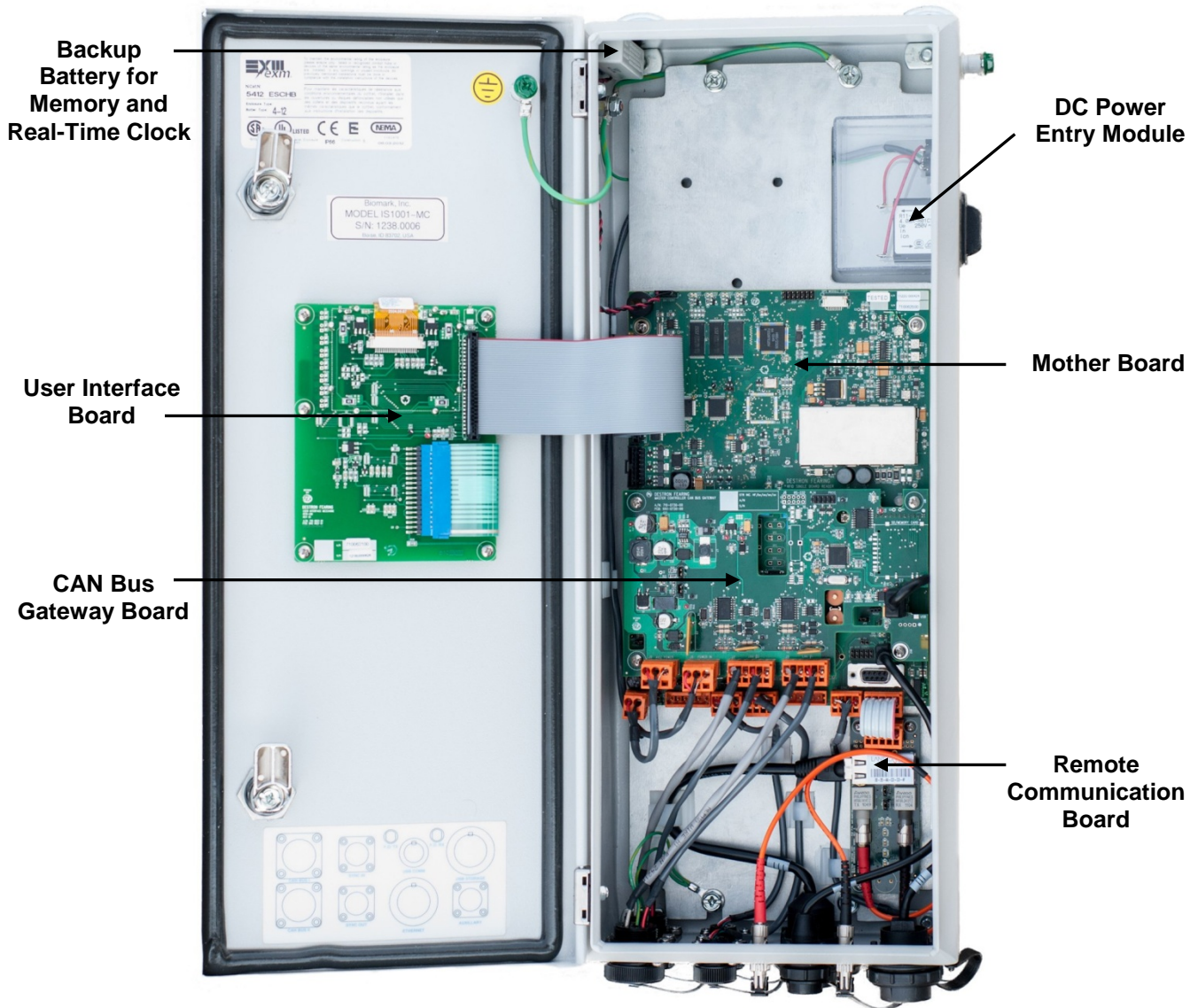
DC Power Entry Module

The DC Power Entry Module accepts 18 - 28V DC input. This DC voltage is used as Mother Board input voltage. It also supplies power to the attached IS1001s.

This module contains a switch with a 4 Amp breaker that will trip if the DC current exceeds 4 Amps.

Mother Board

The Mother Board is the CPU module of the Master Controller. It incorporates the following: USB local communication and remote communication interfaces, Master Controller synchronization interface, User Interface Board interface, and the CAN Bus Gateway Board interface.

CAN Bus Gateway Board

The CAN Bus Gateway Board incorporates input power monitoring and routing to the Mother Board, the IS1001s, the CAN Bus interface, the internal memory, and the external USB storage interface.

This board contains three status LEDs that indicate the following:

- DS4 green "M.B.COMM" LED indicates CAN Bus activity and flashes everytime the Master Controller activates the next IS1001 in sequence.

- DS3 yellow "EX.MEM.READY" LED indicates if a USB flash drive is attached to the USB Storage port and is ready to receive data.

- DS2 red "EX.MEM.ACTIVE" LED indicates if the USB flash drive is active and data is being written to it.

Status LEDs
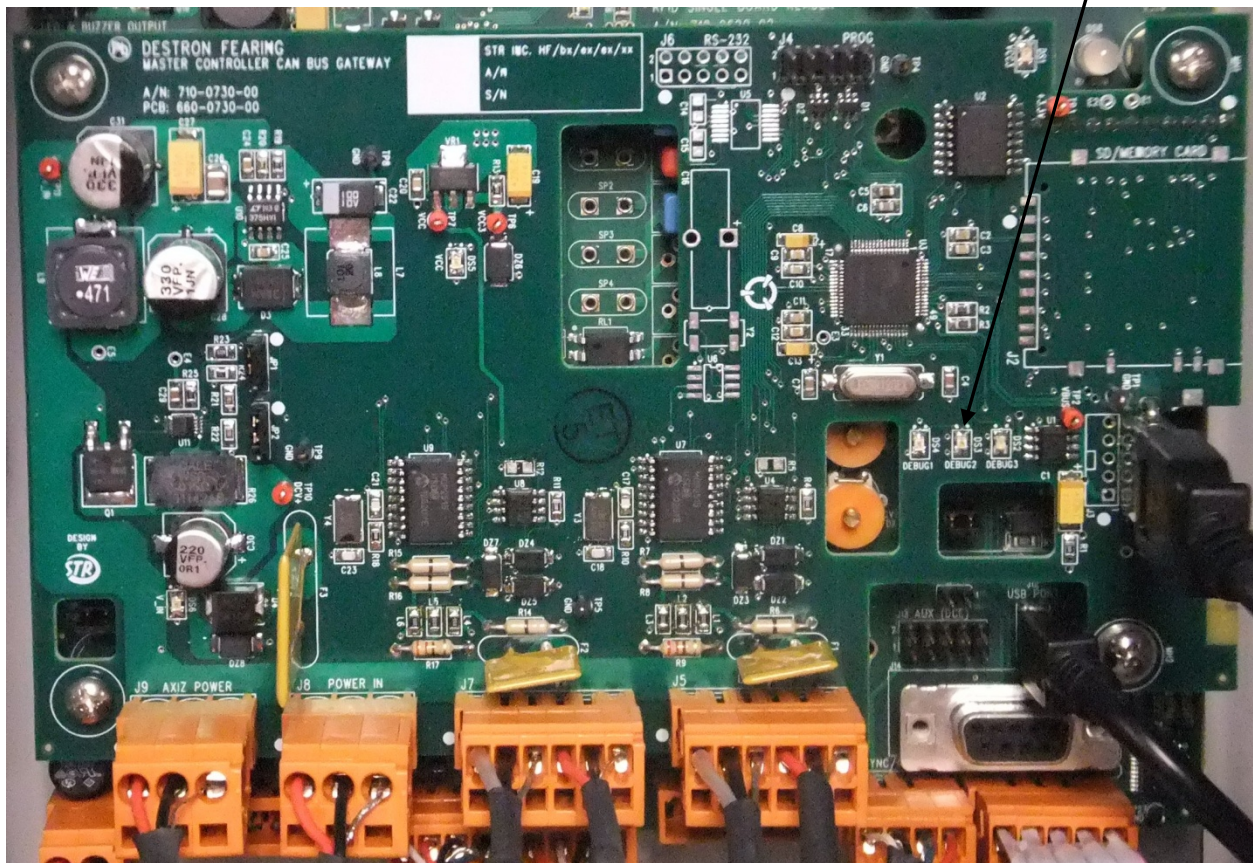
User Interface Board

The User Interface Board incorporates the graphic LCD and the keypad interface.
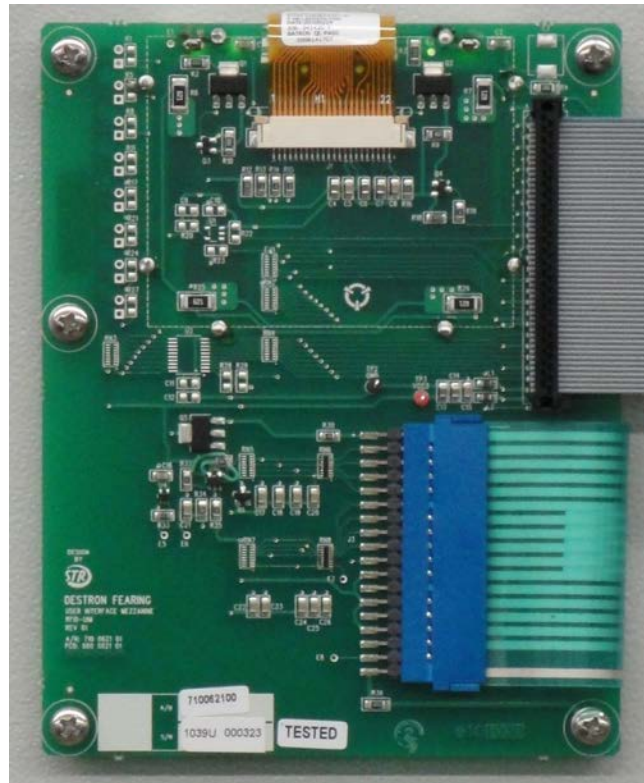
Remote Communication Board

The Remote Communication Board incorporates the Ethernet and fiber optic communication interface. It contains two jumpers that enable the Ethernet and the Fiber Optic ports. To disable one of the ports (for example, to save on power consumption), remove the corresponding jumper.
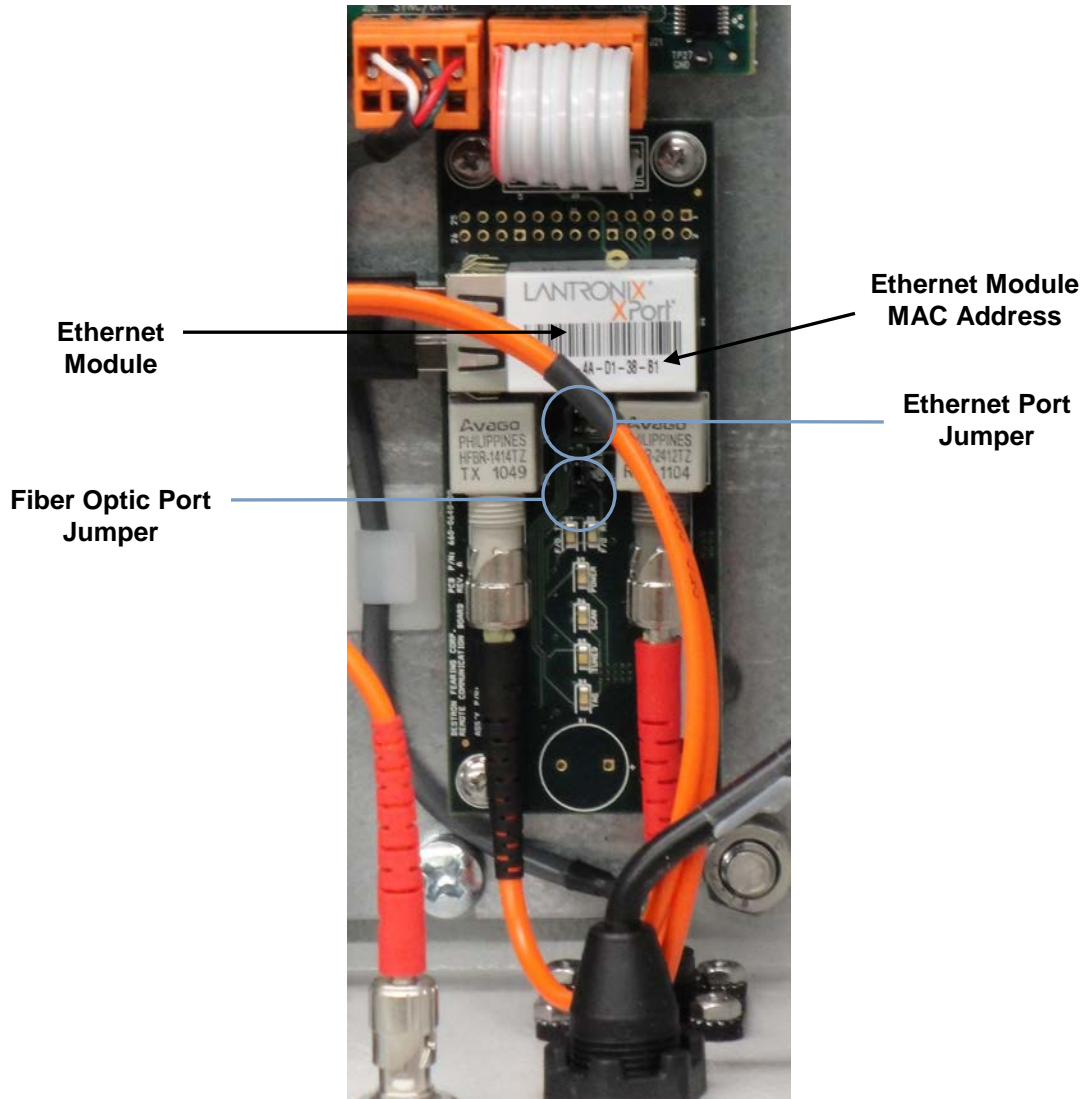
Installing and Configuring Your IS1001s

Installing the IS1001s

1. Remove the IS1001s and all items from the shipping cartons.

2. Locate an area to mount each IS1001.

   Your IS1001-MTS system will include one IS1001 for each antenna in use at your site. The IS1001s can be co-located in a common area (such as a cabinet located along the shore), or each IS1001 can be housed in a separate location near its respective antenna.

   An IS1001 can be mounted to a rigid surface using the six threaded standoffs located on the bottom of the IS1001 assembly. A common installation technique is to mount an IS1001 to a board or plate and then mount the board/plate within your enclosure.

3. Record the serial number of each IS1001.

   You will need to know the serial numbers later during the setup of the Master Controller. The serial number for each IS1001 can be found on a white label on the mother board near the Exciter Board. The serial number has the following format:

   YYWW.NNNN

   where:

   - "YY" is the last two digits of the year the IS1001 was produced
   - "WW" is the week number the IS1001 was produced
   - "NNNN" is the actual IS1001's serial number

   Tip: Make a quick sketch of your antenna configuration and record the serial number of the IS1001 that you assign to each antenna.

4. Make the power connection to each IS1001.

    Power is supplied to each IS1001 from the Master Controller through the CAN BUS ports. Connect the power cable to each IS1001 as follows:

    Tip: Use a narrow screwdriver to open the pin slot before inserting the wire.

    *   Connect the power cable's positive wire to pin 1 (+) of the 3-pin "POWER" connector J6 on the Mother Board.

    *   Connect the power cable's negative wire to pin 2 (-) of the 3-pin "POWER" connector J6 on the Mother Board.

    *   Connect the power cable's shield drain wire and chassis (Earth) ground wire to pin 3 (GNDM) of the 3-pin "POWER" connector J6 on the Mother Board.

    Note: For the best performance, each IS1001 should be locally grounded.
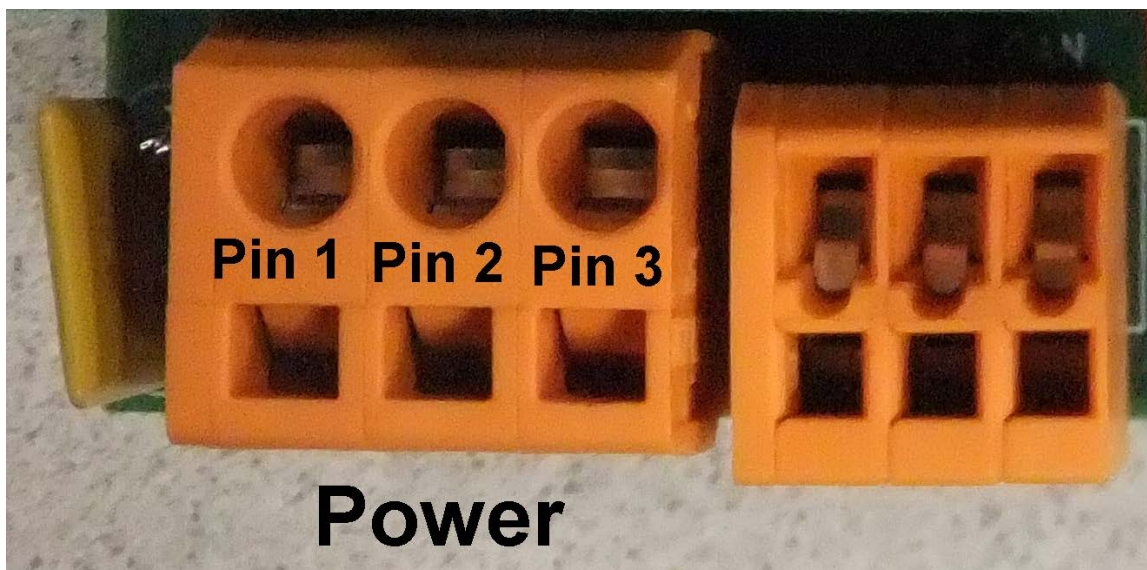
5. Make the communication line connection (CAN bus connection) to each IS1001.

    *   Connect the communication cable's CAN BUS High wire to pin 1 (+) of the 3-pin "EXT CAN" connector J7 on the Mother Board.

    *   Connect the communication cable's CAN BUS Low wire to pin 2 (-) of the 3-pin "EXT CAN" connector J7 on the Mother Board.

    *   Connect the communication cable's shield drain (reference) wire to pin 3 (GND) of the 3-pin "EXT CAN" connector J7 on the Mother Board.

    *   (Optional) If the IS1001 is the last in line, you may need to connect a terminator resistor between the CAN bus lines (pins 1 and 2).

        If the length of the CAN Bus cable is:

        o   **< 100 feet:** No resistor needed
        o   **100 - 500 feet:** Use a 220 Ohm resistor at the far end from the Master Controller
        o   **500 - 1000 feet:** Use a 220 Ohm resistor at the Master Controller and a 110 Ohm resistor at the far end from the Master Controller
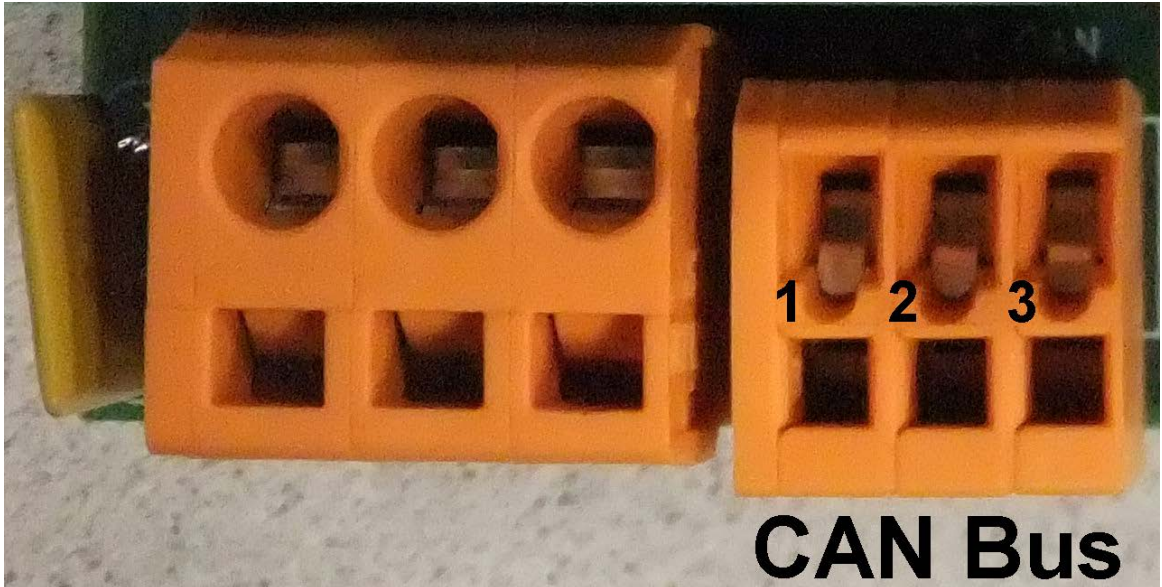
6. Make the antenna connection to each IS1001.

- Connect the antenna leads to pins 1 (+) and 4 (-) of the 4-pin "ANTENNA" connector J8 on the Exciter Board.

  Note: If there is a tuning capacitance connected in series at the antenna, the recommendation is to connect the lead attached to it to Pin 4 and the lead attached to the coil of the antenna to Pin 1; otherwise either lead can be connected to either of those two pins.

- Connect the antenna cable shield drain wire to Pin 3 (SHIELD) or to Pin 2 (GND) of the 4-pin "ANTENNA" connector J8 on the Exciter Board, or leave it unconnected. You can determine which configuration results in the best performance.
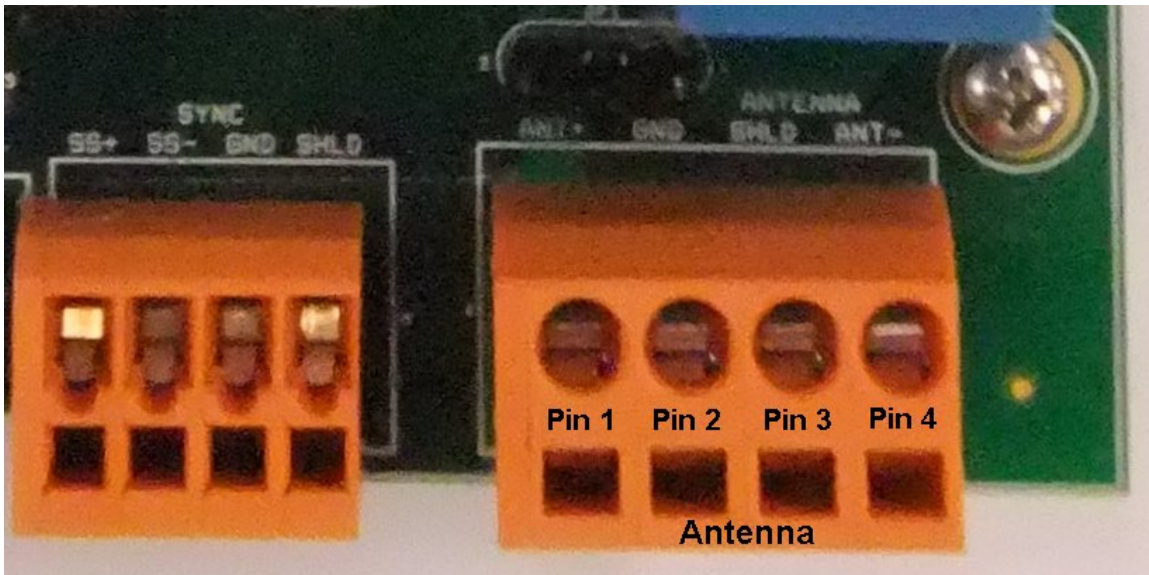
The IS1001 has a 33nF capacitor C57 on the Exciter Board that is connected in series with the IS1001's bank of tuning capacitors and should be used when antenna inductance is somewhere between 130uH and 180uH, no additional capacitance is connected in series at the antenna, and the IS1001 is installed next to or close to the antenna (the antenna cable is less than 6 ft. long). In most other cases this capacitor needs to be shorted out by installing jumper JP1 on the Exciter Board and additional capacitance needs to be added (connected in series) at the antenna to bring it within tuning range of the IS1001 and to reduce the voltage across the antenna cable.

Tuning Each Antenna

The IS1001-MTS system is designed for each antenna to be tuned from the Master Controller. See page 24 for instructions on tuning the antenna.

Installing and Configuring the Master Controller

Installing the Master Controller

1. Remove the Master Controller and all related items from the shipping carton.

2. Locate an area to mount the Master Controller.

   The Master Controller is designed for indoor use or installation into a NEMA 4 cabinet. It must be mounted on a medium or high density vertical surface (such as wood, metal, concrete, etc) using ¼ inch bolts or screws, away from direct sun light and away from any water. A mounting template is provided to help establish the proper mounting hole locations.

3. Install the power cord.

   With the Master Controller's power switch in the off position, plug one end of the supplied power cord into the unit's power connector. Connect the other end to a 24V DC power source in polarity specified on the "DC Input Only" label; the label is located on the side of the Master Controller enclosure above the power connector and is attached to the power cord supplied with the system.

4. Attach the CAN bus/power cable(s) to the Master Controller's CAN BUS port(s).

   This cable allows the Master Controller to communicate with your IS1001s across the CAN bus network and it also provides power to the IS1001s.

   For your convenience the Master Controller contains two CAN BUS ports. This provides some flexibility in how you choose to cable together your IS1001s. You can connect your IS1001s using one continuous branch or you can use two separate branches. All IS1001s are treated as if they are on the same network even if you use both CAN BUS ports. The following figure depicts the two different cabling options.

One Branch Option	**Two Branch Option**
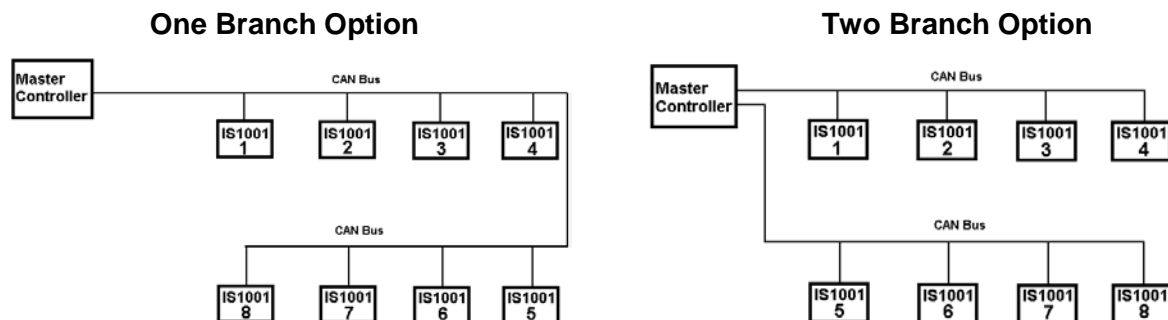
5. Connect the local and/or remote communication lines that you intend to use when managing the Master Controller.

   - If you intend to manage the Master Controller locally you must attach a portable computer to the USB Comm port.

   - If you intend to manage the Master Controller remotely across a network you must attach a network line to either the Ethernet port or to the fiber optic ports.

6. Plug a USB flash drive into the USB storage port.

   This acts as your primary data collector.

7. Power on the Master Controller.

Powering Up the Master Controller

When the Master Controller is powered, on it will quickly cycle through the following three startup steps.

- **Init:** Signifies the Master Controller is going through its initialization phase.

- **Disc:** Signifies the Master Controller is going through the discovery phase. During this phase the Master Controller will automatically scan the local CAN bus for all available IS1001s. For each IS1001 it detects it will read and record the associated serial number. All detected IS1001s will be reported by the Master Controller to both the local port (if enabled) and to the remote port. If the detected serial number is present in the user-defined assignments table, then the IS1001 will be assigned with the corresponding node ID and included in the scanning sequence (according to the user-defined primary and secondary sequences). If an unknown serial number is detected in the network, a corresponding alarm message will be generated by the Master Controller and automatically repeated until the required change to the assignment table is made or the unknown IS1001 is physically disconnected from the network.

- **Scan:** Signifies the Master Controller is ready and has placed itself into scan mode.

The Master Controller will not scan any IS1001 nodes until the IS1001 serial numbers have been assigned to node IDs and the node IDs are used in a primary sequence. These steps are described in the next section.

Configuring the Master Controller

The following configuration steps should be performed immediately after the Master Controller is initially powered on.

Assigning Serial Numbers to Node IDs

Each IS1001 serial number must be assigned to a node ID on the Master Controller. You do this for two reasons:

- It enables you to identify each IS1001 in your system
- It enables you to assign the nodes to a timing sequence

In order to simplify the management of your IS1001-MTS system, you should assign IS1001 serial numbers to the node IDs in the same sequence that they are deployed at your site. Assigning the node aliases in this manner will make it much easier to identify each IS1001 and to define your primary sequence and secondary sequence.

To assign serial numbers to node IDs:

1. Identify the serial number of the IS1001 that is first in line.

   You should have recorded the serial number of each IS1001 during the installation process (see page 15). Only the last four digits are required.

2. Use the **Setup > Node Setup > Node 01 > Serial Number** menu to assign this serial number to Node 1.

3. Identify the serial number of the IS1001 that is next in line.

4. Assign this serial number to the next incrementally available node ID.

5. Repeat steps 3 – 5 for all remaining IS1001s.

Alternatively, this can be done using a computer connected to one of the Master Controller's communication ports. Command "NSNssss,nn" will assign serial number **ssss** to node ID **nn**. Assigning serial number "0000" to a node will remove (disable) the assignment.

Example

In the scenario illustrated here you would assign the node IDs as follows:

Node 01 = 0017	**Node 05** = 0004
Node 02 = 0011	**Node 06** = 0012
Node 03 = 0024	**Node 07** = 0033
Node 04 = 0008	**Node 08** = 0009
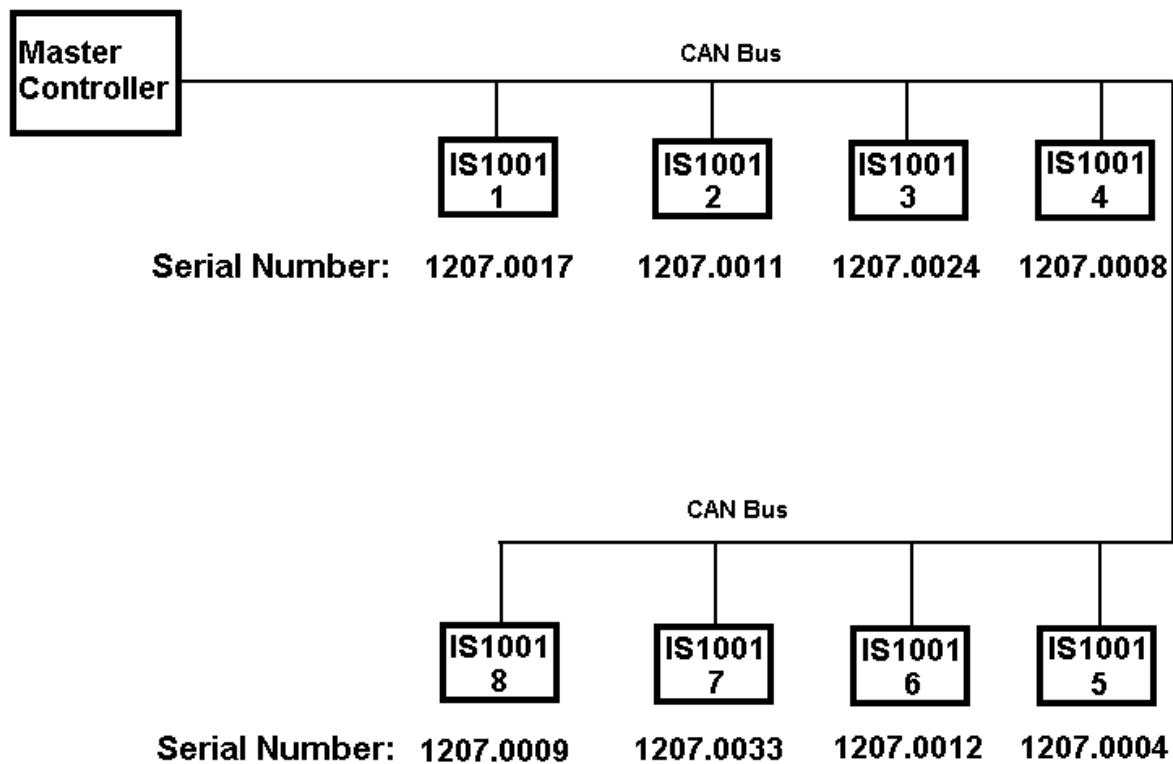
See page 46 for more information about the **Node Setup** menu.

Establishing the Primary and Secondary Activation Sequences

The primary activation sequence identifies the order that the individual IS1001s will be activated and polled by the Master Controller. The activated IS1001 will make any necessary tuning adjustments and scan for the presence of a PIT tag. The IS1001 will remain scanning until the allotted scanning time expires. Any detected tag data is transmitted to the Master Controller and is processed according to user-selected settings. No tag data is stored locally on the IS1001 when it is part of the Multiplexing Transceiver System.

The Master Controller polls the IS1001s in a user-selectable sequence and is able to activate one or two IS1001s at a time.

- Use the **Setup > Master Controller Setup > Network Setup > Primary Sequence** menu to set up the primary sequence. The recommendation is to configure the sequence in the same order the IS1001 nodes are deployed at your site.

  Example:

  Primary sequence = 1, 2, 3, 4, 5, 6, 7, 8
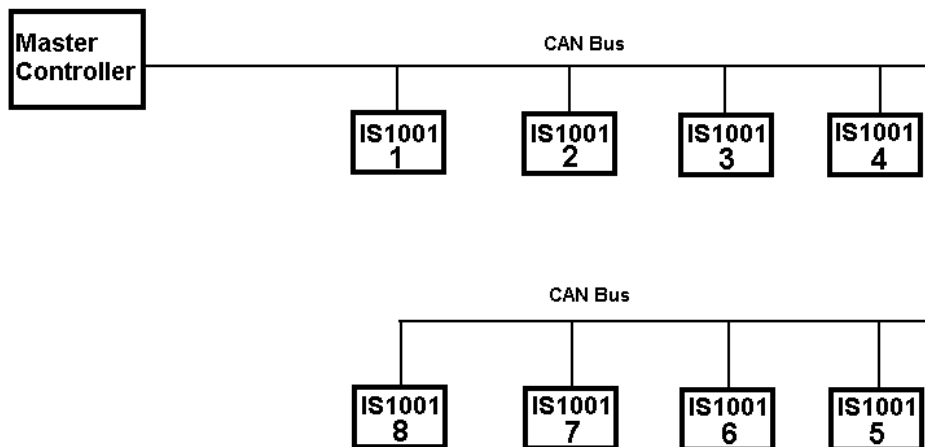
  See page 41 for more information about the **Primary Sequence** menu.

- If you are employing many IS1001s and you want to cycle through the IS1001s quicker, you can activate two IS1001s at a time by defining a secondary sequence. The secondary sequence works in conjunction with the primary sequence to determine how the IS1001s will be paired. The first IS1001s in each sequence will be paired, the second IS1001s in each sequence will be paired, etc.

  Example:

  Primary sequence = 1, 2, 3, 4

  Secondary sequence = 6, 5, 8, 7

  Actual paired timing sequence = 1 & 6, 2 & 5, 3 & 8, 4 & 7

  See the description of the **Setup > Master Controller Setup > Network Setup > Secondary Sequence** menu for more information.

  Important! When defining a secondary sequence, do not pair two IS1001s whose antennas are in close proximity to each other or you could experience noise issues due to antenna interference. Each of the antennas in a pair should be separated by a minimum of 10 feet, and as a general rule you should separate them by as much distance as possible.

Adding and Removing IS1001s from the Sequence

While the Master Controller is powered on it will continually monitor the CAN bus. If an IS1001 becomes unavailable (for example, if it is disconnected from the CAN bus or it cannot be accessed by the Master Controller continuously within 10 seconds), it will be temporarily removed from the activation sequence. Conversely, if an IS1001 becomes available again, the Master Controller will recognize this and add it back to the sequence.

If a node with an unassigned serial number is detected on the CAN bus, a corresponding alarm will be generated. This alarm will be repeated according to the Alarm Unique Delay period until the user has assigned this serial number to a node ID or disconnected the IS1001 containing this serial number.

When the Master Controller is turned on for the first time (or the factory default parameters are reset), all nodes detected on the CAN bus will generate an alarm. You must assign each serial number to a corresponding Node ID and set up both the primary and secondary sequences. If no antenna pairs in the scanning sequence are required, the secondary sequence should be left empty ("--,--,--,--,--,--,--,--,--,--,--,--").

Tip: To remove a serial number assignment from the configuration, you must assign serial number "0000" to the corresponding node ID. Similarly, to remove an ID from the primary or secondary sequence, you must assign ID "00" to the corresponding position in a sequence.

It is easy to do this using a computer connected to one of the Master Controller's ports:

- Use the command "NSNxxxx,yy" to assign serial number xxxx to the node ID yy.

   Examples: NSN0027,02 will assign serial number 0027 to antenna ID 02. NSN0000,03 will erase assignment of antenna ID 03.

- Use the command "NSPxx[,xx]" to set up the primary sequence (1 node ID minimum and 12 node IDs maximum).

   Example: "NSP01" will set up a sequence with one antenna that has the ID 01. "NSP01,02,05,07" will set up the primary sequence to scan four antennas: 01, then 02, then 05, then 07, and then begin with 01 again.

   A node ID of 00 can be used in this command to determine a "skip" position if a secondary sequence is used and if only the antenna from the secondary sequence needs to be active at this time.

   Example: Set the primary sequence by issuing the command "NSP01,02,00,07", and set the secondary sequence by issuing the command "NSS00,08,05,00". In this case the Master Controller will start the scanning cycle by turning on only antenna 01. Next, two antennas will be active simultaneously: 02 and 08 (as set by the second parameter in both commands). Next, only antenna 05 is activated. And at the end of the scanning cycle, only antenna 07 is active.

Modifying Default Parameters (Optional)

During the initial setup phase you should double-check all default parameter settings and make any necessary adjustments. See *Master Controller Setup* on page 37 and *Nodes Setup* on page 46 for information on configuring the parameters. The Master Controller allows you to save two different sets of user-defined parameter configurations that can be reloaded at a later time. You can also restore all parameters to the factory default settings.

Tuning the Antennas

This section describes how to perform the initial tune of each antenna.

Coarse Tuning Each Antenna

The antenna tuning procedure should be performed after each individual IS1001 is in place and connected to an antenna and after the initial installation of the Master Controller.

The coarse tuning procedure is as follows:

1. Select **Setup > Node Setup > Node # > Start Full Tuning**.

2. Wait for the **Status = Tuned** message to be displayed.

3. Repeat these tuning steps for each IS1001 node.

During this process the IS1001 goes through every possible electronically switched capacitor setting combination to tune the antenna more precisely. There are total of 1024 setting combinations (0 to 1023) providing a tuning range from 15nF to 117.7nF.

- Setting "0" means all capacitors are switched off and the tuning value is at a minimum – 15.0nF
- Setting "1023" means all capacitors are switched in and the tuning value is at a maximum – 117.7nF.

The Master Controller will select the final capacitor settings that produced the highest antenna current. At the same time, the antenna signal phase measurement is taken and saved as the tuning target phase value. This value will be used by the dynamic tuning feature (if enabled) to track any changes to the environment (such as water depth, ambient temperature, foreign objects presence, components deterioration, etc.) that may result in antenna de-tuning, and to adjust the capacitor settings accordingly to re-tune the antenna. When the antenna de-tunes it means its signal phase has deviated from the target value. Dynamic tuning tracks this phase deviation to determine when and what adjustments to make to the capacitor settings to return the phase value to the target value and to re-tune the antenna. The adjustments are done gradually so there is no interruption of tag detection. If there is an interruption in tag detection it is due to the antenna being out of tune while dynamic tuning make the necessary adjustments.

Dynamic tuning has a finite range, so not all changes in antenna tuning can be recovered using digitally switched capacitors. With this in mind, it is recommended that you adjust the capacitors at the antenna so that the final dynamic tuning capacitor settings are as close to the mid-range as possible.

There are customizable alarms available that can notify you in advance if you are approaching the limit of the dynamic tuning range. Alarms will also notify you if the antenna is out of range, and they will suggest the direction of changes to make to antenna capacitors.

The responsiveness (sensitivity) of the dynamic tuning can be adjusted by changing the **Antenna Dynamic Tuning Phase Deviation Threshold** value. Dynamic tuning will not attempt any tuning capacitance adjustments until the phase deviation value does not exceed the threshold setting in either direction. This value should be set smaller for high Q systems where smaller antenna tuning changes can result in larger detection degradation. For low Q systems where bigger tuning changes would not cause large detection losses or for systems with rapid and frequent conditions changes, the threshold setting can be set higher to reduce the unnecessary dynamic tuning activity. The threshold value should not be set too low to ensure stable dynamic tuning operation.

If you receive a message indicating that the node capacitance needs to be increased or decreased, do this at the node's antenna and then restart the full tuning process for that node.

Fine Tuning Each Antenna

For most sites the coarse tuning procedure is all that is necessary when implementing the IS1001-MTS system. The fine tuning process described in this section is only necessary if you are interested in achieving the absolute peak efficiency for each antenna.

The fine tuning procedure for each node antenna is as follows:

1. Position a tag near the antenna so that the **FDX-B Efficiency** reading is approximately 50%.

   To view the efficiency reading: **Status > Nodes > FDX-B Efficiency**.

2. Adjust the node's target phase a few points in one direction.

   To adjust the target phase: **Setup > Node Setup > Node # > Target Phase**.

3. See if the read efficiency has increased or decreased.

   Tip: While within the **Node Setup** menu, press the **Status** key to go directly to the **Node Status** screen, where you can view the **FDX-B Efficiency**.

4. Repeat until you have achieved peak efficiency.

Ongoing Tuning

Each IS1001 will automatically adjust its tuning capacitance to keep the attached antenna in tune. If an IS1001 is not able to tune its antenna within four hours, the IS1001 will be temporarily removed from the activation sequence and will be skipped by the Master Controller. Once every four hours the Master Controller will check back with the skipped IS1001 and will give it approximately five minutes to try to tune its antenna. The IS1001 will not be returned to the activation sequence unless its antenna is successfully re-tuned. This allows the Master Controller to save time by skipping a damaged antenna until it is repaired.

Tuning an Antenna Directly From the IS1001

If desired, it is possible to tune an antenna directly from the IS1001 by attaching a portable computer to the IS1001's mini-USB port and entering the Antenna Full Tune (AFT) command. One reason you might want to do this is if the Master Controller is a considerable distance from the antenna and you need to adjust the antenna capacitance during the tuning process. Tuning the antenna directly from the IS1001 will eliminate a lot of unnecessary walking back and forth.

1. Turn on the MTS.

   To avoid possible interference between adjacent antennas during the tuning process, it is recommended to put the Master Controller into standby mode, but if the detection cannot be interrupted you may leave it in scanning mode.

2. Connect a computer to the IS1001's mini-USB port.

3. Establish a connection the same way as with Master Controller's local communication port.

   Install the Silicon Labs CP210x USB to UART Bridge Virtual COM Port (VCP) Windows drivers on the computer used to communicate with the IS1001. Determine the port number the IS1001 is connected to: in BioTerm click the "Refresh" button and look for port *COMn Silicon Labs CP210x USB to UART Bridge*. Use BioTerm or a similar terminal application on the computer to open a connection with that port. The factory default local port speed is 115200 bps.

4. Switch the IS1001 from MTS Node to IS1001 Standalone network operation mode by using the "RNMS" command.

   You should see the echo of all characters in the Data Traffic window as you type. Press Enter and verify the reader's network mode has been changed to "Standalone" from the confirmation message. Master Controller will send a message that communication with this node has been lost and will remove it from the activation sequence.

5. Tune the antenna by entering the Antenna Full Tune (AFT) command.

   The tuning process will take approximately 40 seconds to complete. The IS1001 will report the results of the tuning process and will switch the IS1001 into scanning mode.

6. Switch the IS1001 back from IS1001 Standalone to MTS Node network operation mode by using the "RNMM" command.

   The Master Controller will automatically re-establish communication with this node and will place it back in the activation sequence. If you reset the Master Controller or perform a Reset Network operation, all IS1001s connected to the Master Controller's CAN Bus ports will be automatically switched to MTS Node network operation mode.

Adjusting Antenna Output Power

Antenna output power (current) can be adjusted by changing exciter voltage. There are five steps of exciter voltage adjustments: from 12 V DC to 20 V DC in 2 V increments. Therefore, setting "1" adjusts exciter voltage to 12 V DC and setting "5" adjusts exciter voltage to 20 V DC.

It is recommended that you set antenna output power (current) to the lowest setting that provides the necessary detection range.

Each IS1001 has a built-in antenna current limiting mechanism that will generate an alarm message when an antenna current in excess of 10 A peak-to-peak is detected. It will

automatically reduce the exciter voltage when an antenna current in excess of 11 A peak-to-peak is detected in order to bring it to an acceptable level. If an antenna current exceeds 11 A peak-to-peak even at the minimal exciter voltage setting, the IS1001 will be disabled and removed from the activation sequence until the system is reset or toggled into standby mode and then back to scan mode.

Synchronizing Multiple Master Controllers

If you are employing two or more Master Controllers at your site that are in close proximity to one another, you will have to synchronize the Master Controllers so that they all switch to the next IS1001(s) in their sequence at the same time. This is done in order to avoid interference; if an IS1001's exciter is activated, it can interfere with another IS1001 whose exciter is off while it receives an HDX tag response. In addition, noise spikes from antennas switching on and off at different times by different IS1001s can interrupt FDX-B detection on an already active IS1001.

The following figure illustrates a typical implementation of multiple Master Controllers that requires synchronizing.
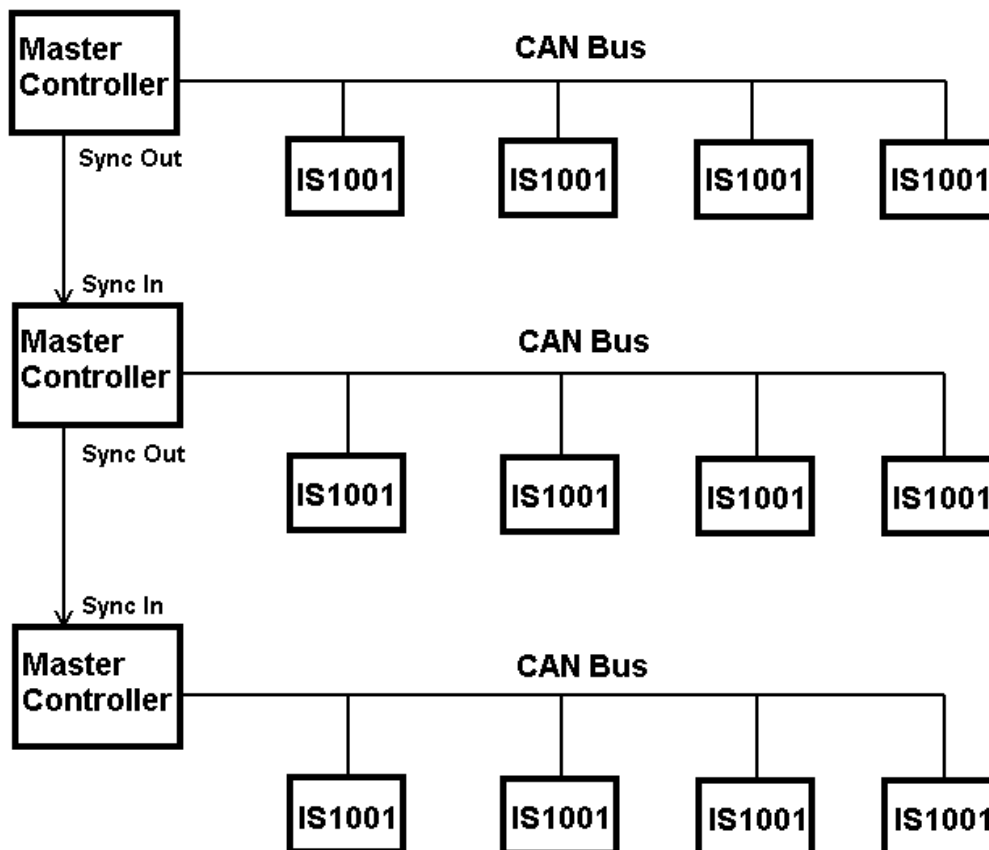
### Hardware Configuration

Cable the Master Controllers together using the Sync In and Sync Out ports. The controllers are connected in a daisy chain configuration, where the synchronization output of the first controller is connected to the synchronization input of the next controller. The first controller does not require synchronization input because it is the source of the synchronization signal.

If using 4-conductor, two twisted pairs, 18-22AWG wire, shielded cable:

- Use the conductors of one pair to connect TX + to RX + and TX - to RX –
- Use the conductors of the second pair as the signal reference connection
- Use the cable shield drain wire to connect to the shield pins

If using single twisted pair, 18-22AWG wire, shielded cable, a cable shield drain wire should be used as a signal reference conductor.

1 -TX/RX+
2- TX/RX-
3 - Ref(0V)
4 - Shield
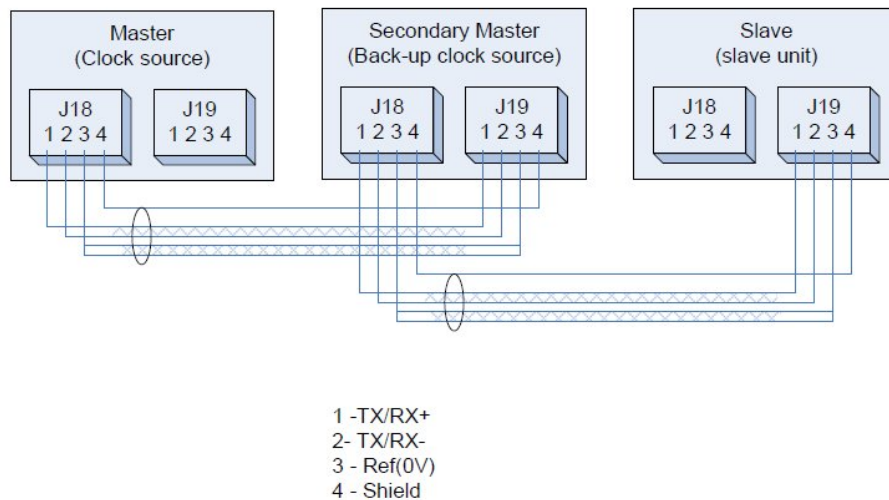
The synchronization input signal is used by each Master Controller to timely switch to the next IS1001 in its sequence. While each Master Controller may have a different number of IS1001s in their sequence, each IS1001 on the site will start scanning synchronized (at the same time), eliminating the interference that can occur when antennas are switched off and on at different times by different IS1001s. Likewise, if HDX detection is active on the site, the scanning cycle will be synchronized so no IS1001 has an exciter on during the HDX detection phase.

Master/Slave/Standalone Concept

Each Master Controller can be configured to operate in one of the four synchronization modes that will define the controller's role and its behavior.

- **Master Mode:** The Master Controller uses its own clock signal to activate nodes and generate synchronization output. The FDX-B and HDX scanning times for each node are constant (70 milliseconds for FDX-B and 20 milliseconds for HDX (if HDX detection is enabled)), and the synchronization input is disabled. If the controller is put in standby mode its synchronization output signal is disabled. The first Master Controller in the chain must be configured as a Master.

- **Secondary Master Mode:** If the Master Controller detects a synchronization signal on its input it acts as a Slave. It uses the input signal to activate each node in sequence and always transmits it to its output, even when put in standby mode. If the synchronization input is not present the Master Controller acts as a Master. If at any point the synchronization signal is detected on its input, the Master Controller will switch back to being a Slave. This mode should be selected for Master Controller dedicated as synchronization signal back up source.

▪ **Slave Mode:** The Master Controller uses the synchronization input signal for its node activation cycle and always transmits it to its output, even when in standby mode. If the synchronization input is not present, its nodes are not activated and no signal is present at the synchronization output.

▪ **Standalone Mode:** The Master Controller always uses its own clock, and synchronization input and output are disabled. In this mode, each node in the sequence adjusts its own FDX-B and HDX scanning times to get the maximum detection performance while maintaining the fastest node cycling.

   o If FDX-B tag presence is not detected, the FDX-B scanning time will be 50 milliseconds

   o If FDX-B tag presence is detected, the FDX-B scanning time will continue until the tag is successfully decoded or until the maximum time of 120 milliseconds is reached

   o If HDX detection is enabled and HDX tag presence is not detected, the HDX scanning time will be 2 milliseconds

   o If HDX detection is enabled and HDX tag presence is detected, the HDX scanning time will continue until the tag is successfully decoded or until the maximum time of 16 milliseconds is reached

Standalone mode should always be used if no other Master Controller has any nodes in close proximity to your nodes.

How to Configure the Master Controllers for Sync Mode

1. Configure the first Master Controller in the chain as the master.

   Setup > Master Controller Setup > Reader Setup > Sync Mode = Master

2. Configure the other Master Controllers in the chain as secondary masters or slaves.

   Setup > Master Controller Setup > Reader Setup > Sync Mode = Sec. Master or Slave

In addition, each Master Controller in the synchronization network must be configured with the same HDX Decoding setting. See page 38 for information on the **Setup > Master Controller Setup > Detection Setup > HDX Decoding** parameter.

If the Synchronization Signal is Lost

If the synchronization signal is lost, any Master Controller that is set as a secondary master will attempt to assume the master role. To prevent multiple Master Controllers from becoming the master, each secondary master will continually monitor for a synchronization input signal from an upstream Master Controller. If a Master Controller receives a synchronization input signal it will stop attempting to assume the master role and will revert to its slave role. So the secondary master that is first in line (furthest upstream in the chain) will ultimately assume the role of the master.

How to Detect and Capture Tag IDs

If the Master Controller contains at least one assigned node that is in the scanning sequence, after a power up or a reset it will automatically start in Scan mode and will immediately begin scanning for tags.

Which Tags are Stored in Memory

- All new tag IDs will be stored in memory.

- Virtual test tag IDs will be stored in memory if **Setup > Master Controller Setup > Memory Setup > Store VTT In Memory = Yes**.

- Duplicate tag IDs (the same tag ID detected multiple times by the same IS1001) may or may not be recorded depending on how **Setup > Master Controller Setup > Reader Setup > Unique Mode** is configured (see page 38).

Where Detected Tags are Sent

- New tag IDs are always sent to the USB storage port. If a USB flash drive is plugged into the USB storage port after the MTS system has been powered on and detecting tag IDs, all tag IDs stored in memory will be written to the USB flash drive. See page 80 for the proper method for ejecting the USB flash drive and collecting the data.

- New tag IDs are always sent to all accessible remote ports (Ethernet and Fiber Optic). Any communication programs that are monitoring these ports will receive the tag data. See pages 56 and 57 for information on using these ports.

- New tag IDs will be sent to the local USB port if **Setup > Master Controller Setup > Communication Setup > Tags to Local Port = Yes** (see page 42). Any communication program that is monitoring this port will receive the tag data. See page 55 for information on using the USB port.

Tag Counter

- To view the number of tags that have been detected by the Master Controller, see the top-right field on the main menu.

- The tag counter behavior is configured using the **Tag Detection Unique Mode setting**.

- To view the number of tags stored in memory, select **Status > Time, Mem. & Comm. > Stored Tag Count**.

Downloading Tag IDs

To download tag IDs that are stored in memory, select **Setup > Master Controller Setup > Memory Setup > Download Tags**.

- If the download process is initiated from the keypad, the tag data will be sent to both the local and remote communication ports. Any communications program that is monitoring these ports will receive the tag data.

- If the download process is initiated from a computer connected to a local or remote port, the tag data will be sent only to that port.
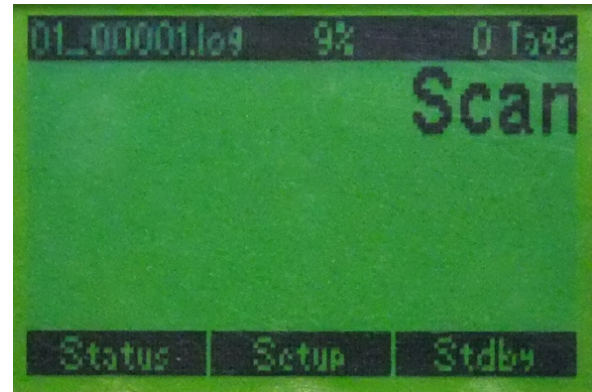
Master Controller Main Menu

When you power on the Master Controller the main menu is displayed.

There are three primary areas on the main menu.

- The top row is a status bar that displays a number of status indicators.

  o The first field is a dual-use field. It displays the name of the file in use on the external USB drive. It will also flash "ALARMS" if any alarms are presently active.

  o The second field displays the percent of memory currently being used.

  o The third field displays the detected tag IDs count. This figure represents the total number of tag IDs that have been detected by the IS1001s connected to the Master Controller since the last reset of the detection counter (via the Power/Reset key).

- The large middle area displays information about the last tag detected by the MTS. The first line displays the manufacturer ID or country code of the tag. The second line displays the unique tag ID.

  This area will also display the operating mode of the Master Controller and the results of the detection efficiency test (if enabled).

- The bottom row contains the following keys:

  o **Status:** Used to access the Status menus. See page 22.

  o **Setup:** Used to access the Setup menus. See page 26.

  o **Scan / Stdby:** Toggles the Master Controller between Scan mode and Standby mode.

Status Screens

Pressing the Status Key on the main menu displays the Status menu. The Status menu contains three sub-menu items:

- ☐ Reader
- ☐ Nodes (see page 34)
- ☐ Alarms (see page 36)

Reader Menu

Press the **Status** key on the main menu and then select **Reader**.

Available information:

- **Reader ID:** Displays the hexadecimal ID of this Master Controller.

  To change this setting: *Setup > Master Controller Setup > Reader Setup > Controller ID.*

- **Reader S/N:** Displays the Master Controller serial number.

- **Reader Date:** Displays the present date using a mm/dd/yyyy format.

  To change this setting: *Setup > Master Controller Setup > Reader Setup > Date.*

- **Reader Time:** Displays the present time using a hh:mm:ss format.

  To change this setting: *Setup > Master Controller Setup > Reader Setup > Time.*

- **Reader Mode:** Displays whether the Master Controller is in **Scan** or **Stby** mode.

  To change this setting, press the **Scan / Stdby** key on the main menu.

- **Sync Input Present:** Displays whether the Master Controller is being synchronized with another Master Controller.

- **Input Voltage:** Displays the present input voltage, in volts.
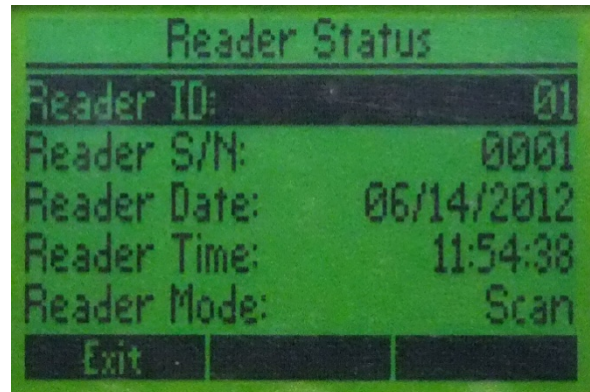
- **Temperature:** Displays the present ambient air temperature of the Master Controller. The Master Controller can operate at temperatures in the range -20°C to 70°C. Alarms will be sent if the internal temperature comes within 5 degrees of either limit (-15°C or 65°C).

- **Lithium Bat. Voltage:** Displays the present status of the lithium backup battery, in volts. The battery protects the internal clock.

- **Det. Counter:** Displays the number of tag IDs that have been detected by the MTS since the last restart of the Master Controller or since the last counter reset.

- **Int.Memory Used:** Displays the percentage of memory space presently in use. The items stored in memory include tag IDs, alarms, messages, and status reports.

  If the internal memory becomes full, the Master Controller will clear 2048 lines of data (1/60th of total memory) and will use that area to write new data.

  To manually download or erase memory: *Setup > Master Controller Setup > Memory Setup.*

- **Intern. Memory Wear:** Displays the internal memory wear percentage. The internal memory is a type of nonvolatile memory (flash memory) that wears down during each rewrite cycle. If this value reaches 100%, the internal memory is not guaranteed to store records properly and must be replaced. The Master Controller has an enhanced memory-

managing algorithm that extends the memory lifespan and allows records to be written or erased from memory up to 4 billion times.

- **Ext.St.Status:** Displays the status of the external storage device (typically a USB flash drive).

- **Ext.St.Rec.Buffer:** Displays the number of records ready to be transferred to the external USB storage device.

- **Ext.St.File:** Displays the active file name on the external USB storage device. The file name consists of a Master Controller ID and an order number that can range from 00001 to 99999. A new file is automatically created with an incremented order number at user selectable intervals (every 1 – 24 hours), or when the Master Controller is restarted. A new file is also created if you change the Master Controller ID. The file order number will be reset to 00001 if the factory default settings are applied.

Nodes Menu

Press the **Status** key on the main menu and then select **Nodes.**

Available information:

- **Node 01 through Node 0C:** Displays either a serial number ID or the word **Disabled**.

  - Serial Number ID: Represents a particular IS1001. To display information about this IS1001, press **Enter**.

  - Disabled: Indicates there is no IS1001 or antenna for this node.

The following parameters apply to each node that is assigned an IS1001.

- **Serial#:** Displays the IS1001's serial number.

- **Connected:** Displays the connection status to the node.

- **Tuned:** Displays the node's antenna tuning status.

- **Dyn. Tuning:** Displays the node's present antenna dynamic tuning setting (Enabled or Disabled).

  To change this setting: *Setup > Node Setup > Node# > Dyn. Tuning.*

- **Ant. Current:** Displays the node's present antenna current, in amperes peak-to-peak.

- **Signal Level:** Displays the node's present FDX-B signal level (0 – 100%).

- **Relative Phase:** Displays the node's present antenna tuning target phase offset measured in phase clocks (0 …+/-200).

- **Target Phase:** Displays the node's present antenna tuning target phase setting (in phase clocks, 300 ... 500).
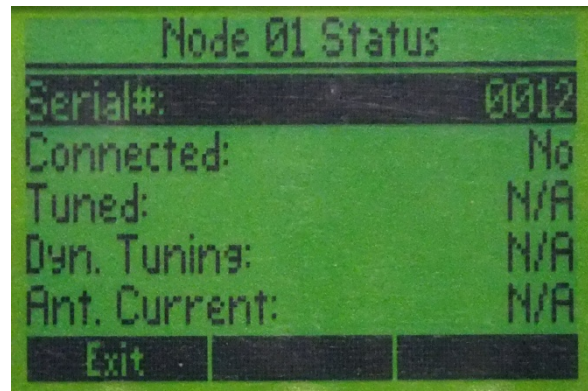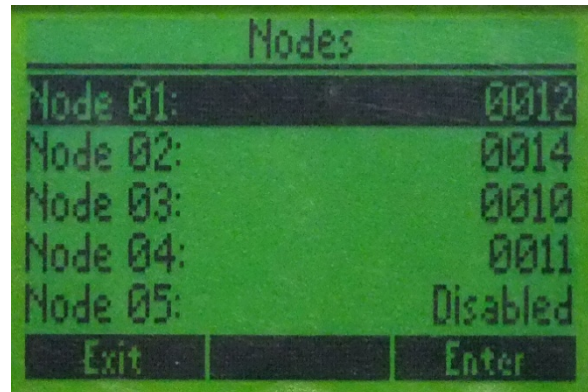
- **Capacitors:** Displays the node's present dynamic tuning capacitance setting. This value can be changed if **Dynamic Tuning** is disabled in *Setup > Node Setup > Node# > Caps* or is controlled by the node when **Dynamic Tuning** is enabled. Valid values are 0 – 1023.

- **Input Voltage:** Displays the node's present input voltage, in volts.

- **Exciter Voltage:** Displays the node's antenna exciter voltage, in volts.

- **Exc.Voltage Level:** Displays the node's antenna exciter voltage level (1 – 5).

  To change this setting: *Setup > Node Setup > Node# > Exc.Voltage Level.*

- **FDX-B Efficiency:** Displays the node's present FDX-B detection efficiency percentage.

- **HDX Efficiency:** Displays the node's present HDX detection efficiency percentage

- **Temperature:** Displays the present ambient air temperature of the IS1001, in degrees Celcius. An IS1001 can operate at temperatures in the range -20°C to 70°C. An alarm is generated if the internal temperature comes within 5 degrees of either limit (-15°C or 65°C).

- **VTT Level:** Displays the node's present virtual tag level (0 – 100%).

  To change this setting: *Setup > Node Setup > Node# > VTT Level.*

Alarms Menu

Press the **Status** key on the main menu and then select **Alarms.**

This screen displays the list of active alarms for each node. Some alarm messages are shortened in order to fit on the screen. See Alarm Messages and Codes on page 72 for the list of all available alarms and their corresponding abbreviated texts.
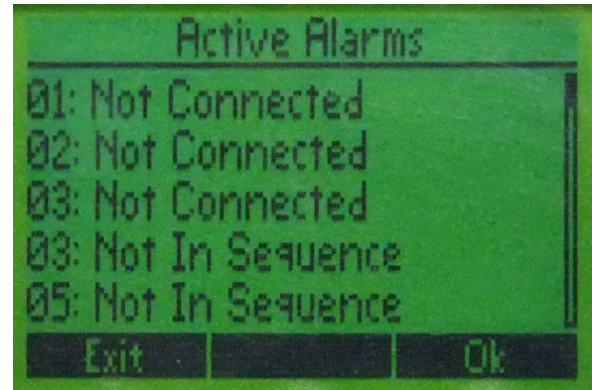
Master Controller Setup

Selecting **Setup > Master Controller Setup** displays the **Reader Setup** menu. This menu contains seven sub-menu items:

- Alarms Setup

- Reader Setup (see page 38)

- Detection Setup (see page 39)

- Network Setup (see page 41)

- Communication Setup (see page 42)

- Memory Setup (see page 43)

- Parameters Setup (see page 44)

- Reports Setup (see page 45)

Alarms Setup Menu

From the main menu select **Setup > Master Controller Setup** and then select **Alarms Setup**.

Available parameters:

- **Tuning Cap. High:** Used to set the tuning capacitance high alarm threshold. If a node's tuning capacitance value becomes equal to or greater than this limit, an alarm will be sent. Valid values are 512 – 1023. Default is 970.

- **Tuning Cap. Low:** Used to set the tuning capacitance low alarm threshold. If a node's tuning capacitance value becomes equal to or lower than this limit, an alarm is sent. Valid values are 0 – 511. Default is 50.
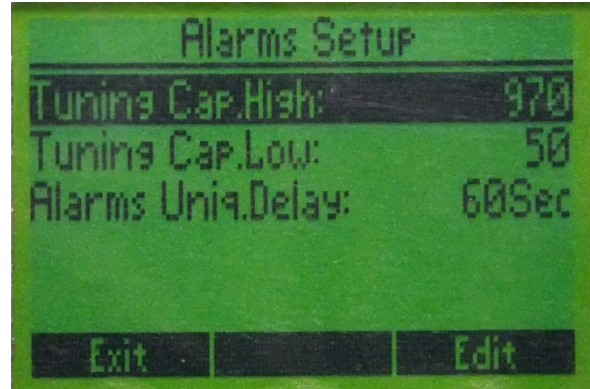
- **Alarms Uniq.Delay:** Used to set the alarm auto rebroadcast period. Valid values are 0 – 3600 seconds.

This specifies how long to wait before rebroadcasting a persistent alarm. For example, if Alarm Unique Delay = 60 and the capacitance low alarm is triggered, the Master Controller will wait 60 seconds before resending the alarm. If the alarm condition clears and then reappears, the new alarm will be sent without delay.

Note: The Virtual Tag Test Failed alarm and the Node Antenna Over Current alarm are the exceptions and will not be rebroadcast. These alarms are triggered only when the condition takes effect.

Reader Setup

From the main menu select **Setup > Master Controller Setup** and then select **Reader Setup**.

To change an option, select it and then press **Edit**.

- **Controller ID:** Sets the unique ID for this Master Controller. The ID is a hexadecimal value in the range 01 – FF. Default is 01.

- **Date:** Sets the present date. The date is specified as mm/dd/yyyy.

- **Time:** Sets the present time. The time is specified using a hh:mm:ss (24 hour) format.

- **Sync. Mode:** Sets the Master Controller synchronization mode. Valid values are Master, Sec. Master, Slave, and Standalone. Default is Standalone. See page 27 for details on multiple Master Controller configurations.

- **Initiation Delay:** Specifies if the Master Controller will delay all automatic diagnostics (such as status report, noise report, and VTT) at startup time. All other functionalities, including tag detection, are not delayed. Valid values are Enabled and Disabled. Default is Enabled.

  The delay time is calculated by multiplying the Controller ID by 1 second.

- **Auto Standby:** Specifes the hour of the day and the duration (in hours) that the Master Controller will be automatically put into standby mode. This is typically done in order to save power during times of the day with little or no tag activity. Use the format HH,DD. Valid values for both fields are 0 – 23. Default is 00,00 (disabled).

- **Tag Display:** Specifies the format to use when displaying detected tag IDs. Valid values are DEC and HEX. Default is HEX.

- **Backlight Mode:** Specifies if the Master Controller's backlight will be used. Valid values are Enabled, Disabled, and Saving. When in Saving mode, the backlight will turn off after 10 seconds of inactivity and will turn back on when a tag is detected or when a key is pressed.

- **Beeper:** Specifies if the Master Controller will issue an audible beep when a tag is detected. Valid values are Enabled and Disabled. Default is Enabled.

  Note: The beeper function also dependes on the **Detection Unique** setting.

Detection Setup

From the main menu select **Setup > Master Controller Setup** > **Detection Setup**.

To change an option, select it and then press **Edit**.

- **HDX Decoding:** Specifies if half duplex decoding is enabled. Enabling HDX decoding enables HDX tags to be decoded by the system, but it also increases the scan time for each node in a sequence and as a result reduces the overall detection performance. Valid values are Enabled and Disabled. Default is Disabled.

- **Det. Eff. Test:** Enables the detection efficiency test. This is used to qualify the performance of the entire system. When enabled, a detection efficiency report will be generated every 2.5 seconds. Valid values are Enabled and Disabled. Default is Disabled.

  Efficiency is calculated as a percentage of the number of detections vs. the maximum possible over the allowed time interval. This test will work with physical tags and with virtual test tags.

- **Detection Counter:** Specifies if you want the Master Controller to keep a running count of the tags detected by the MTS. Valid values are Enabled, Disabled, and Enabled+Reset. Default is Enabled.

  The detection counter counts all detected tag IDs and depends on the **Detection Unique** settings. It resets whenever a Master Controller resets, powers up, or you activate the **Enable+Reset** option.
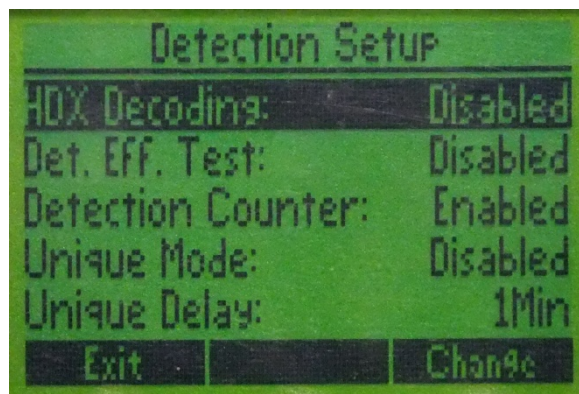
- **Unique Mode:** Specifies how the tag ID is handled if it is detected multiple times by the same IS1001. Valid values are:

  - **1 Tag:** The following occurs only if the tag is different from the tag previously detected by the same IS1001: The tag ID is sent to the communication ports, is stored in memory, and is accompanied by a buzzer sound (if enabled). This is the default value.

  - **5 Tags:** The following occurs only if the tag is different from the last five tag IDs previously detected by the same IS1001: The tag ID is sent to the communication ports, is stored in memory, and is accompanied by a buzzer sound (if enabled).

  - **Delay:** The following occurs only if the specified number of minutes have passed since it was first detected or if it is different from the last five tag IDs previously detected by the same IS1001: The tag ID is sent to the communication ports, is stored in memory, and is accompanied by a buzzer sound (if enabled). Use **Unique Delay** to specify the delay value.

  - **Disabled:** Disables detection unique mode. All tag IDs are sent to the communication ports, stored in memory, and accompanied by a buzzer sound (if enabled).

  Note: The Tag Detected LED flashes and the tag ID is displayed on the LCD

every time a tag is detected regardless of the Unique Mode setting. Information about the previously detected tag ID is cleared if the Master Controller is powered on, restarted, or switched to Standby mode.

- **Unique Delay:** Specifies the delay value for the **Unique Mode > Delay** option. Valid values are 1 – 1440 minutes. Default is 1 minute.

  Note: In order for **Unique Delay** to take effect, **Unique Mode** must be set to **Delay**.

- **VTT:** Uses a virtual tag to perform a test that verifies the MTS system's integrity and sensitivity. It generates an ISO FDX-B tag signal at selectable signal levels (VTT Level) and can be activated in the following manner:

  o Automatically if **Auto VTT Delay** is set to a non-zero value. The test is performed at user-selectable intervals.

  o Manually if **VTT = Single Shot**. The test is initiated on each IS1001 for one activation period.

  o Manually if **VTT = Enabled**. The test is initiated on each IS1001 continuously and works in conjunction with the detection efficiency test. The detection efficiency test is automatically activated when **VTT = Enabled**.

  Note: VTT is available in two ways: for a single node or for all nodes in configured sequence. The functionality of both implementations is the same. Enabling VTT for a single node is available from the **Node Setup** menu or by issuing the command *"NVTnn,s"* from a computer, where *nn* is the node ID and *s* is for the option (0 – Off, 1 – On, S – Single Shot). Enabling VTT for all nodes in sequence is available via Master Controller Setup > Detection Setup > VTT Enabled or by a typing the command "*NVT,s*" from a

local computer, where *s* is for the option (0 – Off, 1 – On, S – Single Shot).

- **Auto VTT Delay:** Used to set the delay period for the single shot automatic virtual tag test. The delay can be set from 0 (disabled) to 1440 minutes (24 hours). When the delay expires, if a real tag is not present in an IS1001's field at that moment then the virtual tag will be enabled for one activation period. This test is done in order to verify that the MTS system is operating properly especially for extended periods when no PIT tags are present.
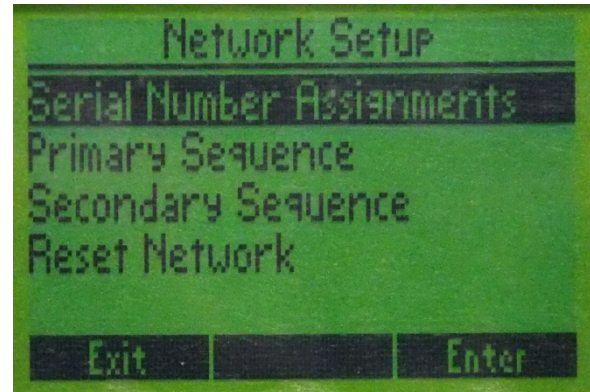
Network Setup

From the main menu select **Setup > Master Controller Setup** > **Network Setup**.

To change an option, select it and then press **Edit**.

- **Serial Number Assignments:** Specifies the unique serial number of the IS1001 you want to assign to each node ID. (A node consists of an IS1001 and an attached antenna.) An IS1001's serial number can be found stamped on its Mother Board. Use only the last four digits when specifying the serial number. Default is 0000 (meaning the node is disabled).

- **Primary Sequence:** Specifies the order that the individual IS1001s will be activated and polled by the Master Controller. Valid values are node numbers 01 – 0C. The default primary sequence is 01,02,03,04,05,06,07,08,09,0A,0B,0C.

- **Secondary Sequence:** Used if you want to activate two IS1001s at one time. Specifies the order that the IS1001 pairs will be activated and polled by the Master Controller. The first IS1001s in the primary and secondary sequence will be paired, the second IS1001s in each sequence will be paired, etc. Valid values are node numbers 01 – 0C. By default the secondary sequence is disabled.

  A node ID of 00 can be used to define a "skip" position if a secondary sequence is being used.

- **Reset Network:** Generates a reset for all the nodes in the network and runs the discovery process.

Communication Setup

From the main menu select **Setup > Master Controller Setup** > **Reader Setup**.

To change an option, select it and then press **Edit**.

- **Local Port Speed:** Sets the speed used on the local USB communication port. Valid options are 9600, 19200, 38400, 57600, or 115200. Default is 115200 Bd/s.

- **Remote Port Speed:** Sets the speed used on the remote communication ports. Valid options are 9600, 19200, 38400, 57600, or 115200. Default is 115200 Bd/s.

  Note: The Ethernet port module is preconfigured to work at 115200 Bd/s, which matches the default setting for this parameter. If you change the **Remote Port Speed** setting (and this is not recommended), you must also reconfigure the Ethernet port module to match the same speed (see page 61 for details).

  Also Note: The Master Controller can control the download of data from internal memory independently for both local and remote ports. If these ports have different speed settings, downloading a large amount of data from one port will not cause a delay on another port. A download can be performed simultaneously from both ports at their respective speeds.

- **Tags To Local Port:** Specifies if tag IDs detected from this point on are sent to the local USB storage port. Valid options are either Yes or No. Default is Yes.

  Note: This parameter does not apply to previously detected tags that are stored in memory.
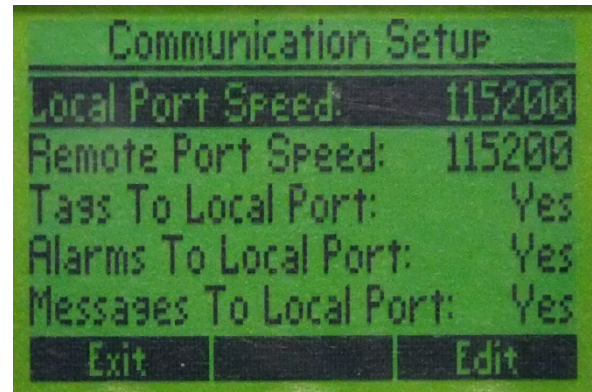
Note: The **Communication Setup** parameters do not affect the speed at which stored data is downloaded to the local port.

- **Alarms To Local Port:** Specifies if alarms issued from this point on are sent to the local USB port. Valid options are either Yes or No. Default is Yes.

  Note: This parameter does not apply to previously issued alarms that are stored in memory.

- **Messages To Local Port:** Specifies if messages issued from this point on are sent to the local USB port. Valid options are either Yes or No. Default is Yes.

  Note: This parameter does not apply to previously issued messages that are stored in memory.

- **Stat.Rep.To Local Port:** Specifies if full status reports generated from this point on are sent to the local USB port. Valid options are either Yes or No. Default is Yes.

  Note: This parameter does not apply to previously generated reports that are stored in memory.

Memory Setup

From the main menu select **Setup > Master Controller Setup** and then select **Memory Setup**.

To download an item from memory, select it and then press **Send**.

In all cases:

- If a download is initiated through the keypad, the data will be sent to both the local and remote ports.

- If a download is initiated through a local or remote port, the data will be sent only to that port. Also, you can specify a date range for data you want to download.

- The Master Controller memory is NOT erased during the download process.

- **Download Full Memory:** Initiates the download of all data contained in the Master Controller's memory.

- **Download Tags:** Initiates the download of all tag IDs contained in the Master Controller's memory.

- **Download Messages:** Initiates the download of all messages contained in the Master Controller's memory.

- **Download Alarms:** Initiates the download of all alarms contained in the Master Controller's memory.

- **Download Status Reports:** Initiates the download of all full status reports contained in the Master Controller's memory.
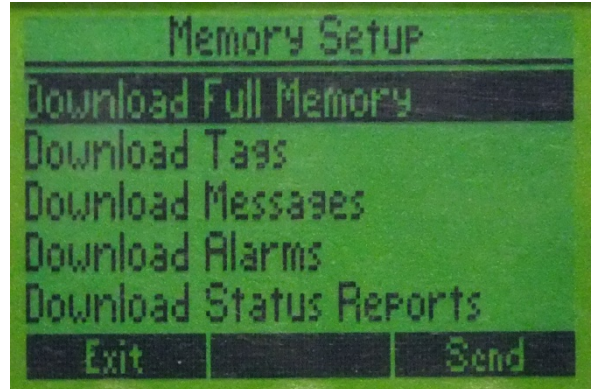
- **Erase Full Memory:** Permanently erases all data contained in the Master Controller's memory. A warnng message is displayed asking you to confirm this action.

  The recommendation is to download the contents of memory to another computer or storage device before erasing memory.

- **Store VTT In Memory:** Specifies if virtual test tag IDs will be stored in memory as they are detected. Valid values are Yes and No. Default is Yes.

- **Ext.ST.File Duration:** Specifies how often a new file is created on the external USB storage device. The file name consists of a Master Controller ID and an order number that ranges from 00001 – 99999. A new file is automatically created with an incremented order number at hourly intervals set by this parameter. Valid values are 01 - 24. Default is 24 hours.

  A new file will also be created if any of the following occur:

  - The **Ext.ST.File Duration** parameter is changed.
  - The Master Controller is restarted.
  - The Master Controller ID is changed.

Parameters Setup

From the main menu select **Setup > Master Controller Setup** and then select **Parameters Setup**.

- **Load Factory Default:** To replace all your current settings with the factory default settings, press **Load** and then press **Load** again on the confirmation screen. The Master Controller will be restarted with the new settings.

- **Load Custom Config. 1:** To replace your current settings with the settings previously saved by you as Custom Configuration 1, press **Load** and then press **Load** again on the confirmation screen. The Master Controller will be restarted with the new settings.

- **Load Custom Config. 2:** To replace your current settings with the settings previously saved by you as Custom Configuration 2, press **Load** and then press **Load** again on the confirmation screen. The Master Controller will be restarted with the new settings.

- **Save Custom Config. 1:** To designate the current settings as your Custom Configuration 1, press **Save** and then press **Save** again on the confirmation screen.

  This command does not save your current serial number assignments or the current external storage file order number.

- **Save Custom Config. 2:** To designate the current settings as your Custom Configuration 2, press **Save** and then press **Save** again on the confirmation screen.

  This command does not save your current serial number assignments or the current external storage file order number.

Reports Setup

From the main menu select **Setup > Master Controller Setup** and then select **Reports Setup**.

To send a report, select it and then press **Send**.

In all cases:

- If a report request is initiated through the keypad, the report will be sent to both the local and remote ports.

- If a report request is initiated through a local or remote port, the report will be sent to the specified port.

Available options:

- **Report FW Versions:** Immediately generates and sends a Firmware Version Report. The report contains the Master Controller application version, the CAN Bus Gateway Board firmware version, and the firmware versions for all available nodes on the network.

- **Report Date/Time:** Immediately generates and sends a Date & Time Report. The report contains the present date and time set on the Master Controller.

- **Report Node Assignment:** Immediately generates and sends a Node Assignment Report. The report contains information about all of the nodes on the network and includes the serial numbers assigned to each node ID.

- **Report Sequences:** Immediately generates and sends a Sequences Report. The report contains information about both the primary and secondary activation sequences.

- **Report Full Status:** Immediately generates and sends a Full Status Report. This report contains vital configuration settings and diagnostic data for the Master Controller and all available network nodes.

    See page 67 for details.
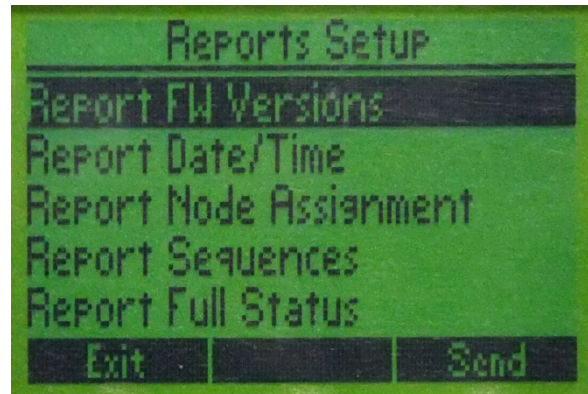
- **Report Noise:** Immediately generates and sends a Noise Report. The report provides noise statistics (such as present, average, and peak noise measurement values) for all available network nodes. The report contains all information since the last time the report was generated or since the last system reset.

- **Report Settings:** Immediately generates and sends a Settings Report. This report contains configuration settings for the Master Controller and all available network nodes.

- **Noise Rep.Delay:** Specifies how often to automatically send the Noise Report. Valid values are 0 (disabled) to 1440 minutes (once every 24 hours). Default is 0.

- **Status Rep.Delay:** Specifies how often to automatically send the Full Status Report. Valid values are 0 (disabled) to 1440 minutes (once every 24 hours). Default is 60 minutes.

Note: An automatically generated full status report will include an abbreviated version of itself. Refer to page 69 for more information about the abbreviated report.

Node Setup

Selecting **Setup > Node Setup** displays the **Node Setup** menu. This menu contains twelve sub-menu items (Node 01 – Node 0C), one for each node that can be supported by the Master Controller. A node consists of an IS1001 and an attached antenna.

All nodes contain the same setup parameters.

- **Serial#:** The IS1001 serial number assigned to this node ID. Valid values are 0001 - 9999. Default is 0000 (disabled).

- **Start Full Tuning:** Used to initiate the full auto-tune process for the antenna attached to this node. It is used to determine the optimum tuning parameters. During this process the IS1001 goes through every possible electronically-switched capacitor setting combination to find the one that produces the maximum current in the antenna. The corresponding measured phase value is then automatically set as the target phase value for this node.

  The full auto-tune process will typically take about 40 seconds to complete.

  Note: The full auto-tune process should be performed during initial system installation on each node and anytime the antenna has been repaired, replaced, or moved to a new location, as this may change the optimal settings for the antenna.

- **Current Low Thrshld:** Used to set the low antenna current alarm threshold. Valid values are 0.0 – 9.0A. Default is 1.0A.

  An Antenna Current Low alarm will be issued for this node if the current in its antenna drops below the specified value. A low antenna current may be caused by an out-of-tune antenna, a damaged antenna, or a bad antenna connection.
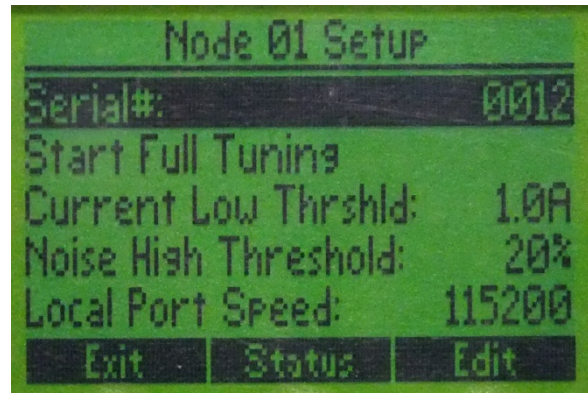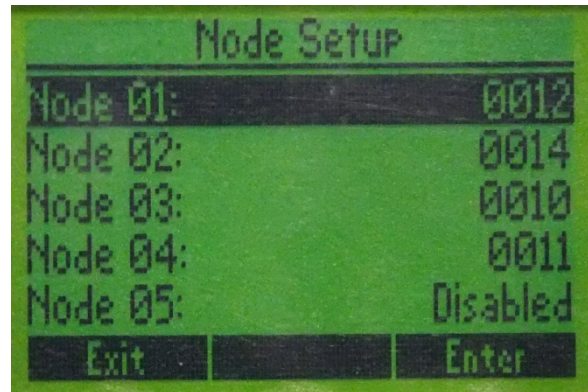
- **Noise High Threshold:** Used to set the excessive noise level alarm threshold. Valid values are 0 – 100%. Default is 20%.

  A Node Noise High alarm will be issued for this node if the noise level exceeds the specified level. A high noise level may indicate a tuning or connection problem.

- **Local Port Speed:** Sets the speed used on the node's local USB communications port. Valid values are 9600, 19200, 38400, 57600, 115200. Default is 115200 bps.

- **Beeper Enabled:** Specifies if the IS1001's internal speaker will issue an audible beep when a tag is detected. Valid values are Enabled and Disabled. Default is Disabled.

  Note: The node's internal beeper is contained on the optional accessory board.

- **Dyn. Tuning:** Used to set antenna dynamic tuning to either Enabled or Disabled. Default is Enabled.

  Dynamic Tuning automatically adjusts the tuning capacitor settings to achieve the desired target phase value.

- **Exc.Voltage Level:** Sets the antenna exciter voltage level to adjust the antenna output power (current). Valid values are 1 –5. Default is 1.

- **Phase Deviation:** Used to set the tuning phase deviation threshold. Valid deviation values are 2 – 15. Default is 4.

  This specifies how far the actual antenna signal phase can deviate from the target phase before the IS1001 begins the dynamic auto-tune process. During this process the IS1001 adjusts capacitance in an effort to return to the target phase and retune its antenna.

  Note: In low Q systems you might set the Phase Deviation rather high (7 – 15). In high Q systems requiring more finely tuned antennas you might set the deviation rather low (2 – 5). But beware of setting the deviation value so high that the IS1001 is not making any adjustments or so low that the controller is not able to maintain the tune point.

- **Capacitors:** Used to set the specific antenna tuning capacitance bank setting. Valid values are 0 – 1023.

  Note: This value is also controlled by the dynamic tuning mechanism. You should turn off dynamic tuning while manually adjusting the tuning capacitors or the settings will be overridden by the auto-tuning mechanism. Changing capacitors manually should only be considered if a high-precision tune is required. In this case you can set up any value in the tuning capacitors bank and check the read performance. When the desired read performance is achieved, note the corresponding measured phase and set this value as the target phase for this node.

Tip: While in the **Node Setup** menu, press the **Status** key to go directly to the **Node Status** screen, where you can view the **FDX-B Efficiency**.

- **Target Phase:** Used to set or adjust the dynamic tuning target phase. Valid values are 300 – 500. Default is 400.

- **VTT:** Uses a virtual tag to perform a test that verifies the MTS system's integrity and sensitivity. It generates an ISO FDX-B tag signal at selectable signal levels (specified by the **VTT Level** parameter) and can be activated in the following manner:

  o Automatically if **Auto VTT Delay** is set to a non-zero value. The test is performed at user-selectable intervals.

  o Manually if **VTT** = **Single Shot**. The test is initiated on the IS1001 for one activation.

  o Manually if **VTT = Enabled**. The test is initiated on each IS1001 continuously and works in conjunction with the detection efficiency test. The detection efficiency test is automatically activated when **Virtual Test Tag = Enabled**.

Note: VTT Enabled is available in two ways: for a single node or for all nodes in a configured sequence. The functionality of both implementations is the same. Enabling VTT for a single node is available from the **Node Setup** menu or by issuing the command *"NVTnn,s"* from a computer, where *nn* is the node ID and *s* is for the option (0 – Off, 1 – On, S – Single Shot). Enabling VTT for all nodes in sequence is available via Master Controller Setup > Detection Setup > VTT Enabled or by a typing the command "*NVT,s*" from a local computer, where *s* is for the option (0 – Off, 1 – On, S – Single Shot).

- **VTT Level:** Used to specify the VTT signal level. The higher this value is set the stronger the VTT signal that will be generated. This allows you to check the node performance for sensitivity. Valid values are 0 – 255. Default is 128.

Menu Structure

Menus and Parameters			
Menu	**Sub Menu**	**Sub Menu**	**Settings**
Status	Reader Settings		Display: Reader ID Reader S/N Reader Date Reader Time Reader Mode Sync. Input Present Input Voltage Temperature Lithium Bat. Voltage Det. Counter Int. Memory Used Intern. Memory Wear Ext.St.Status Ext.St.Rec.Buffer Ext.St.File
	Nodes	Node 01	Display: Serial # Connected Tuned Dyn. Tuning Ant. Current Signal Level Relative Phase Target Phase Capacitors Input Voltage Exciter Voltage Exc.Voltage Level FDX-B Efficiency HDX Efficiency Temperature VTT Level
		Node 02 – Node 0C	Same as Node 01
	Alarms		Display: The list of active alarms

Menus and Parameters				
Menu	**Sub Menu**	**Sub Menu**	**Sub Menu**	**Settings**
Setup	Master Controller Setup	Alarms Setup	Tuning Cap. High	Set Tuning Capacitance High Alarm Threshold {512-1023} (Default: 970)
			Tuning Cap. Low	Set Tuning Capacitance Low Alarm Threshold {0-511} (Default: 50)
			Alarm Uniq. Delay	Set Alarms Unique Delay in Seconds {0-3600} (Default: 60)
		Reader Setup	Controller ID	Set Unique ID for Master Controller {01-FF} (Default: 01)
			Date	Set Master Controller Date {MM/DD/YYYY} (Default: 01/01/2010)
			Time	Set Master Controller Time {HH:MM:SS} (Default: 00:00:00)
			Sync. Mode	Set Master Controller Synchronization Mode {1} Master, {2} Secondary Master, {3} Slave, {0} Standalone (Default: 2)
			Initiation Delay	Set Master Controller Initiation Delay {Enabled, Disabled} (Default: Enabled)
			Auto Standby	Set Master Controller Automatic Standby {HH,DD} (Default: 00,00)
			Tag Display	Set Tag ID Display Format {HEX, DEC} (Default: HEX)
			Backlight Mode	Set Master Controller Display Backlight {Enabled, Disabled, Saving} (Default: Saving)
			Beeper	Set Master Controller Beeper {Enabled, Disabled} (Default: Enabled)

Setup	Master Controller Setup	Detection	HDX Decoding	Set HDX Detection {Enabled, Disabled} (Default: Disabled)
			Det. Eff. Test	Enable or disable the detection efficiency test; disabled upon controller restart
			Detection Counter	Set Detection Counter {Enabled, Disabled, Enabled+Reset} (Default: Enabled)
			Unique Mode	Set Detection Unique Mode {Disabled, 1 Tag, 5 Tags, Delay} (Default: Last 1)
			Unique Delay	Set Detection Unique Delay in Minutes {1 – 1440} (Default: 1)
			VTT	Set Detection Virtual Test Tag {Enabled, Disabled, Singe Shot} (Default: Disabled)
			Auto VTT Delay	Set Automatic Detection Virtual Test Tag Single Shot Delay in Minutes {0 – 1440} (Default: 60)
		Network Setup	Serial Number Assignments	Set Serial Number for each IS1001 {0001 – 999999} Default: 0000 (disabled)
			Primary Sequence	Set Primary Sequence (Default:01,02,03,04, 05,06,07,08,09,0A,0B,0C)
			Secondary Sequence	Set Secondary Sequence (Default: blank)
			Reset Network	Resets all nodes in the network and initiates the discovery process.
		Communication Setup	Local Port Speed	Set Local Communication Port Speed {9600, 19200, 38400, 57600, 115200 (Default: 115200)
			Remote Port Speed	Set Remote Communication Port Speed {9600, 19200, 38400, 57600, 115200 (Default: 115200)
			Tags to Local Port	Set Tags Communication to Local Port {Yes, No} (Default: Yes)
			Alarms To Local Port	Set Alarms Communication to Local Port {Yes, No} (Default: Yes)
			Messages To Local Port	Set Messages Communication to Local Port {Yes, No} (Default: Yes)
			Stat.Rep.To Local Port	Set Status Report Communication to Local Port {Yes, No} (Default: Yes)

Setup	Master Controller Setup	Memory Setup	Download Full Memory	Download Full Memory to Local and Remote Communication Ports
			Download Tags	Download Tags to Local and Remote Communication Ports
			Download Messages	Download Messages to Local and Remote Communication Ports
			Download Alarms	Download Alarms to Local and Remote Communication Ports
			Download Status Reports	Download Status Reports to Local and Remote Communication Ports
			Erase Full Memory	Erase all data from internal memory
			Store VTT in Memory	Save Virtual Tags to Memory {Yes, No} (Default: Yes)
		Parameters Setup	Load Factory Default	Reset to Factory Default Parameters
			Load Custom Config. 1	Reset to Custom Parameters Configuration 1
			Load Custom Config. 2	Reset to Custom Parameters Configuration 2
			Save Custom Config. 1	Save Current Parameters Configuration as Custom Configuration 1
			Save Custom Config. 2	Save Current Parameters Configuration as Custom Configuration 2
		Reports Setup	Report FW Versions	Send Firmware Versions Report to Local and Remote Communication Ports
			Report Date/Time	Send Date/Time Report to Local and Remote Communication Ports
			Report Node Assignment	Send Node Assignment Report to Local and Remote Communication Ports
			Report Sequences	Send Sequences Report to Local and Remote Communication Ports
			Report Full Status	Send Full Status Report to Local and Remote Communication Ports
			Report Noise	Send Noise Report to local and remote ports
			Noise Rep.Delay	Set Noise Report Delay in Minutes {1 – 1440} (Default: 0)
			Status Rep.Delay	Set Full Status Report Delay in Minutes {1 – 1440} (Default: 60)

Setup	Node Setup	Node 01	Serial#	Set IS1001 Serial Number {0001 – 999999} Default: 0000 (disabled)
			Start Full Tuning	Perform Antenna Full Tune
			Current Low Thrshld	Set Current Low Alarm Threshold in Amperes {025} (Default: 1.0)
			Noise High Threshold	Set Noise High Alarm Threshold in Percents {0-100} (Default: 20)
			Local Port Speed	Set USB Communication Port Speed {9600, 19200, 38400, 57600, 115200 (Default: 115200)
			Beeper Enabled	Set IS1001 Beeper {Enabled, Disabled} (Default: Enabled)
			Dyn. Tuning	Set Antenna Dynamic Tuning {Enabled, Disabled} (Default: Enabled)
			Exc.Voltage Level	Set Antenna Exciter Voltage Level {1 – 5} (Default: 1)
			Phase Deviation	Set Antenna Dynamic Tuning Phase Deviation Threshold {2-15} (Default: 1)
			Capacitors	Manually Set Antenna Tuning Capacitance {0-1023}
			Target Phase	Set Antenna Dynamic Tuning Target Phase {300-500} (Default: 400)
			VTT	Set Detection Virtual Tag Test {Enabled, Disabled, Singe Shot} (Default: Disabled)
			VTT Level	Set Detection Virtual Tag Test Level {0 – 255} (Default: 128)
		Node 02 – Node 0C	Same as Node 01	

Establishing a Connection with the Master Controller

There are three ways to make a connection with the Master Controller:

- **USB port:** Connects the Master Controller to a local device such as a laptop. Use this port to monitor, maintain, and update the Master Controller and the attached IS1001s while at the local site. Tags detected by the IS1001s are sent to this port only if **Setup > Master Controller Setup** > **Communication Setup > Tags to Local Port = Yes**. This port operates using the ASCII protocol. See page 55 for information on using this port.

- **Fiber Optic transmit and receive ports:** Connects the Master Controller to a high speed fiber optic network for long distance communication. Use this port to monitor, maintain, and update the Master Controller and the attached IS1001s from a remote site. Tags detected by the IS1001s are automatically sent to this port. This port operates using the ASCII protocol. See page 56 for information on using these ports.

- **Ethernet port:** Connects the Master Controller to a local area network (LAN). Use this port to monitor, maintain, and update the Master Controller and the attached IS1001s from a remote site. Tags detected by the the IS1001s are automatically sent to this port. This port operates using the ASCII protocol. See page 57 for information on using this port.

Note: Although you can use all connection options at the same time, the recommendation is to use only one or the other. This will prevent conflicting configuration commands from being sent simultaneously from different sources.

ASCII Protocol

ASCII (American Standard Code for Information Interchange) is a character-encoding scheme based on the ordering of the English alphabet. A string of 7 binary digits represents each character. This is the simplest communications protocol. It transmits only ASCII characters and uses ASCII control codes. It implies little or no error checking. This protocol is supported by the BioTerm communications program developed by Biomark and by most standard communications programs such as Terminal, HyperTerminal, Tera Term Pro, ProComm, PuTTY, etc.

Note: BioTerm is supplied on the USB Flash memory device included with the IS1001-MTS system. It is also available at: http://www.biomark.com/Contact_Us/Manuals___Videos___Applications/.

To help sort the data, all messages have an identifier that delineates their type:

- "MSG:" used to define an informational message

- "ALM:" used to define an alarm or error message

- "TAG:" used to define a tag ID message

- "SRP:" used to define an abbreviated status report message

- "INF:" used to define the beginning or end of multi-line informational messages (such as reports, memory downloads, etc.)

Note: An asterisk (*) at the beginning of a message indicates that the message is being sent as part of a memory download.

USB Port Operation

The Master Controller can be operated and configured locally using the USB communication port.

1. Install the Silicon Labs CP210x USB to UART Bridge Virtual COM Port (VCP) Windows driver on a local computer being used to communicate with the Master Controller:

    a. Copy the "CP210x_VCP_Win_XP_S2K3_Vista_7.exe" file to a directory of your choice on the computer.

       Note: This file is supplied on the USB Flash memory device included with your IS1001-MTS system. This file is also available on the following website: http://www.silabs.com/products/mcu/pages/usbtouartbridgevcpdrivers.aspx

    b. Double-click the file and follow the installation instructions.

2. Connect the Master Controller to the local computer using a USB type A-to-mini USB type B cable (not supplied).

3. Start the BioTerm communications program.

    Note: BioTerm is supplied on the USB Flash memory device included with your IS1001-MTS system. It is also available at: http://www.biomark.com/Contact_Us/Manuals___Videos___Applications/.

4. In the **Serial Port** box, make sure that **COMx Silicon Labs CP210x USB to UART Bridge** is selected (where x is the port number assigned to the local computer's USB port).

5. In the **Baud Rate** box, make sure you match the Master Controller's local port speed setting.

6. Make a serial port connection to the Master Controller by clicking **Open**.

7. (Optional) To record and store all communication data such as tag IDs, alarm messages, reports, etc., configure the BioTerm utility program to act as a data logger by selecting **Tools > Enable Capture** or by clicking the **Capture On/Off** button.

8. Type commands to perform the desired actions.

    To verify the connection between the computer and the Master Controller, within BioTerm type **?** and then press **Enter**. If a list of available commands is displayed you know you have a working connection. The valid commands are described on page 63.
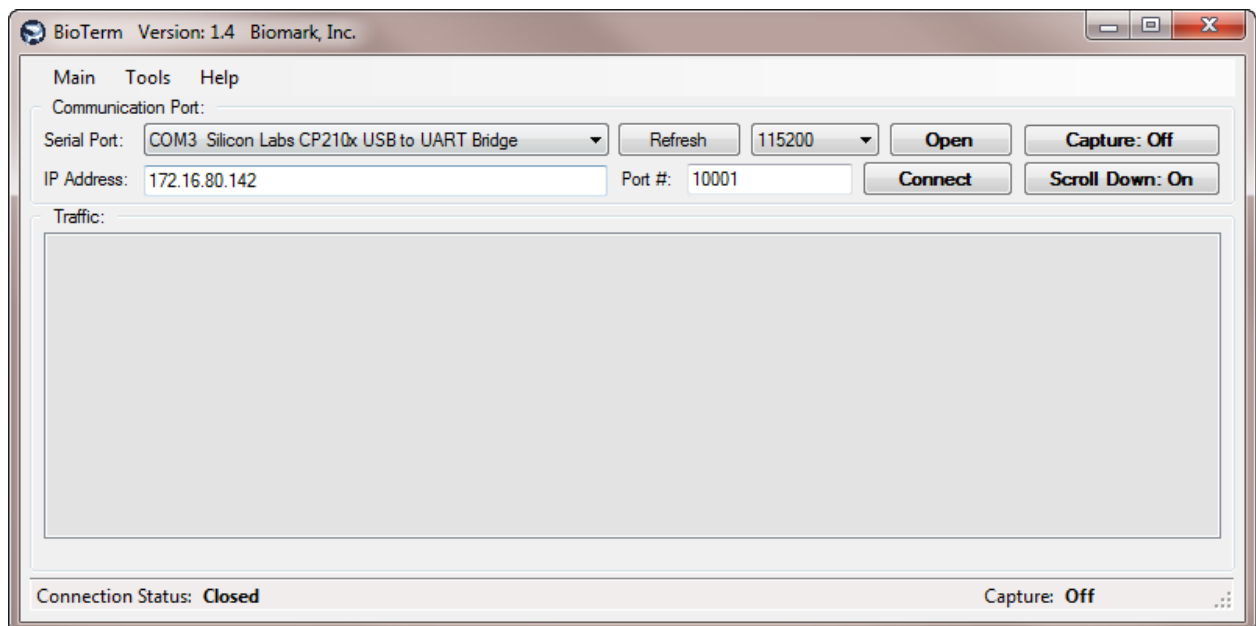
Fiber Optic Port Operation

The Master Controller can be operated and configured remotely using a fiber optic connection. To establish a connection:

1. Connect the Master Controller to the network using fiber optic cables (not supplied).

2. Start the BioTerm communications program.

   Note: BioTerm is supplied on the USB Flash memory device included with your IS1001-MTS system. It is also available at: http://www.biomark.com/Contact_Us/Manuals___Videos___Applications/.

3. Determine the communication port number assigned to the port that the fiber optic-to-serial communication converter is connected to on the remote computer.

4. In the BioTerm **Serial Port** box, select the serial port number you identified in the previous step.

5. In the **Baud Rate** box, make sure you match the Master Controller's remote port speed setting.

6. Make a serial port connection to the Master Controller by clicking **Open**.

7. (Optional) To record and store all communication data such as tag IDs, alarm messages, reports, etc., configure the BioTerm utility program to act as a data logger by selecting **Tools > Enable Capture** or by clicking the **Capture On/Off** button.

8. Type commands to perform the desired actions.

   To verify the connection between the computer and the Master Controller, within BioTerm type **?** and then press **Enter**. If a list of available commands is displayed you know you have a working connection.

   The valid commands are described on page 63.

Ethernet Port Operation

The Master Controller can be monitored and configured remotely across a local area network.

1. Connect the Master Controller to your local area network using a CAT5 Ethernet cable (not supplied).

2. Start the BioTerm communications program.

3. Determine the Master Controller's IP address by selecting **Tools > Lantronix Device Utilities** within the BioTerm utility.

   Note: BioTerm is supplied on the USB Flash memory device included with your IS1001-MTS system. It is also available at: http://www.biomark.com/Contact_Us/Manuals___Videos___Applications/.

The Master Controller is set to automatically obtain an IP address when it is powered on. The easiest way to discover the assigned IP address is to use the BioTerm communications program. This utility program will scan your network for Lantronix products (the Master Controller uses a Lantronix XPort Ethernet module) and will display the IP addresses of the devices it finds. If there are multiple Master Controllers on the network use the MAC addresses of the Master Controller's Ethernet module to help identify each one.
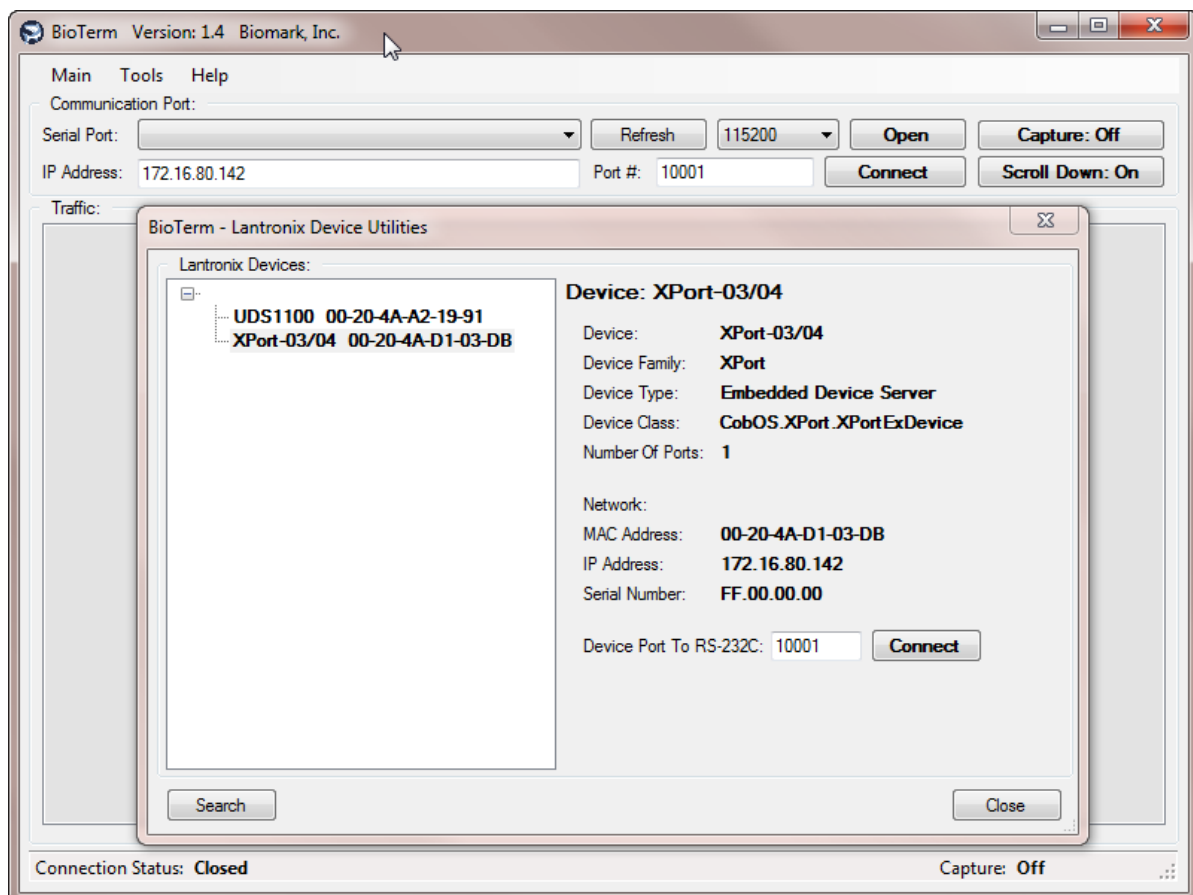
4. Click **Connect** to make a connection to the Master Controller.

    If you receive an error when attempting the connection, make sure the BioTerm communication parameters are configured as follows:

    - *IP address* = the Master Controller's IP address

    - *Port* = 10001

    - *Connection type* = TCP/IP

    If connection problems persist or if the Master Controller is not shown in the list of found devices, use the Lantronix DeviceInstaller utility to reconfigure the XPort Ethernet module (described in *Configuring the Master Controller's LAN Settings).*

5. (Optional) To record and store all communication data such as tag IDs, alarm messages, reports, etc., configure the BioTerm utility to act as a data logger by selecting **Tools > Enable Capture** or by clicking the **Capture On/Off** button.

6. Type commands to perform the desired actions.

    To verify the connection between the computer and the Master Controller, within BioTerm type **?** and then press **Enter**. If a list of available commands is displayed you know you have a working connection.

    The valid commands are described on page 63.

Configuring the Master Controller's LAN Settings

This section describes how to properly configure the Master Controller's Ethernet module (XPort module) so you can establish a remote Ethernet connection to the Master Controller. The module has been preconfigured by Biomark prior to shipping so your Master Controller is ready to be connected to your LAN upon installation. Changes may be necessary, however, if a firmware upgrade becomes available for the Lantronix XPort module or if your local network requires changes to the configuration.

To perform these changes, an extended configuration utility is available from Lantronix called the Lantronix DeviceInstaller. This free Windows-based application will scan your network for Lantronix devices (the Master Controller uses Lantronix XPort Ethernet module) and will display the devices it finds. For example:

Note: For additional information see the Lantronix XPort User Guide, available from the Lantronix Web site: http://www.lantronix.com/pdf/XPort_UG.pdf.

This utility is available at:

http://www.lantronix.com/device-networking/utilities-tools/device-installer.html

The utility will allow you to:

- Load the appropriate firmware

- Assign IP & other network specific addresses

- Load custom web pages

- Enable web-based configuration of the device server

- Ping or query the attached device(s) over the network

- Allow Telnet communication with the device(s)

- View specific device data files

Assigning a static IP address to the Master Controller

When you first connect the Master Controller to your network it will typically be assigned a random IP address based on your network addressing scheme. Depending on your network configuration, this IP address may change each time you power the Master Controller off and on. To assign the Master Controller a static IP address:

1. Obtain an IP address from your network administrator.

2. Connect the Master Controller to your network using the Ethernet port.

3. Within the Lantronix DeviceInstaller, click **Search** to locate the Master Controller and identify its present IP address.
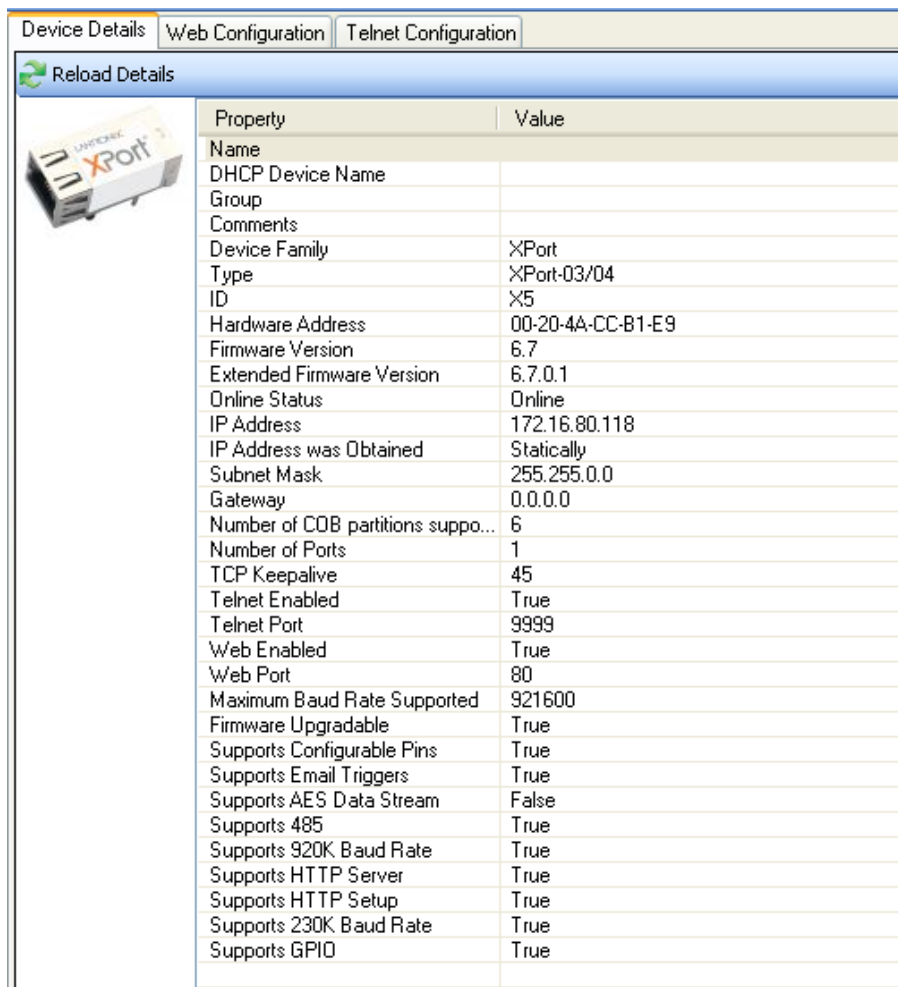
   Note: If you have multiple Master Controllers at your site you may need to connect them one at a time to the network in order to determine exactly which Master Controller the program is finding.

4. Click **Assign IP**.

5. Follow the on-screen instructions for assigning a specific IP address.

Configuring the Master Controller's Ethernet settings

Important! Only experienced and qualified network administrators should attempt to modify any of the Master Controller's Ethernet configuration settings.

1. In the left-hand pane, select the Master Controller.

Property	Value
Name	
DHCP Device Name	
Group	
Comments	
Device Family	XPort
Type	XPort-03/04
ID	X5
Hardware Address	00-20-4A-CC-B1-E9
Firmware Version	6.7
Extended Firmware Version	6.7.0.1
Online Status	Online
IP Address	172.16.80.118
IP Address was Obtained	Statically
Subnet Mask	255.255.0.0
Gateway	0.0.0.0
Number of COB partitions suppo...	6
Number of Ports	1
TCP Keepalive	45
Telnet Enabled	True
Telnet Port	9999
Web Enabled	True
Web Port	80
Maximum Baud Rate Supported	921600
Firmware Upgradable	True
Supports Configurable Pins	True
Supports Email Triggers	True
Supports AES Data Stream	False
Supports 485	True
Supports 920K Baud Rate	True
Supports HTTP Server	True
Supports HTTP Setup	True
Supports 230K Baud Rate	True
Supports GPIO	True

2. In the right-hand pane, select the **Web Configuration** tab.

    The Master Controller's IP address is displayed at the top.

3. To the right of the IP address, click the green arrow.

    The Master Controller's configurable network settings are displayed within the Lantronix DeviceInstaller browser. For example:

4. Use the browser interface to modify the desired settings.

Important! Make sure the Xport Serial Settings match the Master Controller's remote port settings. The Master Controller's default remote port speed is 115200 but is a configurable item and may have changed.

Master Controller Commands

The Master Controller commands are made up of three or more characters followed by a carriage return, as illustrated in the following example:

ACL 1.0↵

Generally, the first three letters designate the command group and the remaining letters/digits designate the command parameters. The commands are not case sensitive. The backspace key can be used to correct an improper command. The Esc key can be used to cancel a command.

The following table is a list of the available commands.

Cmd	Format	Description
?		Display list of available commands
Alarms		
ACL	{NN, 0.0-25.0}	Set Node Antenna Current Low Alarm Threshold in Amperes
ANH	{NN, 0-100}	Set Node Noise High Alarm Threshold Percent
ATH	{512-1023}	Set Tuning Capacitance High Alarm Threshold
ATL	{0-511}	Set Tuning Capacitance Low Alarm Threshold
AUD	{0-3600}	Set Alarms Unique Delay in Seconds
Communication		
CAL	{1|0}	Set Alarms Communication to Local Port {1} On, {0} Off
CML	{1|0}	Set Messages Communication to Local Port {1} On, {0} Off
CRL	{1|0}	Set Full Status Reports Comm. to Local Port {1} On, {0} Off
CSL	{bps}	Set Local Communication Port Speed
CSR	{bps}	Set Remote Communication Port Speed
CTL	{1|0}	Set Tags Communication to Local Port {1} On, {0} Off

Detection		
DCS	{1|0|R}	Set Detection Counter {1} On, {0} Off, {R} Reset
DET	{1|0}	Set Detection Efficiency Test {1} On, {0} Off
DHT	{1|0}	Set HDX Detection {1} On, {0} Off
DUM	{5|1|0|D}	Set Detection Unique Mode {5} 5 Tags, {1} 1 Tag, {0} Off, {D} Delay
DUD	{1-1440}	Set Detection Unique Delay in Minutes
DTD	{0-1440}	Set Automatic Virtual Test Tag Single Shot Delay in Minutes
DVT	{1|0|S}	Set Virtual Test Tag For All Nodes In Sequence {1} On, {0} Off, {S} Single-Shot
Memory		
MAD		Memory Alarms Download
MAD	{MM/DD/YYYY-MM/DD/YYYY}	Memory Alarms Download From Date to Date
MFD		Download Full Memory
MFD	{MM/DD/YYYY-MM/DD/YYYY}	Download Full Memory From Date to Date
MFE		Erase Full Memory
MFT	{1-24}	Set External Storage File Duration Time in Hours
MMD		Memory Messages Download
MMD	{MM/DD/YYYY-MM/DD/YYYY}	Memory Messages Download From Date to Date
MND		Memory Noise Reports Download
MND	{MM/DD/YYYY-MM/DD/YYYY}	Memory Noise Reports Download From Date to Date
MSD		Memory Status Reports Download
MSD	{MM/DD/YYYY-MM/DD/YYYY}	Memory Status Reports Download
MTD		Memory Tags Download
MTD	{MM/DD/YYYY-MM/DD/YYYY}	Memory Tags Download From Date to Date
MVT	{1|0}	Store Virtual Test Tags to Memory {1} On, {0} Off

Network		
NSN	{SSSS,NN}	Assign Node Serial Number SSSS to Node ID NN
NSP	{NN,NN,…,NN}	Set Primary Sequence
NSS	{NN,NN,…,NN}	Set Secondary Sequence
NRS		Reset Network
Nodes		
NBS	{NN, 1|0}	Set Node NN Beeper {1} On, {0} Off
NDT	{NN, 1|0}	Set Node NN Dynamic Tuning {1} On, {0} Off
NFT	{NN}	Perform Node Full Tune
NLS	{NN, bps}	Set Node NN Local Port Speed
NTC	{NN, 0-1023}	Set Node NN Tuning Capacitors
NTP	{NN, 300-500}	Set Node NN Dynamic Tuning Target Phase
NTS	{NN, 2-15}	Set Node NN Target Phase Deviation Threshold
NVE	{NN, 1-5}	Set Node NN Exciter Voltage Level
NVL	{NN, 0-255}	Set Node NN Virtual Test Tag Level
NVT	{NN, 1|0|S}	Set Node NN Virtual Test Tag {1} On, {0} Off, {S} Single Shot
Parameters		
RCP1		Load Custom Parameters Configuration 1
RCP2		Load Custom Parameters Configuration 2
RDP		Load Factory Default Parameters
SCP1		Save Custom Parameters Configuration 1
SCP2		Save Custom Parameters Configuration 2

Reader		
RAS	{HH,DD}	Set Reader Automatic Standby {HH} Start hours, {DD} Duration hours
RBS	{1|0}	Set Reader Beeper {1} On, {0} Off
RDS	{MM/DD/YYYY}	Set Reader Date
RDB	{1|0|S}	Set Display Backlight Mode {1} On, {0} Off, {S} Saving
RDF	{H|D}	Set Tag ID Display Format {H} Hexadecimal, {D} Decimal
RID	{1,0}	Set Reader Initiation Delay {1} On, {0} Off
RIS	{01-FF}	Set Reader ID in HEX
ROM	{1|0|R}	Set Reader Operation Mode {1} Active, {0} Standby, {R} Reset
RSM	{1|2|3|0}	Set Master Controller Synchronization Mode {1} Master, {2} Secondary Master, {3} Slave, {0} Standalone
RTS	{HH:MM:SS}	Set Reader Time (24-hour)
Reports		
RDT		Report Reader Date and Time
RFS		Report Full Status
RFV		Report Firmware Versions
RNA		Report Node Assignment
RND	{0-1440}	Set Automatic Noise Report Delay in Minutes
RNS		Report Noise Status
RRS		Report Reader Settings
RSD	{0-1440}	Set Automatic Status Report Delay in Minutes
RSS		Report Scanning Sequence

Report Structures

Full Status Report Structure

A full status report contains important configuration settings and diagnostic data for the Master Controller and all available network nodes. The report consists of three parts: Master Controller status report, nodes status report, and active alarms list.

STATUS MESSAGE	MESSAGE INFORMATION
Master Controller Status	
Reader	
Reader SN	Reader Serial Number (RSN)
Reader Date	Reader date
Reader Time	Reader time
Last Shutdown Date	Reader last shutdown date
Last Shutdown Time	Reader last shutdown time
Reader Application	Application firmware version
Reader ID	Reader ID setting in HEX (01-FF)
Reader Initiation Delay	Reader automatic diagnostics delay setting (On/Off)
Reader Operation Mode	Reader operation mode (Scan/Standby)
Synchronization Mode	Master Controller synchronization mode (Master/Secondary Master/Slave/Standalone)
Sync Input	Master Controller synchronization input signal presence (Yes/No)
Tag ID Display Format	Tag ID display format setting (Hex/Dec)
HDX Decoding	HDX decoding for all nodes (Enabled/Disabled)
Beeper	Master Controller beeper (Enabled/Disabled)
Display Backlight Mode	Master Controller LCD backlight mode (On/Off/Saving)
Detection	
Detection Unique Mode	Detection unique mode (1 Tag/5 Tags/Delay/Off)
Detection Unique Delay	Detection unique delay in minutes
Detection Counter Enabled	Detection counter (Enabled/Disabled)
Detection Counter	Current detection counter value
Memory	
Store Virtual Tags to Memory	Store virtual test tags to memory (Enabled/Disabled)
Internal Memory Used	Percent of used internal memory
External Storage Status	External storage (flash thumb drive) status (Connected/Disconnected)
External Storage Records Buffer	Number of records pending to be synchronized to the external storage
External Storage Present File	Current file name for the external storage
Communication	
Local Port Speed	Master Controller local USB port speed
Remote Port Speed	Master Controller remote port speed (Ethernet, Fiber Optic)

Tags Communication to Local Port	Tags communication to local port (Enabled/Disabled)
Alarms Communication to Local Port	Alarms communication to local port (Enabled/Disabled)
Messages Comm. to Local Port	Messages communication to local port (Enabled/Disabled)
Status Reports Comm. to Local Port	Status reports communication to local port (Enabled/Disabled)
Configured Node Sequence	
Pri. Seq	Configured by user primary sequence
Sec. Seq	Configured by user secondary sequence
Active Node Sequence	
Pri. Seq	Current active primary sequence
Sec. Seq	Current active secondary sequence
Diagnostics	
Input Voltage	Master Controller input DC voltage level in Volts
Lithium Battery	Master Controller lithium battery (for clock/calendar) voltage level in Volts
Temperature	Master Controller enclosure temperature in Celsius
Alarms Unique Delay	Alarms unique delay in seconds
Automatic VTT Delay	Automatic VTT delay in minutes
Automatic Status Report Delay	Automatic full status report delay in minutes
Automatic Noise Report Delay	Automatic noise report delay in minutes
Tuning Cap. High Alarm Threshold	Tuning capacitance high alarm threshold for all nodes (512-1023)
Tuning Cap. Low Alarm Threshold	Tuning capacitance low alarm threshold for all nodes (0-511)
Node #	
Node Status	
Serial Number	Node serial number
Connected	Node connection status (Connected/Disconnected)
Node Status (displayed only for nodes with the connection status Connected)	
Firmware Version	Node firmware version number
Tuned	Node current tuning status (Tuned/Tuning/Off+/Off-//Out Of Range+/Out Of Range-)
Antenna current	Node measured antenna current in Amperes
Signal Level	Node measured FDX-B signal strength percent
Capacitors	Node current capacitors bank value (0-1023)
Relative Phase	Node measured relative phase
Input Voltage	Node measured input DC voltage level in Volts
Exciter voltage	Node measured exciter voltage level in Volts
Temperature	Node enclosure temperature in Celsius
Active Alarms	**Contains the list of all active alarms**

Abbreviated Status Report Structure

An automatically generated full status report will include an abbreviated version of itself. The abbreviated status report contains critical dynamic diagnostic parameter information for the Master Controller and for all available network nodes.

An abbreviated status report is a record with an "SRP" designator, Master Controller ID, node ID (if the report is for a node), date/time stamp and a line of numbers representing diagnostic parameters. An status report is a data representation format designed to be easily decoded and converted by automated logging systems or user-made applications.

The values in each line of the report are separated by a comma. The following table shows the values in an abbreviated status report and provides descriptions for each value range.

Master Controller abbreviated status report format:

SRP 01 00 08.16.2012 17:15:23 V1,V2,V3,…,V23

A space character divides the following sections:

SRP: Status report designator

01: Master Controller ID

00: Node ID (0 designates this as a Master Controller status report)

08.16.2012: Report date

07:15:23: Report time

V1,V2,V3,…V23: Values of the Master Controller report data

Order	Value	Value range/decode
V1	Reader operation status	Reader operation status codes: 0 = Init (Master Controller is in the initialization mode) 1 = Disc. (Master Controller is in the discovery process) 2 = Scan (Scanning) 3 = Stdby (Standby) 4 = Tune (One of nodes is currently in a full tuning process) 5 = VTT (One or all nodes have VTT enabled continuously)
V2	Memory usage	In percent: 0 – 100
V3	Input voltage	In 0.1 Volt units: 0 = 0, 10 = 1.0V, 112 = 11.2V, etc.
V4	Lithium battery voltage	In 0.1 Volt units : 0 = 0, 30 = 3.0V, 36 = 3.6V, etc.
V5	Detection counter	0 – 999,999
V6	Master Controller temperature	In 0.1 Celsius units with bit 15 for the sign: 0x0017 = +2.3C 0x0125 = +29.3C 0x8053 = -8.3C 0x8021 = -3.3C If temperature sensor fails and temperature not available then value 0 is written.
V7 – V18	Active present sequence	Bits 0 – 3 for primary sequence, bits 4 – 7 for secondary sequence, 0 - off 0x03 = Node ID 03 fired at this step 0x18 = Node ID 01 and node ID 08 simultaneously fired at this step 0 = No nodes fired at this step
V19 – V23	Present active alarms	Alarm codes. Refer to page 72 for alarm codes

Node abbreviated status report format:

SRP 01 04 08.16.2012 17:15:23 V1,V2,V3,...,V16

A space character divides the following sections:

- **SRP** – Status report designator
- **01** – Master Controller ID
- **04** – Node ID
- **08.16.2012** – Report date
- **17:15:23** – Report time
- **V1,V2,V3,...,V16** – values of the node report data

Order	Value	Value range/decode
V1	Connection status	0 = Not connected, 1 = Connected
V2	Tuning status	Tuning status codes: 0 = Not available 1 = Tuned 2 = OFF- (requires capacitors bank to adjust up) 3 = OFF+ (requires capacitors bank to adjust down) 4 = Dynamic tuning is in process 5 = Full tune process is active 6 = Out of range high (requires more capacitance in the antenna) 7 = Out of range low (requires less capacitance in the antenna)
V3	Node bit-range settings	Each bit represents one of nodes On/Off settings. Currently implemented: bit 0 – Dynamic tuning: 0 = disabled, 1 = enabled bit 1 – Node beeper: 0 = disabled, 1 = enabled bit 2 and up – reserved Currently implemented combinations: 0 = both dynamic tuning and beeper disabled 1 = dynamic tuning enabled, beeper disabled 2 = dynamic tuning disabled, beeper enabled 3 = both dynamic tuning and beeper enabled
V4	Node exciter level	1 – 5, 1 is the lowest, 5 is the highest
V5	Present antenna current	In 0.1 Amp units: 0 = 0, 30 = 3.0A, 82 = 8.2A, etc.
V6	FDX-B signal level	In millivolts: 100 = 100 mV, 270 = 270 mV, etc.
V7	Capacitors bank value	0 – 1023
V8	Relative phase	Measured node relative phase with bit 15 for the sign: 0x0000 = 0 0x0004 = +4 0x8003 = -3 0x8043 = -67
V9	Exciter voltage level	In 0.1 Volt units: 0 = 0, 10 = 1.0V, 112 = 11.2V, etc.
V10	Input DC voltage level	In 0.1 Volt units: 0 = 0, 10 = 1.0V, 112 = 11.2V, etc.

V11	Node temperature	In 0.1 Celsius units with bit 15 for the sign: 0x0017 = +2.3C 0x0125 = +29.3C 0x8053 = -8.3C 0x8021 = -3.3C If temperature sensor fails and temperature not available then value 0 is written.
V12 – V16	Active alarms	Alarm codes. Refer to page 72 for alarm codes

Alarm Messages and Codes

When an abnormal condition is detected by the Master Controller it generates an alarm message that is displayed on the LCD screen and is sent to memory and to the communication ports. The following table is a list of the available alarms and their corresponding codes.

Source	Alarm Code	Conditions to Trigger Alarm	Alarm Text	Shortened Alarm Text for LCD
Master Controller	1	Master Controller internal data memory reading/writing error detected. Corrent memory is not guaranteed to be correct. Unit requires repair.	Internal Data Memory Error	Intern.Memory Error
Master Controller	2	Master Controller internal configuration data memory reading/writing error detected. Corrent memory is not guaranteed to be correct. Unit requires repair.	Configuration Memory Error	Config.Memory Error
Master Controller	3	Master Controller main board unable to communicate to gateway board. Master Controller unit requires repair.	Gateway Board Not Responding	Gateway Not Respond.
Master Controller	4	Master Controller has lost current Date/Time due to low/absense of lithium battery voltage supply.	Reader Date/Time Lost	Date/Time Lost
Master Controller	5	Master Controller has detected input voltage level below specification.	Reader Input Voltage Low	Input Voltage Low
Master Controller	6	Master Controller has detected Date/Time calendar clock supply voltage below specification. Replace internal lithium battery.	Reader Lithium Battery Low	Lithium Battery Low
Master Controller	7	Master Controller has detected internal memory is near the end of life. Master Controller service/repair required soon.	Reader Internal Memory Near Life End	Reader Mem.Near End
Master Controller	8	Master Controller has detected internal memory is weared dpwn to 100%. Master Controller service/repair required.	Reader Internal Memory Weared Down	Reader Mem. Weared
Node	9	Master Controller is unable to communicate to a node. Werify node is powerd, on and CAN bus wiring is intact.	Node Not Connected	Not Connected
Node	10	Node's antenna is currently out of tune. If dynamic tuning is enable then node is currently in process of adjustment antenna capacitors. If dynamic tuning is disabled in configuration for this node then manual tuning capacitance adjustment is required.	Node Out Of Tune	Out Of Tune
Node	11	Master Controller has removed this node from it's active sequence due to a problem with node. Additional alarm or message is supplied with this alarm to indicate the reason. Master Controller removes nodes from active scanning sequence in order to maintain the lowest sequence cycle time for better detection performance. Node will be automatically included back in to scanning sequence when the issue is resolved. In case if the node was excluded from active sequence as a result of being consistently out of tune a "Standby" and "Scan" cycle required to have system to recheck the node antenna tuning additionally to the automatic rechecking every 4 hrs.	Node Removed From Sequence	Not In Sequence
Node	12	Node is unable ro reach the desired antenna tuning using internal capacitors bank. Manual antenna capacitance adjustment required for this node.	Node Tune Out Of Range, Decrease Capacitance	Tune Out,Dec.Caps
Node	13	Node is unable ro reach the desired antenna tuning using internal capacitors bank. Manual antenna capacitance adjustment required for this node.	Node Tune Out Of Range, Increase Capacitance	Tune Out,Inc.Caps
Node	14	An automatic virtual test tag failed for this node. Verify noise and tuning are correct for this node. VTT level adjustment may also be needed.	Node VTT Test Failed	VTT Test Failed
Node	15	Node has detected antenna current drop below user-defined specification. Verify antenna tuning and DC power supply to the node. Node antenna exciter voltage level adjustment may be needed for the node. Node antenna current threshold adjustment for the node may be needed.	Node Antenna Current Low	Antenna Curr. Low

Node	16	Node has detected the antenna noise level above user-defined specification. Verfy antenna tuning of the node. Verify surrounding environment for the couse of the noise. Node antenna noise alarm threshold adjustment may be needed.	Node Noise High	Noise High
Node	17	Node has detected the current internal capacitors setting is below user-defined alarm threshold. Verify antenna environment is not the cause of the problem (water level significant change, metal objects in the antenna field, etc.). Manual antenna capacitance may be needed for the node. Node tuning capacitance low threshold adjustment may be needed.	Node Tuning Capacitance Low	Tuning Cap. Low
Node	18	Node has detected the current internal capacitors setting is above user-defined alarm threshold. Verify antenna environment is not the cause of the problem (water level significant change, metal objects in the antenna field, etc.). Manual antenna capacitance may be needed for the node. Node tuning capacitance low threshold adjustment may be needed.	Node Tuning Capacitance High	Tuning Cap. High
Node	19	Node has detected the input DC power supply is below factory specifications. Verify node power source. In case node is powered by CAN bus, verify CAN bus wiring is intact.	Node Input Voltage Low	Input Voltage Low
Node	20	Node has detected the antenna exciter DC voltage is below factory specifications. Verify node power source. In case node is powered by CAN bus, verify CAN bus wiring is intact.	Node Exciter Voltage Low	Exciter Volt. Low
Master Controller	21	Master Controller internal memory has collected data for 95% of available space. Verify all data is backed up to an external data storage (USB thumb drive) and erase memory. Master Controller will soon start to overwrite the oldest data records in memory. At that point the old data, if not synchronized to an external memory storage will be lost permanently.	Memory Low	Memory Low
Master Controller	22	Master Controller internal memory has collected data for all available space. Verify all data is backed up to an external data storage (USB thumb drive) and erase memory. Master Controller will now overwrite the oldest data records in memory. All of that data, if not synchronized to an external memory storage will be lost permanently.	Memory Full	Memory Full
Master Controller, Node	23	Master Controller or node has detected temperature inside its enclosure below manufacturer specification. Unit is not guaranteed to work properly.	Temperature Low	Temperature Low
Master Controller, Node	24	Master Controller or node has detected temperature inside its enclosure above manufacturer specification. Unit is not guaranteed to work properly.	Temperature High	Temperature High
Master Controller	25	Master Controller is set to operate as Secondary Master or Slave and has lost the input synchronization signal. Verify the up-chain master is working properly. Verify the synchronization wiring is intact.	Sync. Input Not Present	Sync. Not Present
Master Controller	26	Master Controller is set to operate as Secondary Master, has lost the input synchronization signal and set itself to Master mode. Verify the up-chain master is working properly. Verify the synchronization wiring is intact.	Reader Set To Master	Reader Set To Master
Master Controller	27	Initial system startup or manufacturer default settings were applied. Master Controller has no node assignment/sequence seting information or the settings are insufficient to perform tag detection. Verify node assignments, primary sequence and secondary sequence.	System Not Set Up	System Not Set Up
Node	28	Node has detected an excessive current in antenna that is approaching the manufacturer specification. Verify antenna environment is not the cause of the problem (water level significant change, metal objects in the antenna field, antenna viring, etc.). Verify antenna cable is intact. Node exciter voltage level adjustment may be needed for the node.	Node Antenna Current Exceeded 10.0 Amp. Limit	Ant. Current Above 10A

| Node | 29 | Node has detected an excessive current in antenna that has reached the manufacturer specification. The node will automatically reduce its exciter voltage setting. Verify antenna environment is not the cause of the problem (water level significant change, metal objects in the antenna field, antenna viring, etc.). Verify antenna cable is intact. Node exciter voltage level adjustment may be needed for the node. | Node Antenna Current Exceeded 11.0 Amp. Limit | Ant. Current Above 11A |
| Master Controller | 30 | The input voltage has dropped to 20 volts. To reduce the wear on the battery power source, the Master Controller has been forced into standby mode. Once the input voltage reaches 22 volts, the Master Controller will switch itself back into scan mode, but only if no user activity was detected while the Master Controller was in standby mode. | System Forced to Standby | System Forced to Stdby |

Self-Tests and Diagnostics

The Master Controller contains integrated self-test and diagnostics that are used to verify the integrity of the hardware. The following tests are performed on the Master Controller:

- Power-up self-tests are performed each time the Master Controller is turned on.

  When the Master Controller is turned on it verifies that the input voltage level is within an acceptable range (18 – 28 V DC) and that there is an in-rush current limiter. The Master Controller then automatically performs a number of tests on its internal components (the initialization firmware, flash memory, RAM memory, etc.). The Master Controller will not start unless all tests are successful.

- Start-up diagnostics are performed when the Master Controller is successfully powered on:

  - o Lithium battery level check

  - o CAN Bus network check for the presence and initiation of IS1001s

  - o Sync In signal presence check (for multiple Master Controller synchronization configuration).

  - o System performance check by activating the virtual tag single shot test on each IS1001 in the sequence. If a real tag is detected in an antenna field the test is aborted.

  - o A full status report is generated and sent.

- Automated virtual tag single shot tests.

  The Master Controller can be configured to automatically activate a virtual test tag single shot on a periodic basis. This test is done in order to verify that the Master Controller is operating properly. It is especially useful if you have extended periods when no PIT tags are present. See page 29 for information on configuring the virtual test tag settings.

- Automatically and manually issue reports.

  A number of different reports can be generated automatically or manually. The reports provide status information about the Master Controller. See page 34 for details.

- Input voltage monitoring.

  The Master Controller continuously monitors the input voltage level for the following reasons:

  - o To protect its internal components from an excessive voltage level, the Master Controller will shutdown if the input voltage reaches 30 V DC. The Master Controller will turn itself back on automatically if the voltage drops down below 28 V DC.

  - o To minimize wear on the battery power source as it discharges, the Master Controller will force itself in standby mode if the input voltage drops down to 20 V DC. An alarm message will be generated stating the condition. The Master Controller will automaticallyswitch itself back into scan mode only if the input voltage reaches 22 V DC and if there was no user activity (operation mode changes, node full tuning activation, etc.) during the time the Master Controller was in forced into standby.

- o To protect the battery power source from deep discharge and to prevent a failure of the internal components, the Master Controller will generate an alarm if the input voltage drops down to 18 V DC and will shut down if the input voltage drops to 16 V DC. It will turn itself back on automatically if the voltage reaches 18 V DC.

- Antenna current monitoring

  To protect its internal components from an excessive antenna current level, the IS1001 has a built-in antenna current limiting mechanism that will generate an alarm message if an antenna current in excess of 10 A peak-to-peak is detected. If an antenna current in excess of 11 A peak-to-peak is detected, the IS1001 will automatically reduce its exciter voltage in order to bring it to the acceptable level. If the antenna current exceeds 11 A peak-to-peak even when the minimal exciter voltage setting is applied, the IS1001 will be disabled and removed from the activation sequence until the system is reset or put in standby and back in scan mode.

IS1001 Maintenance and Diagnostic Connections

Maintenance Connection

1. Using a USB-A to Mini-USB-B cable, connect a PC to the "USB PORT" connector J5 on the IS 1001 Mother Board.

2. Use communication software such as BioTerm (or HyperTerminal or TeraTerm Pro) to configure the communication settings as follows:

   - **Bit Rate:** 115200

   - **Data Bits:** 8

   - **Parity:** None

   - **Stop Bits:** 1

   - **Flow Control:** None

Diagnostics Connection

1. Attach a current probe to either one of the antenna leads.

   This is used to monitor the antenna current to verify that the IS1001's antenna current measurement is well calibrated.

2. Connect a voltage probe to the white "BFLTR" test point TP16 on the Mother Board.

   This is used to:

   - Monitor the IS1001's FDX-B tag signal decoding filters output

   - Check for the presence of excessive noise and help determining its source

   - Verify the integrity of an FDX-B tag signal.

   The probe's ground lead can be attached to the shield SH1 on the Mother Board.

3. Connect a voltage probe to the white test point TP15 on the Mother Board.

   This is used to:

   - Monitor the IS1001's HDX tag signal decoding filters output

   - Check for the presence of excessive noise and help determining its source

   - Verify the integrity of an HDX tag signal

   The probe's ground lead can be attached to the shield SH1 on the Mother Board. HDX detection must be enabled.

4. Attach another voltage probe to the white "HDX_EN" test point TP7 on the Mother Board.

   This is used to monitor the IS1001's HDX tag signal decoding filters output. It triggers the view by the rising slope of this signal.

Troubleshooting

This section provides solutions to the most common MTS errors.

⚠️ **Warning!** The Master Controller must be powered off by toggling the power switch to off position ("0") and disconnecting the power cord by unplugging it from DC power source or from the Master Controller before performing any repairs. Only qualified service personnel should access the internal components of the MTS.

Master Controller does not power up

1. Open the Master Controller enclosure and check if the DC voltage status LED on the CAN Bus Gateway Boards lights up when the Master Controller power switch is toggled to the On position. If not, toggle the switch to the Off position and:

   a. Check for a proper power cord connection.

   b. Check all wire connections to the CAN Bus Gateway Board connector J8 (POWER IN).

   c. Disconnect the cables from the CAN Bus ports and try to power on the Master Controller. If Master Controllers powers up it means that the CAN Bus power draw is too high and it is triggering either the in-rush current limiter or the power input module breaker. Try reducing the number of IS1001s attached to the CAN Bus network, or try disconnecting the IS1001s one at a time to find the faulty one.

   d. If problem is not resolved the Master Controller must be sent to the manufacturer for repair.

2. If the DC voltage status LEDs on the CAN Bus Gateway Board light up, check if the LEDs on the Mother Board light up. If not, toggle the switch to the Off position and:

   a. Check all wire connections from the CAN Bus Gateway Board connector J9 (POWER OUT) to the Mother Board connector J15 (POWER).

   b. Check fuse F1 on the Mother Board by pulling it out of the socket. If it is bad, replace it with: 2A, 250V, time-lag T, thermoplastic, 8.5mm fuse; Schurter p/n: 0034.6618 or similar.

   c. If problem is not resolved IS1001 must be sent to the manufacturer for repair.

No node connection detected

1. Check the CAN Bus connection and integrity at the Master Controller and at the node.

2. Toggle the Master Controller power switch to the off position, open the Master Controller enclosure and:

   a. Check the CAN Bus port wire connections.

   b. Check all wire connections to the CAN Bus Gateway Board connectors J5 "CAN #1" and J7 "CAN #2".

3. If problem is not resolved the IS1001 must be sent to the manufacturer for repair.

No antenna connection detected

1. Check the node's antenna tuning.

2. Check the node's antenna connection and integrity.

3. Toggle the Master Controller power switch to the off position, open the node's enclosure and:

   a. Check the antenna port wire connections.

   b. Check all wire connections to the IS1001 Exciter Board connector J8 (ANTENNA).

4. If the problem is not resolved the IS1001 must be sent to the manufacturer for repair.

Checking and replacing the backup battery

The backup battery protects the internal clock from resetting when the Master Controller is powered off. When backup battery low voltage level detected:

1. Open the Master Controller enclosure and check the backup battery proper connection.

2. Check the backup battery voltage. If below 2V toggle the Master Controller power switch to the Off position and replace with new 3.6V, 2.1Ah, lithium battery pack with leads and connector; Tadiran Batteries p/n: TL-5242/W or similar.

   Note: The Master Controller's date and time will be lost and will need to be reset.

3. If the problem is not resolved the Master Controller must be sent to the manufacturer for repair.

For all other problems

For all other problems that cannot be resolved by checking the proper wire or cable connections, the Master Controller and/or the IS1001(s) must be sent to the manufacturer for repair.

Maintenance

<div>

⚠️ **Warning!** The Master Controller must be powered off by toggling the power switch to off position ("0") and disconnecting the power cord by unplugging it from AC power source before performing any maintenance. Only qualified service personnel should access the internal components of the Master Controller or an IS1001.

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The IS1001-MTS system requires very little maintenance. To keep it operating at peak efficiency you should periodically do the following:

- Check all wire and cable connections
- Remove any dust
- Perform a full re-tune of each IS1001 (see page 12)

Periodically collect data from the local USB flash drive

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⚠️ **Warning!** Do not remove a USB flash drive while data is being written to it. To safely remove a flash drive, use the **Eject External Storage** menu command or power off the Master Controller.

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If you are using a local USB flash drive as a data collector, you must periodically collect the data before the flash drive becomes full. You have two options:

- You can swap in an entirely new flash drive.
- You can temporarily remove the existing flash drive, download its contents to a portable computer, erase the flash drive, and then reinsert it.

How often you need to do this depends on the amount of data you are collecting. One line of tag data represents approximately 50 bytes of data, and a large status report can be 15KB. If you use the maximum size USB flash drive (32GB), it may be months before the flash drive becomes full. Each situation is unique, however, so you must monitor the amount of data being stored and set your own schedule.

To safely remove the USB flash drive:

1. Select **Setup > Eject External Storage**.
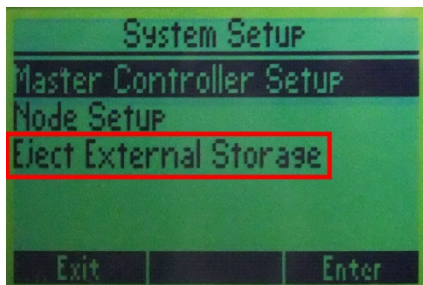
2. Wait for the **Safe To Remove External Storage** message.
3. Remove the USB flash drive from the USB storage port.

Updating the Firmware

Updating the Master Controller Firmware

Important! Depending on the extent of the update, the Master Controller's memory may or may not be cleared during the firmware update process. As a precaution, you should download all tag IDs and short status reports contained in memory before initiating the update process. See page 43 for details on the memory download process.

New or updated firmware may periodically become available for the Master Controller. To update the Master Controller firmware:

1. Connect the Master Controller to the local computer using a mini USB type B cable (not supplied).

2. Start the BioTerm communications program.

   Note: BioTerm is supplied on the USB Flash memory device included with your IS1001-MTS system. It is also available at:
   http://www.biomark.com/Contact_Us/Manuals___Videos___Applications/.

3. In the **Serial Port** box, make sure that **COM3 Silicon Labs CP210x USB to UART Bridge** is selected.
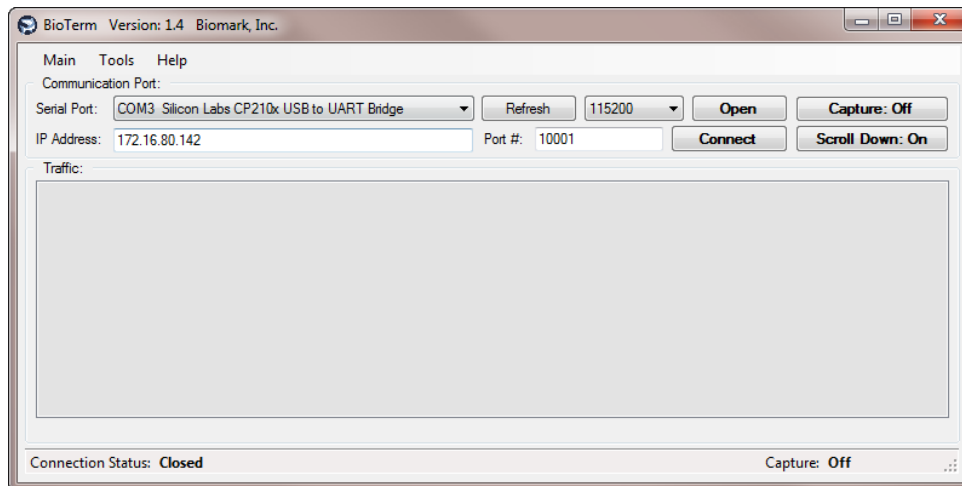
4. Make a serial port connection to the Master Controller by clicking **Open**.

5. Select **Tools > Update Device Firmware**.

6. Go to the location of the new Master Controller application firmware file and then click **Open**.

7. Click **Start Programming**.

8. On the confirmation dialog, click **OK**.

The firmware update process will take a minute or two to complete.

9. On the **Application Update – Success** dialog, click **OK**.

Updating the IS1001 Firmware

New or updated firmware may periodically become available for the IS1001. To update the IS1001 firmware:

1. Connect the Master Controller to a computer using one of the communication ports (mini USB, fiber optic, or Ethernet).

2. Start the BioTerm communications program.

   Note: BioTerm is supplied on the USB Flash memory device included with your IS1001-MTS system. It is also available at: http://www.biomark.com/Contact_Us/Manuals___Videos___Applications/.

3. In the **Serial Port** box, make sure that **COM3 Silicon Labs CP210x USB to UART Bridge** is selected.
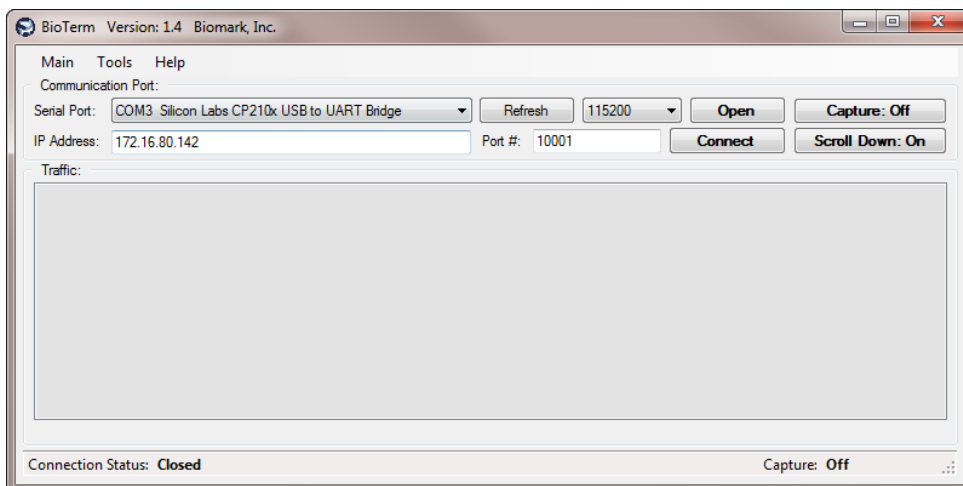
4. Make a serial port connection to the Master Controller by clicking **Open**.

5. Select **Tools > Update Device Firmware**.

6. Go to the location of the new IS1001 application firmware file and then click **Open**.

7. Click **Start Programming**.

    The following dialog is displayed:
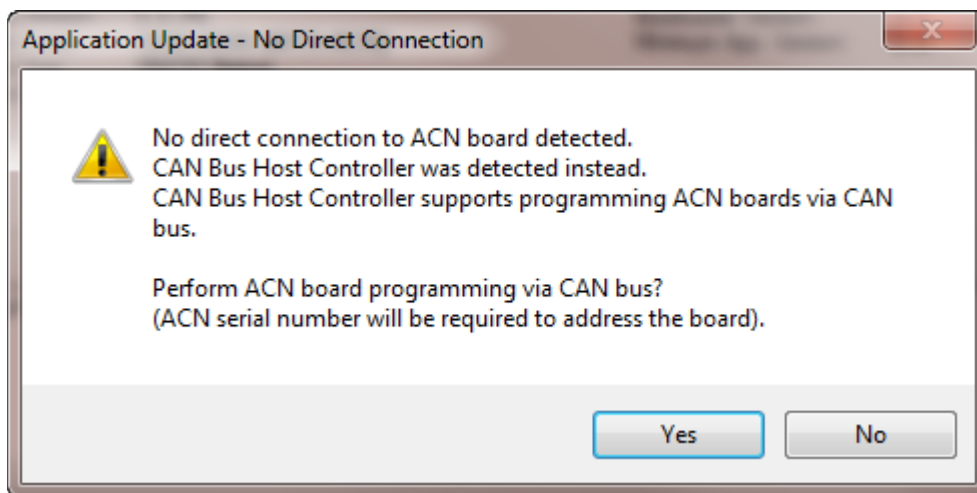
8. To perform the IS1001 firmware update via the CAN Bus, click **Yes**.

    The following dialog is displayed:
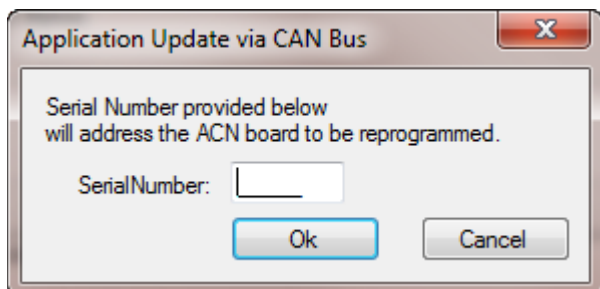
9. Type the last four digits of the IS1001 that you want to update and then click **OK**.

    The following status dialog is displayed.
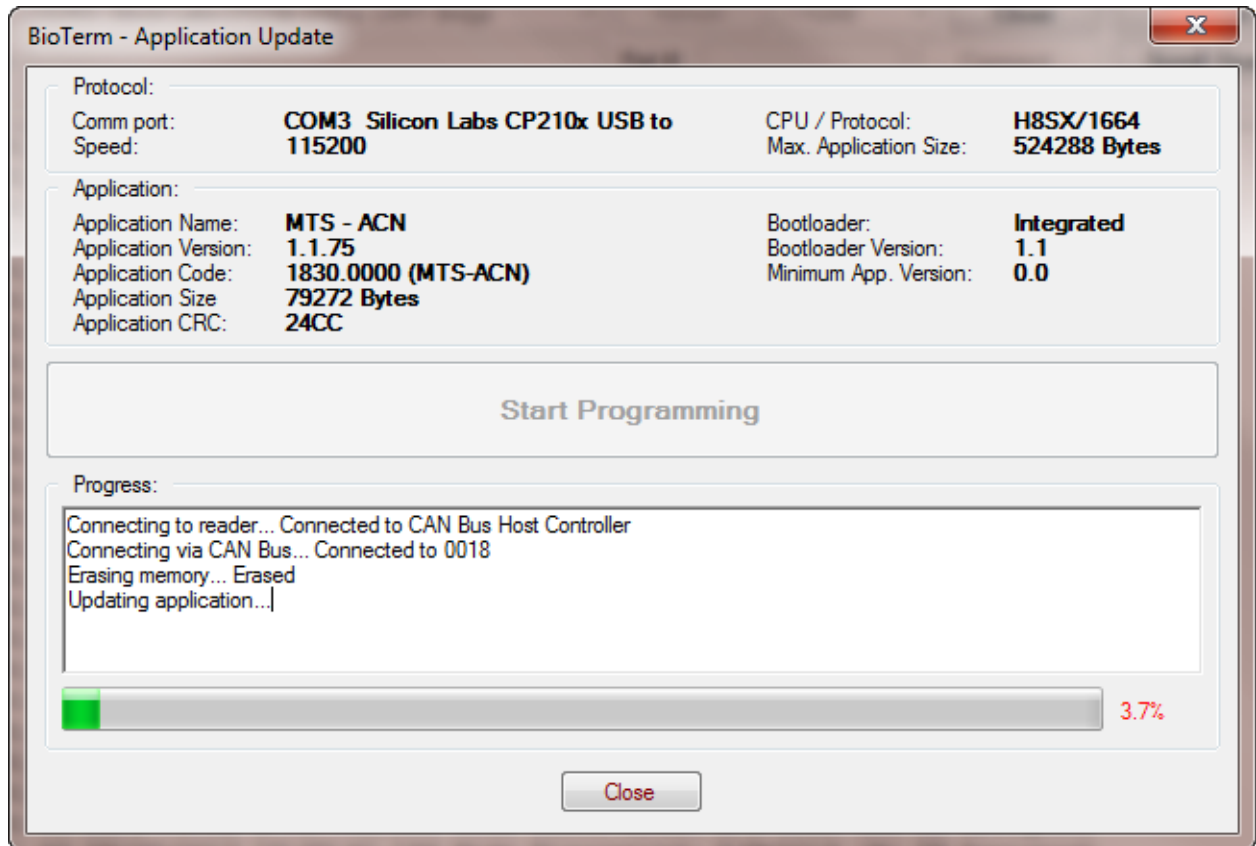
    The IS1001 firmware update process will take a 5 – 10 minutes to complete.

10. On the **Application Update – Success** dialog, click **OK**.

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