AI1200 Reader
User Guide

(Firmware Versions 2.6, 2.7, and 2.8)

TransCore
8600 Jefferson Street NE
Albuquerque, New Mexico 87113

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P/N 411026-007

For further information, contact:

TransCore
3410 Midcourt Road, Suite 102
Carrollton, Texas 75006 USA

Phone: (214) 461-4031
Fax: (214) 461-6478

Technical Support
Web: transcore.com/rfidsupport
Phone: (505) 856-8007

For comments or questions about this document, e-mail tech.pubs@transcore.com.

WARNING TO USERS IN THE UNITED STATES

FEDERAL COMMUNICATIONS COMMISSION (FCC)
LOCATION AND MONITORING SERVICE STATEMENT
47 CFR §90.351

NOTE: The user is required to obtain a Part 90 site license from the FCC to operate this radio frequency identification (RFID) device in the United States. See product label for FCC ID number. Access the FCC Web site at www.fcc.gov/Forms/Form601/601.html for additional information concerning licensing requirements.

NOTE: Users in all countries should check with the appropriate local authorities for licensing requirements.

FCC RADIO FREQUENCY INTERFERENCE STATEMENT
47 CFR §15.105(a)

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate RF energy and may cause harmful interference to radio communications if not installed and used in accordance with the instruction manual. Operating this equipment in a residential area is likely to cause harmful interference, in which case, depending on the regulations in effect, the user may be required to correct the interference at their own expense.

NO UNAUTHORIZED MODIFICATIONS
47 CFR §15.21

CAUTION: This equipment may not be modified, altered, or changed in any way without permission from TransCore, LP. Unauthorized modification may void the equipment authorization from the FCC and will void the TransCore warranty.

USE OF SHIELDED CABLES IS REQUIRED
47 CFR §15.27(a)

NOTE: Shielded cables must be used with this equipment to comply with FCC regulations.

TransCore, LP
USA

AI1200 SERIES READERS

PRODUCT UPDATE NOTICE—FIRMWARE VERSION 2.8

IMPORTANT! PLEASE READ CAREFULLY!

Purpose

The purpose of this update is to communicate changes associated with the new primary microcontroller firmware version 2.8 installed in series AI1200 readers.

Audience

This update is for all technical personnel using the AI1200 readers with firmware version 2.8 commands and operations.

Related Documentation

AI1200 Reader User Guide Version 2.6
AI1200 Reader Testing Version 2.6
AI1200 Product Update Notice Version 2.7

Version 2.8 Revisions

Firmware version 2.8 offers an extended command set designed to support additional modem types.

The following table lists additional commands implemented as a result of version 2.8 firmware revisions:

COMMAND	DESCRIPTION
#6811	This command is used to select the modem type as a MultiTech 224E (factory default). This command is currently implemented and documented in the *AI1200 User Guide*. Customers now using this model modem should not be affected.
#6812	This command is used to select the modem type as a generic MultiTech-compatible modem. This command supports different manufacturers and models of MultiTech-compatible modems. The modem command **ATN0** is used to perform modem dialing.
#6813	This command selects the modem type as a generic Hayes-Compatible modem. Supports different manufacturers and models of Hayes-compatible modems. The modem command **ATDS=0** is used to perform modem dialing.

Minimum Modem Configuration Requirements

The modem used must be configured according to the manufacturer's documentation. However, to use a generic MultiTech or Hayes-compatible modem with the AI1200 readers, you must **configure the modem to support the minimum requirements.** Failure to do so may prevent correct operation with the AI1200 readers.

Perform Reset

The modem must assert reset on the loss of data terminal ready (DTR). When necessary, the reader drops DTR to the modem for 100 ms in order to perform the modem reset.

Note: The reader also issues command **ATZ** (reset) following the loss of DTR.

Locked Baud Rate

Because the modem performs speed conversion and buffering, its DCE baud rate should be set to a fixed data rate to match the operating baud rate of the reader. When modem operating parameters are properly configured, modems with data rates faster than 2400 baud can be used.

Note: The reader default data rate is 300 baud. Use commands from the command list to change data rates (Appendix A, *AI1200 Reader Command List*).

Programmed Dial-Out Number

The dial-out number in the dial register should be **0**. The AI1200 readers issue the command **ATN0** (command #6812) or **ATDS=0** (command #6813) to provide dial-out capabilities.

Carrier Detect

The modem must provide carrier detect only when connected to another modem. The AI1200 transmits tag data to the modem when this signal is asserted.

AI1200 Command Support

The modem must support the following commands used by the reader to implement commands #6812 and #6813.

COMMAND	DESCRIPTION
AT	Attention
+++AT	Command Mode Selection
ATO	Call Originate Selection
ATZ	Reset
ATN0 (#6812) or ATDS=0 (#6813)	Dial number programmed in modem register 0

Drop and Return to Connection

The modem must not drop a connection when the **+++AT** command is received and must restore the connection when the **ATO** command is received. The AI1200 readers use this feature to implement command #6870 (telephone number).

Software Flow Control

To prevent buffer overflows, the user must enable XON/XOFF software flow control in both the modem and the reader.

CAUTION: Data loss may occur if flow control is not enabled.

Vorsicht: Datenverlust ist möglich, wenn die Datenflußkontrolle nicht aktiviert ist.

Precaución: Es posible que se pierdan datos si no se habilita el control de flujo.

Précaution 1: Il y a risque de perte des données si le débit n'est pas régulé.

Attenzione: Se non viene attivato il controllo del flusso può verificarsi la perdita di dati.

Hardware flow control between the modem and the reader is not a valid option due to the cable requirements outlined in the *AI1200 User Guide.*

Command Response Codes

The reader will ignore all command responses and codes returned from the modem. The returned commands and codes will not affect reader operation.

Additional Commands

The user may issue additional modem commands as part of the modem configuration. It is the users responsibility to verify that any additional modem commands will function as required.

Example: Enable hardware error correction in modems that support this feature.

AI1200 SERIES READERS

PRODUCT UPDATE NOTICE—FIRMWARE VERSION 2.7

IMPORTANT! PLEASE READ CAREFULLY!

Purpose

The purpose of this update is to communicate changes associated with microcontroller firmware version 2.7 installed in series AI1200 readers.

Audience

This update is for all technical personnel using the AI1200 readers with firmware version 2.7 commands and operations.

Related Documentation

AI1200 Reader User Guide Version 2.6
AI1200 Reader Testing Version 2.6

Version 2.7 Revisions

Firmware version 2.7 offers three new features and an enhancement to change the XON/XOFF communications algorithm to comply with industry standards.

Features

The three new features included in the 2.7 revision are:

1. Modification of the algorithm for uniqueness. Allows a dual-frame tag with matching data in both fields to be accepted as a read-only tag.

2. Addition of command #570. Users may display the handshake count of the last tag reading for antenna output channel 0 or 1.

   Command #570 returns: #HDSH C0 xx C1 xx

   Where:

   C0 indicates the handshake count for antenna channel 0.

   C1 indicates the handshake count for antenna channel 1.

   Values for xx are hexadecimal 00 to FF.

3. Modification of command #693x. Changed to provide users with presence true time-out values as follows:

x = 0	0 ms (always true)
x = 1	20 ms
x = 2	32 ms
x = 3	60 ms
x = 4	92 ms
x = 5	152 ms
x = 6	300 ms
x = 7	452 ms
x = 8	600 ms
x = 9	752 ms
x = A	1.5 sec
x = B	3 sec
x = C	6 sec
x = D	12 sec
x = E	24 sec
x = F	infinite (never true)

Enhancement

The XON/XOFF communications protocol is modified to recognize the XON/XOFF characters in data mode and command mode.

Note to AI1200 Users:

Amtech document *GUI.USR.1200.05* reflects Version 2.6 reader firmware updates to the *AI1200 User Guide*.

Primary features implemented in Version 2.6 firmware are:

- User selectable <som> (start-of-message) characters, via the #615 series commands.
- Status of the #615 series commands is accessed through the #525 (Enquire Communication Protocol Status) command.

A vertical bar to the left or right of text denotes additions or modifications to the text.

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Chapter 1
Introduction to Amtech Technology
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Purpose of Guide

This guide contains the information necessary to operate an installed Amtech AI1200 RF Identification system.

This guide also provides an overview of the Amtech technology and its applications.

A separate chapter provides practical exercises to augment user orientation to the system.

The reference appendices included in this guide are:

- Summary of Commands,
- Reader Default Settings,
- Troubleshooting Guide, and
- Component Specifications Sheets.

System Overview

This section provides an overview of and an introduction to the Amtech system technology, the Amtech components, and an example of how the technology and components are utilized in a typical installation.

Technology

The Amtech RF Identification system uses radio frequency (RF) waves, in a process called "modulated backscatter," to identify objects.

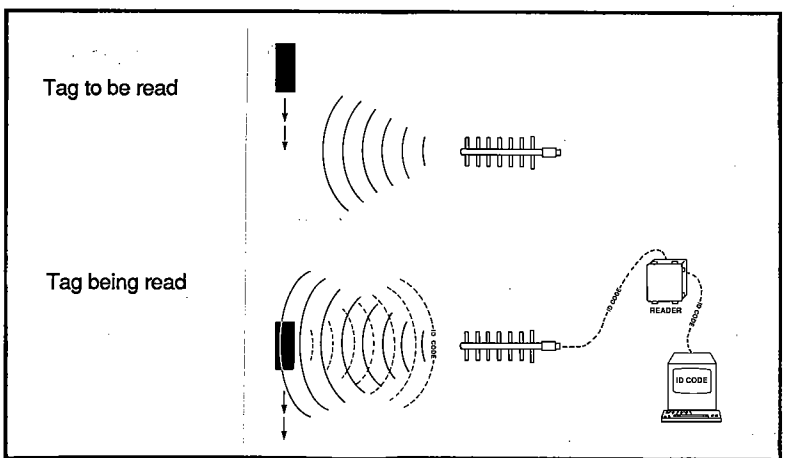
A small electronic *tag* is attached to an object to be identified. Each tag is programmed with a unique alphanumeric message or identification number.

An RF signal is generated by the *RF module(s)* and broadcast through the system *antenna(s)*. The system can support two separate antennas, each providing a separate broadcast field (reading range). Tags entering an antenna's reading range modify and reflect a portion of this signal back to the originating antenna.

The antenna receives this modified, or "modulated," signal and transmits it back through the RF module to the system *reader*.

The reader decodes the signal, validates the ID code, appends pertinent information to the code, and transmits the code to a host computer system for further processing.

Operational control of the system is accessible to the user through reader commands. These commands are detailed in Chapter 2, System Operation.



The system antenna transmits radio frequency waves. The tag modifies and reflects a portion of this signal back through the antenna and RF module to the reader. This modulated signal carries the tag's ID code.

Components

The Amtech RF Identification system consists of four fundamental components:

- reader,
- RF module,
- antenna, and
- tag.

The RF module generates a continuous-wave RF signal. The antenna, in turn, broadcasts the signal into the environment. In the presence of this signal from the system, the tag reflects back to the antenna a modified form of the original signal containing the tag's unique, encoded message. The RF module demodulates this signal, preconditions it, then transmits it to the reader. The reader then processes information and transmits it to the host computer.

It is important to note that *tags are not radio transmitters and do not radiate signals by themselves.* They serve only as coded reflectors for the RF signal emitted through the antenna.

The following figure shows the basic arrangement of the four principal Amtech components. Also shown are a proximity sensor and host computer, both of which are optional items.

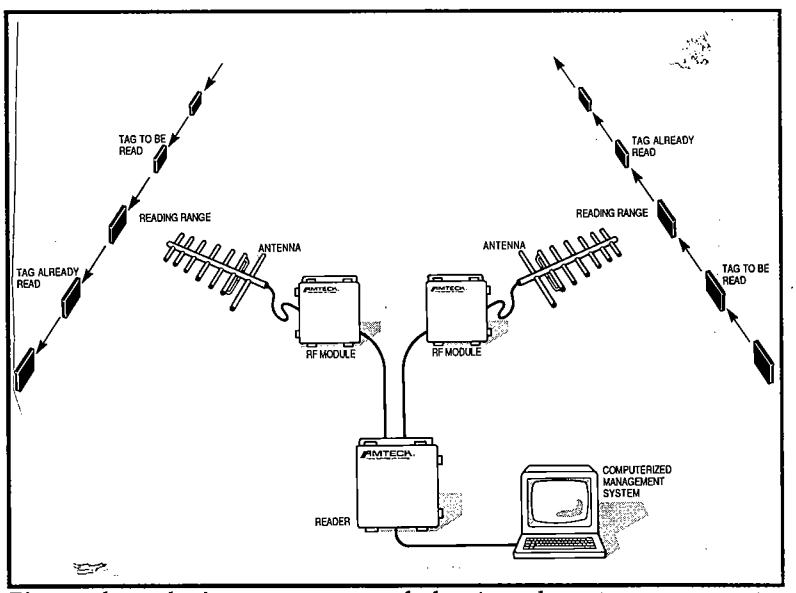


Figure shows basic arrangements of the Amtech system components. Also shown are a proximity sensor and the host computer.

When a tagged object nears an antenna, the optional proximity sensor causes the RF module to turn on and the antenna to broadcast an RF signal. Proximity sensors are often used when power conservation is desirable, as with battery-operated readers.

Reader Functions

Signal Processing. The reader receives the demodulated signal from the RF module. It amplifies the signal, then decodes it and validates it.

Data Management. The reader transmits the ID codes to a host computer system. The IDs may also be transmitted to a printer or other data collection device.

The user can instruct the reader to append certain information to the ID codes prior to transmission to the host computer. This information can be time, time and date, and/or auxiliary information. Auxiliary information consists of reader and antenna identification, number of times the previous tag was read, and sensor status information.

The reader's standard 32K memory holds approximately 2,000 ID codes without appended information and 1,000 ID codes with the additional information appended. The optional 64K memory doubles this capacity.

An additional serial communications port (AUX-2) can be installed in the reader at the factory. Through a local terminal connected to this optional AUX-2 port, the user can manually enter IDs for untagged objects.

The reader can search for specified ID codes. The reader's ID search function can be controlled through reader commands entered at the host computer or through the terminal connected to the AUX-2 port.

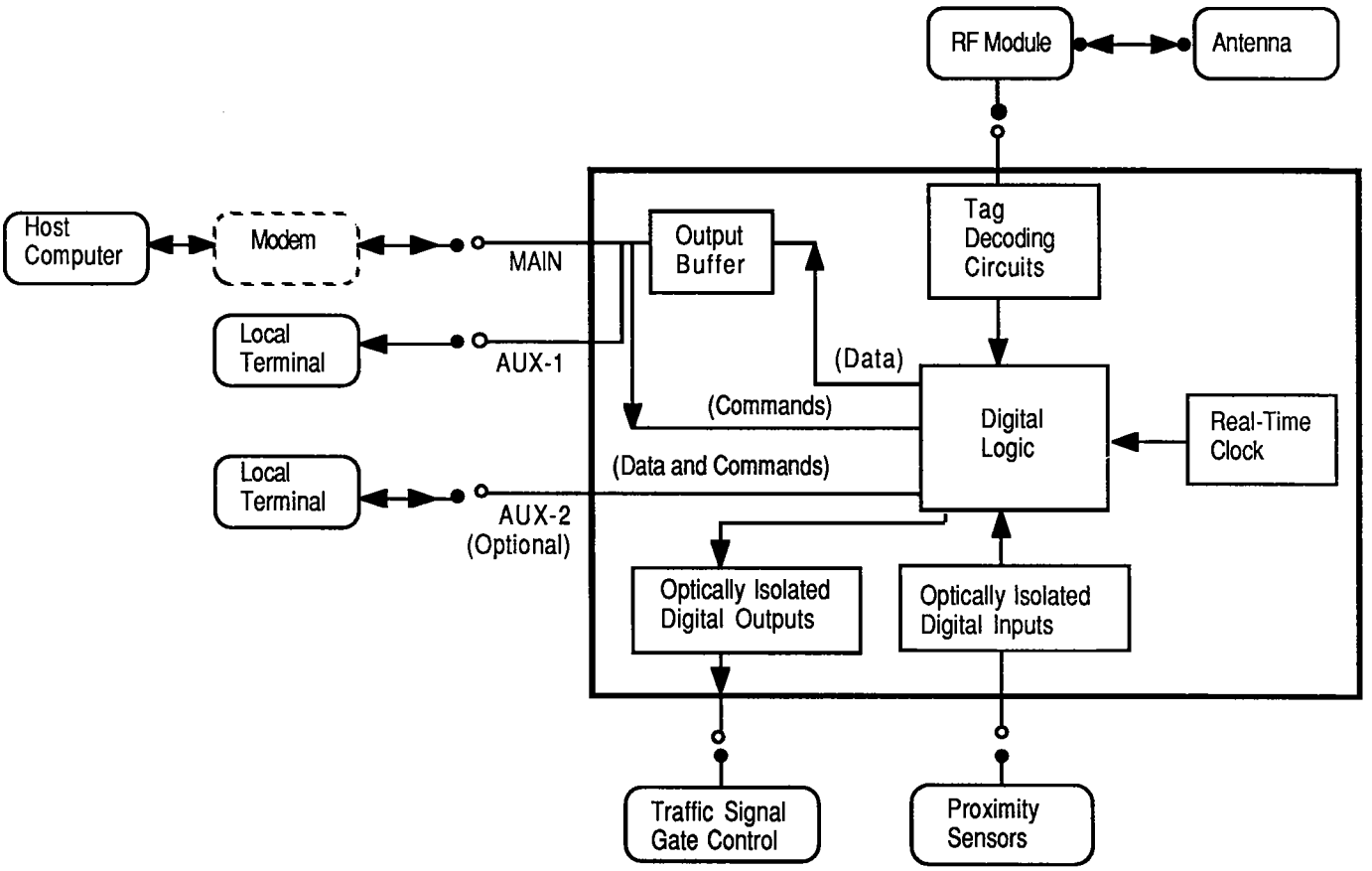
RF Control. The reader is configured at the factory for single-channel operation. The configuration to allow multiplex operation is available either from the factory, or can be field modified by Amtech certified personnel.

Control of RF module(s) is accomplished through reader commands for either single channel or multiplex operation; or by input from proximity sensors connected to the reader's Sense Input terminals.

Output Control. The operation of external equipment, such as gates or signal lights, connected to the reader's Status Output terminals can be controlled by the reader. reader commands allow the user to set and change output operation parameters as necessary.

Host Communications. The reader's communication ports provide standard RS-232 DTE communications. Reader firmware sets reader-to-host communications parameters such as baud rate, parity, number of stop bits, and EOL communications link delay. These commands provide XON/XOFF and data enquire host communication protocols.

Modem control parameters may be set through the reader to define conditions under which a reader at a remote station will call or be called by the host computer.



Standard Reader Features

The AI1200 has a standard 32K byte data storage buffer. The MAIN and AUX-1 serial communication ports are standard on the AI1200.

The reader operates on 110 or 220 VAC, which the reader converts to DC for use by the system. The AI1200 is housed in a weatherproof Type 4X NEMA* enclosure. Standard operating temperature range for the reader is 0° C to 70° C.

Reader Options

The AI1200 is available with an optional data storage buffer which increases the capacity to 64K bytes.

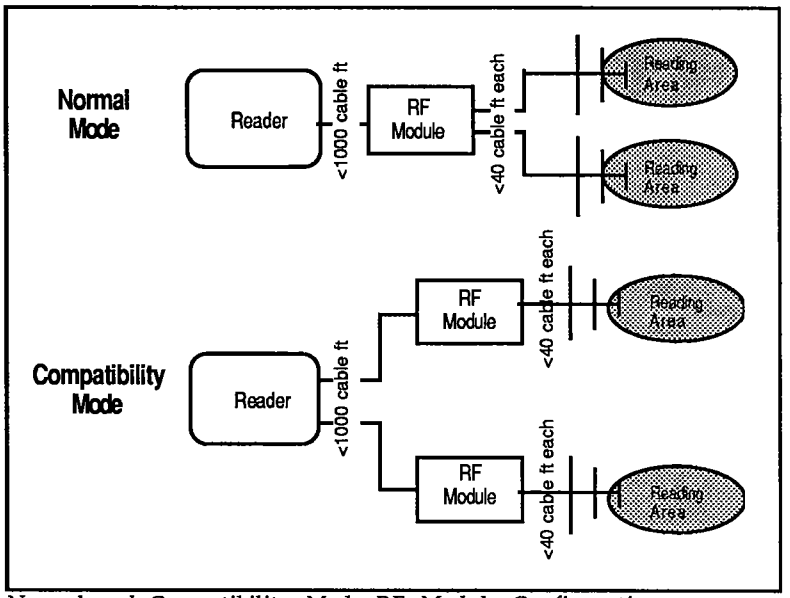
A second serial communications port, the optional AUX-2 port, can be specified when ordering the AI1200.

The reader may be ordered with a 12, 24 or 72 VDC power supply.

The AI1200 is available in an optional, ruggedized industrial version which is vibration resistant and operates at temperatures between -40° C and 70° C.

* NEMA stands for National Electrical Manufacturers Association.

The AR2100 and2500 RF Modules can be used to operate one antenna each. The AR2200 RF Module can operate two antennas when only one RF Module is connected to the reader configured in *Normal* Mode. Normal Mode configuration may be used when the desired reading areas are within 80 feet of one another and the required cable length is less than 40 feet.



Normal and Compatibility Mode RF Module Configuration.

In *Compatibility* Mode, two RF modules are connected to the reader, and each Module operates one antenna. Compatibility Mode is the recommended configuration when the desired reading areas are widely separated and long cable runs (more than 40 feet) are required.

The AR2200 RF Module also contains a built-in Range Sensitivity Adjustment feature which allows variable control of the system's sensitivity to RF noise and stray signals.

Tags

Amtech tags (sometimes called *transponders)* contain electronic circuitry which responds with a 128 bit message in the presence of a signal from the system. The tag may contain up to 20 user-selected alphanumeric characters.

Tags are divided into categories by *operating frequency, power source,* and *industry environment.*

Operating Frequency. For applications in the United States, tags operate in the 915 MHz band (902-928 MHz) as allowed by the Federal Communications Commission (FCC). Other countries permit operation of RF identification equipment at 2450 MHz or 880 MHz.

Power Source. Although tags are not RF transmitters, a minute amount of power is needed to operate the internal circuitry.

Some tags derive this power directly from the incoming RF signal. These are considered to be "passive" tags and are *beam* powered. Beam powered tags have an indefinite life since there is no battery and they have no moving parts.

Other tags use a small lithium battery to drive the internal circuitry. These are considered to be "active" tags and are ***battery*** powered. Battery powered tags have a life of eight to fifteen years, which is based on battery life. These tags can be read further from the antenna than beam powered tags.

Industry Environment. Each tag case design specifically meets the rigors defined by three major industry environments: the Toll industry, the Intermodal/General Transportation industries, and the Rail industry.

Interference. Interference from RF and electrical sources can degrade system performance and is also factored into system design and installation. Existing sources of interference at the site may be shielded or removed, affected equipment may be positioned adequately distant from the source, or filters may be added to the system. Fluorescent lights, neon signs, nearby radio stations or power lines can interfere, to some degree, with the optimal functioning of the system. Even the "noise" from relays, whose opening and closing control the operation of a gate, can disrupt the RF signal.

The system is designed to perform optimally under all site conditions which exist (and reasonably can be expected to exist intermittently) at the time of installation; therefore, *any subsequent changes can potentially affect system performance, and should only be made with the advice of Amtech certified personnel.*

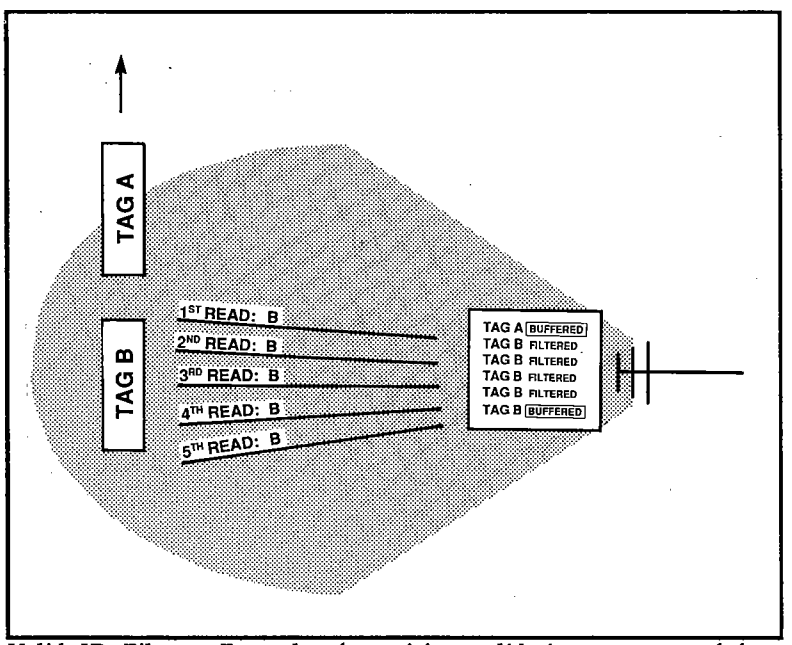
Reader Firmware Control

After the physical environment on site has been factored into system design, the system can be further configured through *reader firmware control.*

Through reader firmware commands, the system can filter and manipulate signals received, testing them against user-accessible criteria prior to transmitting them to the host.

ID Filter Parameter commands allow the user to control the conditions upon which an ID that has been read will be buffered and transmitted. A tag can be read many thousand times a minute when in the system reading range. It is normally useful to set conditions to "filter" out unwanted acquisitions of the same tag or occasional IDs received from the fringes of the reading range. These conditions include: the number of times in succession a tag must be read before its ID is buffered, or logged (*Select Valid ID*); the number of different codes which must separate an ID code from itself in previous reads (*Select Unique ID*); and the time limit (*Variable Time-Out*) applicable to the Unique ID filter.

The *Select Valid ID* command allows the system to filter out unwanted tag signals. In most cases, tags passing through the designated reading range will be read many times before exiting the range. This factor allows the system to require a minimum number of successive reads in order to consider an ID code valid. Although signals which "stray" into range may be picked up by the antenna, they generally will not be strong enough to register the minimum number of successive reads to be considered valid.



Valid ID Filter - Example of requiring validation sequence of four reads before buffering and transmitting an ID.

Because the system receives and decodes a tag's ID many times a second while the tag is in the antenna's reading range, it is normally desirable to "filter" the duplicate reads of a single tag. The *Select Unique ID* command sets the number of different ID codes which must separate an ID code from previous reads of itself (*separation criteria*).

As an example, consider a tagged railcar standing a full minute next to a switchyard antenna. The system would receive this ID code several thousand times during this minute. To prevent the reader's output buffer from filling with the same ID, the reader's Select Unique ID filtering function permits the ID to be stored in the buffer only the first time it is acquired.

With a separation criterion of 1, the railcar's tag will not be buffered again until at least one different ID has been acquired. With a required separation of 2, two different IDs must be acquired before the first can be read and buffered again, and so on.

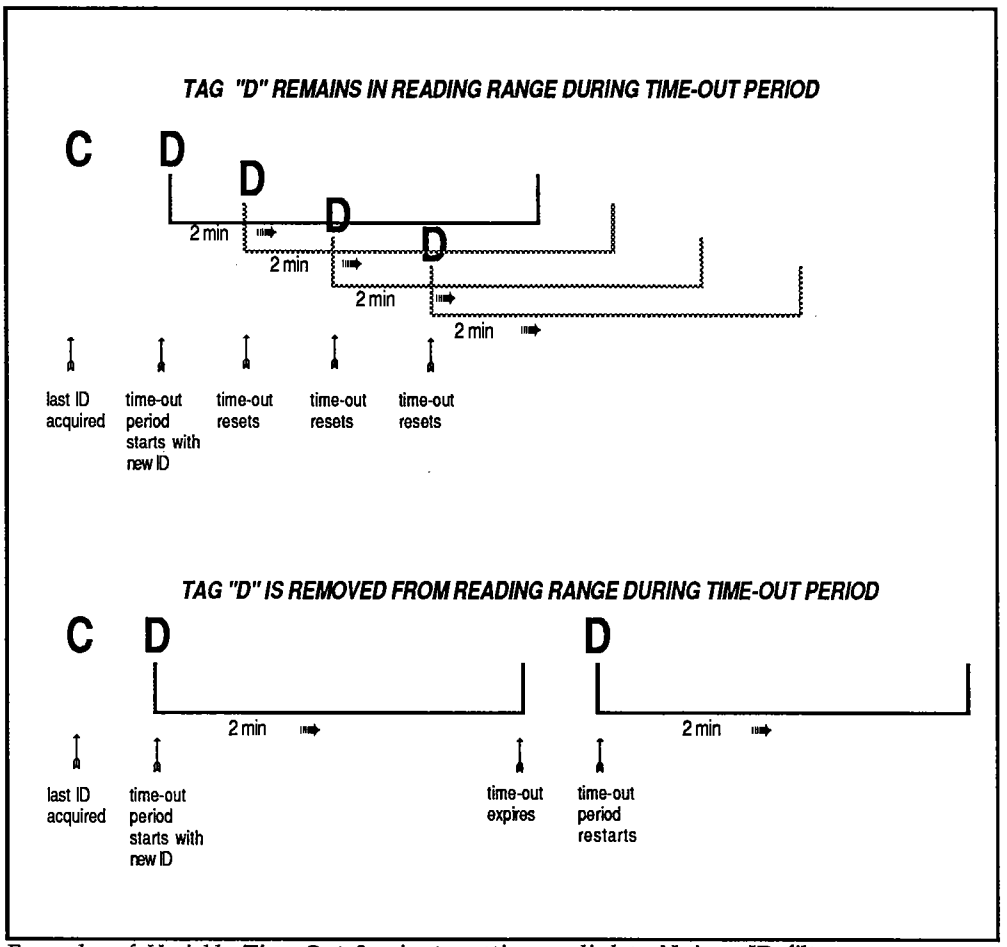
Tags Read *Select Valid ID of 1 Read*	**Tags Buffered for Comparison**	**Tags Transmitted** *Select Unique ID Separation* 1	2	3	4
A	A	A	A	A	A
B	B	B	B	B	B
C	C	C	C	C	C
C	-	-	-	-	-
A	A	A	A	-	-
A	-	-	-	-	-
B	B	B	B	-	-
A	A	A	-	-	-
C	C	C	C	C	-

Table showing the effect of the Select Unique ID criteria.

The Variable Time-Out (#44N) clock is continually reset (does not expire) with each duplicate read of a tag's ID. Thus, in the railcar example, car "D" must be removed from the reading range for a period long enough to allow the time-out to expire in order that the system will accept the car's ID as valid when it backs out.

The diagram below illustrates examples of the time-out effect on the Unique ID filter. In the first example, as the tag continues to be read, each successive read resets the timer. Thus, tag "D" could not be acquired a second time.

In the second example, tag "D" is read and buffered once as it enters the siding, and moves out of the reading range until the time-out period has expired. It is read and buffered a second time as it backs out because the time-out period has expired and the system now sees its ID as new.



Examples of Variable Time-Out 2 minute setting applied to Unique ID filter.

The uniqueness can also be reset directly at any time with the *Reset Uniqueness* command.

System Control

The user controls the system through commands given to the reader through the MAIN port using the host computer or attached terminal. These commands are divided into eight groups according to their primary function.

Command Group	Function
0	Data and Command Mode Control
1	Communication Port Control
2	Real-Time Clock Control
3	Format ID (Append Information)
4	ID Filter Parameters
5	Reader Status
6	Reader Control Functions
7	Search Functions
8	Auxiliary Reader Control

These commands are discussed in depth in Chapter 2, System Operation.

Special Reader Functions

With the optional AUX-2 port installed, the user can manually enter IDs and initiate ID search directly through a local terminal connected to the reader.

Manual entry of IDs allows identification of untaggged objects through the system. This is useful, for example, at a terminal entry gate where all vehicles may not be tagged.

The AUX-2 search facility is ideally suited to mobile inventory vehicles. These vehicles operate at terminal yards and are equipped with readers. The operator enters the equipment number (container, chassis, etc.) to be found into the reader. The reader notifies the operator when a match is found.

System Licensing

Amtech systems must be licensed by government regulatory agencies in the country of installation. Because of the length of time needed for the licensing process, licensing applications are normally filed during the site survey phase of system design. This licensing must be complete prior to the operation of the Amtech system.

Frequency and Power

Operation of the Amtech equipment must comply with the laws of the country in which the installation is located. These laws regulate the operating frequency and power of installations emitting radio waves.

The Amtech RF Identification system operates in the United States using radio waves in the 902-928 MHz band. This band complies with regulations of the Federal Communications Commission (FCC) for this type of equipment.

For operation in certain countries in the Far East and Europe, Amtech manufactures equipment which operates between 2400 and 2500 MHz.

Before purchasing an Amtech system, each user must verify that local laws allow operation of the equipment.

United States Licensing

In the United States, Amtech installations using more than 3 milliwatts of RF power *must* be licensed by the FCC under Section 90.239. This is accomplished by completing FCC Form 574. It is the *user's* responsibility to file the proper application with the FCC. Amtech will, if requested, advise the user of this process.

Departments or agencies of the federal government must have frequencies allocated and licenses approved through the local frequency coordinator of the Interdepartmental Radio Advisory Committee (IRAC).

The licensing procedure must be started well before Amtech equipment is delivered to allow sufficient processing time by the FCC or the IRAC.

International Licensing

Each country has an agency regulating radio transmission. It is the *user's* responsibility to file the proper forms and applications with the appropriate agency. In addition to licensing, some countries require additional equipment certification.

Amtech will, if requested, advise the user of these processes.

Chapter 2
System Operations

Chapter 2
System Operation
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System Operation

This chapter describes the operation of the *installed* Amtech RF Identification system.

This chapter describes both *component* and *command* operation of the system.

Component operation deals with the physical components of the system. It describes the basic functions of the components and physical manipulation of the system accessible by the user.

Command operation deals with system functions controlled through reader firmware commands. All reader commands are given, although some commands are intended for diagnostic use by Amtech certified personnel.

The Amtech system is designed and installed to provide optimal performance within each site's unique operating environment. Factors such as RF signal power, antenna type and orientation, and tag type have been carefully selected to provide the desired performance with respect to such elements as proximity of other antennas, speed and angle of tag passage, and RF signal obstructions, reflectors, and sources of interference.

The user should not attempt to modify system configuration except through reader commands provided in this chapter, or upon instruction from Amtech certified personnel.

Reader Power

All electrical power to the system is supplied through the reader. The reader converts AC (or optional DC) power into DC power for use by the other components.

Power Switch and Supply. The reader power switch is located on the side of the power supply housing. Turning power off to the reader also turns power off to the RF module and antenna. However, it must be remembered that the reader power supply unit is wired directly to the power source. Do not service the power supply unless the power has been turned off through a circuit breaker or other means.

Voltage Selection. The reader is factory wired to operate on AC voltage at 110V or 220 V, 50 or 60 Hz. The reader can also be ordered with a DC power supply operating at 12, 24, or 72 VDC. The voltage selection switch, located on the top of the power supply unit, is set and tested during installation of the system. In the unlikely event the voltage selection should need to be altered, follow these steps:

1. *If the reader has active power connections,* first turn off power to the circuit, then turn off the power supply switch. Do not attempt to change the voltage selection with live power connected to the power supply.
2. With all power to the reader completely off, disconnect existing wires to the power supply unit.
3. Use a medium screwdriver to turn the voltage selection switch to the new setting.
4. Connect the reader power supply unit to the new power source.
5. Turn on the power to the circuit; then turn on the reader power supply switch.

Note: DC and Harsh Environment power module options have no voltage selection switch. Care must be taken to operate these units within their specified voltage input ranges.

Note: Operating the AI1200 with an incorrect voltage setting can severely damage the reader. It is recommended that Amtech certified personnel or an electrician make voltage selection adjustments to the reader.

Fuse. The reader's internal circuitry is protected from faults causing excessive current demands by a fuse located next to the power switch. If necessary, the fuse may be replaced with an equivalent fuse whose rating matches that shown on the power module's input ratings decal.

Connection of Other Components

The reader provides central control for the function of external components. Sense input modules, status output modules, serial communication connections, and system RF modules are physically connected through the AI1200 backplane. Connections to these components are made from terminal blocks inside the reader case. The terminals are labeled from 1 through 51 and are grouped according to function.

Status Output and Sense Input Modules

Terminals 1 through 16 are associated with the Sense Input and Status Output modules. Status Output modules provide signals for the control of external equipment, such as lights or gates. Sense input modules receive signals from external equipment, such as proximity sensors.

The configuration and connection of these modules is done during the design and installation. Any alteration to the modules or their terminal connections should be done by Amtech certified personnel.

Serial Communication Ports

The Dual Channel reader has three RS-232 serial **communications ports**, designated **MAIN** port (terminals 17 through 23), **AUX-1** port (terminals 24 through 28), and the optional **AUX-2** port (terminals 29 through 35).

All connections made to these communications ports require minimum 22 gauge RS-232 cable. ***FCC regulations require that this cable and all adapters be shielded.*** In permanent installations, all cables are run through metallic conduit into the NEMA box.

MAIN port communications. The MAIN port transmits ID information to and receives commands from the host computer. When the MAIN port is receiving commands, it cannot transmit data, and vice-versa. Also the MAIN port can be "locked" (i.e., unable to receive commands) either by the optional AUX-2 port or directly through host computer commands. The terminal connections are as follows:

Terminal Number	Labeled	RS-232 Signal	Function
17	TXD1	TD	Transmit Data
18	RXD1	RD	Receive Data
19	DTR1	DTR	Data Terminal Ready
20	RTS1	RTS	Request to Send
21	CTS1	CTS	Clear to Send
22	GND1	GND	Signal Ground
23	CHASS	None	Chassis Ground

The factory communication parameter settings for the MAIN port are as follows:

Baud	300
Parity	Disabled
Stop Bits	1
Data Bits	8
EOL Delay	0 ms

These parameters are changed through reader commands described later in this chapter. ***All communication parameter commands for the MAIN port also apply to the AUX-1 port.***

AUX-1 port communications. The **AUX-1** port is a transmit-only port that echoes all information transmitted via the MAIN port. AUX-1 allows information being transmitted via the MAIN port to also be sent to a printer or other logging device.

Terminal Number	Labeled	RS-232 Signal	Function
24	TXD2	TD	Transmit Data
25	DTR2	DTR	Data Terminal Ready
26	RTS2	RTS	Request to Send
27	GND2	GND	Signal Ground
28	CHASS	None	Chassis Ground

The factory setting communication parameters for the AUX-1 port are the same as the MAIN port, and can only be changed simultaneously with the MAIN port.

AUX-2 port communications. The optional AUX-2 RS-232 port allows additional communication and control of reader functions through a secondary local terminal. It is used primarily for special reader functions, such as manual entry of IDs and ID search.

Terminal Number	Labeled	RS-232 Signal	Function
29	TXD3	TD	Transmit Data
30	RXD3	RD	Receive Data
31	DTR3	DTR	Data Terminal Ready
32	RTS3	RTS	Request to Send
33	CTS3	CTS	Clear to Send
34	GND3	GND	Signal Ground
35	CHASS	None	Chassis Ground

The factory setting communication parameters for the AUX-2 port are as follows:

Baud	300
Parity	Disabled
Stop Bits	1
Data Bits	8
EOL Delay	0 ms

Terminals 36 through 39

Terminals 36 through 39 are reserved for future use, and normally will not be connected in an installed, operating system.

RF Module Connection

Terminals 40 through 51 are used to connect the RF modules. These terminals transmit DC power to the RF modules, transmit the RF power on/off signal to the modules, and receive the ID-bearing IF (Intermediate Frequency) signals from the modules. These connections are made during the installation of the system. All terminals 40-51 are used in two-antenna systems. In systems utilizing only one antenna, only terminal 40 or terminal 41, but not both, will be used.

Reader Indicator Lights

Indicator lights on the AI1200 reflect system status. The **PWR ON** light indicates power to the reader is on.

SEARCH 0 and **SEARCH 1** indicate the control lines to RF Channels 0 and 1, respectively, are activated and the RF power is turned on. With the reader operating in **multiplex** mode each SEARCH light will be lit alternately when no tags are present in either antenna reading range. In systems operating with single RF, only the active RF channel's SEARCH light will be on (i.e., SEARCH 0 is operational if RF channel 0 is being utilized).

The **LOCK** light indicates that signal reception is taking place for the antenna/RF channel whose SEARCH light is on.

Stat Output LIGHTS 0 through 3 indicate output module activation. **Sense Input LIGHTS** 4 through 7 indicate input module activation.

RF Module

The RF module generates the RF power necessary to read a tag. It also contains receiver and pre-amplifier circuitry to preprocess the tag signal returned through the antenna. The RF module is connected to the reader and antenna during installation and should require no further mechanical adjustment from the user.

Always ensure an antenna or termination is connected before turning on power to the reader *Turning on RF power with either antenna port disconnected could damage the RF module. Always terminate unused antenna ports with a 50 ohm load.*

The RF module receives DC power through cable connections made to the reader. The reader-to-RF module cable also carries the demodulated tag signal from the RF module to the reader and the on/off control signal from the reader to the RF module.

As a factory setting, RF power is on whenever the system is on. However, one or both RF channels may be turned off through reader firmware commands. RF power can also be controlled through interfacing proximity sensors with the reader. Proximity sensors allow RF power to be turned on only in the presence of objects to be identified. Proximity sensors are useful in installations utilizing battery power or where continuous RF power is not desirable. Proximity sensors are interfaced through the SENSE 0 through SENSE 3 input modules during installation.

Increases or decreases of the RF signal strength directly impact the system's reading range. In order to confine the reading range to its optimal area, attenuators to decrease the RF signal can be installed in the coaxial cable between the RF module and the antenna, or in the jumper cable on an AR2200 RF module. Increasing the RF signal strength should not be attempted by the user. This is to preserve system design integrity and to ensure the RF module conforms to its FCC certification parameters.

Long cable runs between the RF module and antenna can degrade system performance and are avoided in system configuration.

Antenna

The antenna has two functions: to transmit the RF signal to the tag, and collect the coded signal reflected by the tag. The antenna is connected to the RF module during system installation, and should require no further mechanical adjustment from the user.

Antenna type and alignment are determined by the Amtech system designers to deliver optimal performance within each location's unique operating environment. ***If an antenna becomes misaligned, or if permanent obstructions are placed in the installation area, the user should contact Amtech immediately.***

Reader Functions and Command Operations

Reader functions are characterized as **principal, auxiliary,** and **special functions.**

Principal functions are to decode the signal acquired through the RF channels, filter and store IDs in the output buffer, and transmit buffered IDs to the host or local terminal.

Auxiliary functions are functions that are subordinate to the principal functions, but which give the reader great flexibility in handling the retrieved ID information. These functions are manipulated through the use of reader commands. These functions include appending information to the ID codes and other transmissions sent to the host computer, and controlling external hardware.

Special functions normally require the use of the optional AUX–2 port. These functions include manually entering ID codes of untagged equipment, and using the reader to search for a specific ID number.

Many system operations are controlled through **reader commands,** including the auxiliary and special functions. Although the reader firmware is set to certain conditions (default values) at the factory, the user may change those conditions through the use of reader commands.

Reader Operating Modes

The reader has two primary modes of operation. The first permits transmission of data to the host computer (Data Mode); and the second accepts commands sent from the host computer (Command Mode).

Data Mode is the factory setting mode for the reader. Data Mode allows the transmission of IDs from the reader to the host computer via the MAIN port. The only command accepted by the reader in Data Mode is the one switching the reader into Command mode. *Note:* The reader is always in Data Mode on power up.

Command Mode allows commands to be sent from the host computer to the reader also via the MAIN port. Command Mode halts the transmission of IDs from the reader to the host computer. Any IDs acquired by the reader while in Command Mode are stored in the output buffer until the buffer is full. When the buffer is full, the reader issues an error message to the host computer and all new IDs are lost. It is important to return from Command Mode to Data Mode once all reader commands are complete.

The reader also operates in a third mode when the AUX-2 port is active. The AUX-2 port can "lock-out" transmissions from the MAIN port. When the MAIN port is locked out, the reader ignores commands from the host computer as it does in Data Mode.

Reader Command Groups

Reader commands are divided, by primary function, into eight groups. Following is a general discussion of the functions of the eight command groups.

Group 0 Reader Mode Control

Command Group 0 controls reader mode and locks or unlocks the MAIN port.

Data Mode is the factory default setting which allows the reader to transmit buffered IDs to the host computer via the MAIN port.

Command Mode permits the host computer to transmit commands to the reader via the MAIN port. Tag ID data transmission from the reader is suspended while the reader is in Command Mode.

Note: The reader supports XON/XOFF flow control for output while in Data Mode. However, transmission of reader output (i.e., IDs) is never suspended until the current ID has been completely transmitted.

The reader also supports hardware flow control via the RTS and CTS lines in both Data and Command Modes. Transmission of reader output is suspended within one character after the CTS line goes "false."

Group 1 Communication Port Control

Group 1 commands configure the **communications parameters** used by the three serial communication ports. ***Note:*** Applying Group 1 commands to the MAIN port automatically applies them to the AUX-1 port as well. Parameters for the optional AUX-2 port are set separately.

Through Command Group 1, the user may set **baud rate, stop bits, parity,** and **end-of-line delay.**

Group 2 Real-Time Clock

Group 2 commands control the **real-time clock** which maintains the **time and date.** Group 2 commands allow the user to set or display the time and date.

The real-time clock is supported by an internal lithium battery, so time and date are preserved in case of power outage. The minimum life of the battery is five years, and has a typical life expectancy of 19 years.

Group 3 Append Information

Group 3 commands append useful information to reader transmissions such as IDs, error messages, and sensor input reports. The reader is set at the factory to append time and date to all IDs. Auxiliary information, such as reader number, antenna number (or manual entry code), number of times the previous tag was read, and sensor input status can also be appended to the ID through the use of Group 3 commands.

Group 4 ID Filtering

Group 4 commands perform three different filtering functions: **Select Unique ID, Variable Time-Out,** and **Select Valid ID.**

The **Select Unique ID** commands filter out repetitive IDs and only transmit a single ID to the host computer. This feature is valuable because a tag's ID code can be acquired approximately 70 times per second. The factory setting is to compare a new ID to the most recently buffered ID to see if it is the same. The reader can compare new IDs up to the four most recently buffered IDs.

For practical reasons, the Select Unique ID commands have an expiration limit imposed by the Variable Time-Out commands described below.

The three **Variable Time-Out** commands are used in conjunction with the Select Unique ID commands. They place a time limit on the Unique ID filter. The time-out period can be set to 2, 20, or 60 minutes. These commands allow the same ID to be buffered twice, after a period of time, rather than being filtered out. The time-out period can also be directly reset by the *Reset Uniqueness* command.

The four **Select Valid ID** commands filter IDs decoded by the reader. These commands instruct the reader to read an ID a specific number of times in succession before storing it in the output buffer. The reader can be set to require sequences of one, four, sixteen, or sixty-four reads.

These commands are applied before the Select Unique ID parameters. That is, an ID must be read the specified number of times *prior* to being compared to the specifications defined by the Select Unique ID commands.

The validation test is primarily useful in multiple antenna installations to filter out IDs received from fringe areas of the reading range.

Group 5 Reader Status

Group 5 commands provide status reports on the parameters and operation of the reader. The user can display operational conditions of the reader, such as the status of the I/O modules or communication port parameters. Also obtainable through these commands is information on the parameters set through reader commands, such as filtering criteria and appended information status.

Group 6 Reader Control Functions

Group 6 commands set reader control functions such as output pulse duration, RF control, modem control, and also invoke the diagnostic menu of the reader. These commands are also used to turn on an automatic report when presence detectors are activated, but no tag ID is acquired. The majority of these commands are

used by Amtech certified personnel in the installation or modification of the system. Some of these commands, such as OUTPUT CONTROL (#620N), can be sent by host computer systems to control external equipment.

Error correcting protocol is accessed through the #611 command and its timeout is specified by using the #612 command.

Group 7
Search Control Functions

Group 7 commands control the reader's search control functions when performed through the MAIN port. These search functions can also be implemented through the optional AUX-2 port.

Group 8
Auxiliary Reader Control

Group 8 commands provide control of reader functions such as the system check tag. These commands also control writing parameters to and restoring parameters from the EEPROM.

Reader Command Protocol

The reader only accepts commands from the device (either host computer or local terminal) connected to the MAIN port. Functions performed through the AUX-2 port are accomplished through menu selections rather than commands. The AUX-2 functions are discussed in a separate section later in this chapter.

Giving commands to the reader is a three step process:

1. Put the reader into Command Mode (SWITCH TO COMMAND MODE [#01] command).
2. Issue the appropriate commands.
3. Return the reader to Data Mode (SWITCH TO DATA MODE [#00] command).

The reader must be returned to Data Mode after any command operations to ensure proper transmission of acquired IDs. If the buffer fills to 75% while the reader is in Command Mode, the reader issues an Error message. This allows the user to return the reader to Data Mode before the buffer completely fills and new IDs are lost.

All reader commands are preceded by the "#" character, and the reader echoes all characters, beginning with this character.

Command Entry Conventions

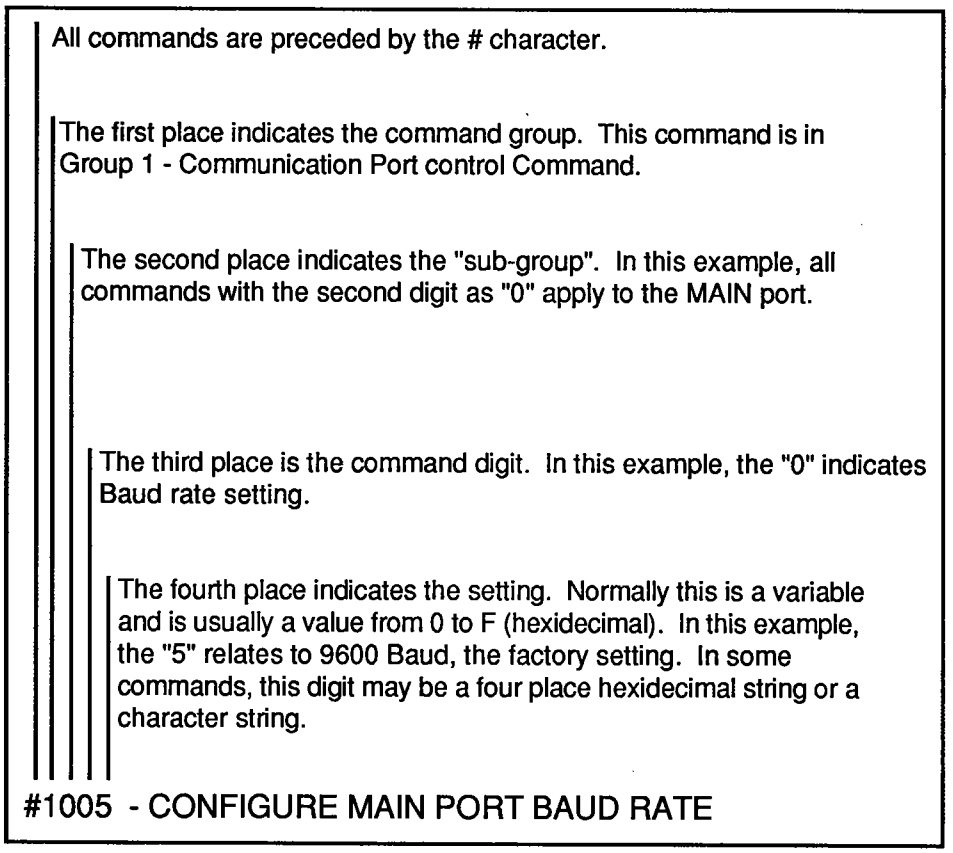
Commands are preceded by the "#" character, and are completed by the "ENTER" or "RETURN" key. For example, the SWITCH TO COMMAND MODE (#01) command is typed as follows:

#01<ENTER>

where, <ENTER> is the "ENTER" or "RETURN" key.

In the following paragraphs, command characters may be represented by the letter "N". This indicates the user is to supply a value. Maximum valid entries are the numbers 0-9 and the ***uppercase*** letters A-F. (This allows up to sixteen available user responses and is based on the hexadecimal numbering system.)

Commands have at least two characters following the "#" character. The following figure shows the basic structure of a four-character command.



Command Response Conventions

Like reader commands, responses are preceded with the "#" character.

Many reader commands respond with #Done or #Error indicating the command was or was not recognized and completed. *Note:* Both #Done and #Error are six-character responses followed by carriage return and line feed. The #Done response has a trailing space (i.e., '#Done ').

Other commands respond with a four character identifier followed by one or more values.

In the command discussions that follow, reader response characters may be shown in brackets <>. This indicates that the response is a value in the range of characters in the brackets. ***The brackets are not part of the response.*** For example, the DISPLAY POWER OUTAGE BIT (#520) command responds with either a "0" or a "1". In the command discussion the response is shown as:

#PWRB <0-1>

The ***actual*** reader response is one of the following:

#PWRB 0
#PWRB 1

In the above example "PWRB" is the four character identifier for "power outage bit", and the "0" or "1" is the value. All spaces shown in the response are actual spaces sent from the reader. In the example above, there is one space between the letter "B" and the number.

Carriage return and line feed characters are at the end of each reader response.

Reader Command List

This Reader Command List reflects version 2.6 of the reader firmware. Each reader command is listed in order with an explanation of the corresponding reader action. Factory settings of the reader are indicated. A condensed listing of commands (without explanation text) is found in Appendix A of this guide.

Command Group 0 Mode Control

Group 0 commands determine whether the reader is operating in Data or Command Mode. These commands also lock and unlock the MAIN port on the reader.

All Group 0 Commands respond with either #Done or #Error.

#00 SWITCH TO DATA MODE *(factory setting)*

Switches the reader to Data mode which allows transmission of data (ID codes) to the host computer. This is the mode the reader assumes on power up, and is the factory setting. While in this mode, the reader accepts the following commands only: SWITCH TO COMMAND MODE (#01), PERFORM SYSTEM CHECK TAG TESTS (#811X), and SWITCH TO DATA MODE (#00).

The reader supports XON/XOFF protocol while in Data Mode. However, transmission of reader output (i.e., IDs) is never suspended until the current ID has been completely transmitted.

The reader also supports hardware flow control via RTS and CTS lines

#01 SWITCH TO COMMAND MODE

Switches the reader to Command mode which allows the reader to receive commands from a host computer or terminal. While in this mode, the reader does not transmit IDs to the host computer but instead stores them in its output buffer for later transmission. If the buffer becomes full, additional new IDs are lost, and the reader sends an Error 02 message to the host computer. The SWITCH TO DATA MODE (#00) command must be issued to resume transmissions of IDs to the host computer. *(Note:* The reader also issues an error when the buffer fills to 75% capacity, and another message when it empties to 50%.)

#02 LOCK OUT MAIN PORT

Disables the MAIN port from receiving commands from the host computer. The only commands accepted from the MAIN port when it is locked is SWITCH TO COMMAND MODE (#01) followed by UNLOCK MAIN PORT (#03). ID transmission still occurs when the MAIN port is locked, as long as the reader is in Data Mode.

Note: When the MAIN port is locked, the reader continues to echo any command characters. However, the reader returns #Error in response to any command except those listed above.

#03	UNLOCK MAIN PORT *(factory setting)*	Unlocks MAIN port, whether the MAIN port was locked by LOCK OUT MAIN PORT (#02) command or through the optional AUX-2 port. This is the factory setting.

Command Group 1 Communication Port Control

Group 1 commands configure the communication links between the reader and the host computer,local terminal, printer, or modem. Applying Group 1 commands to the MAIN port simultaneously applies them to the AUX-1 port as well. AUX-2 port parameters are set independently. *Commands applying to the AUX-2 port return #Error if the AUX-2 port is not installed.*

Note: Reader response to Group 1 commands is at the pre-command setting. For example, when changing the baud rate from 300 baud to 1200 baud, the reader responds with #Done at the pre-command setting of 300 baud. Once the #Done response is transmitted, the new configuration becomes effective.

All Command Group 1 commands respond with either #Done or #Error.

#100N CONFIGURE MAIN AND AUX-1 PORT BAUD RATE

Sets the baud rate for the MAIN and AUX-1 ports. The factory setting is 300 baud. The N variable sets the baud rate as follows:

Command	Baud Rate	
#1000	110	
#1001	300	*(factory setting)*
#1002	1200	
#1003	2400	
#1004	4800	
#1005	9600	
#1006	19200	

#101N SET MAIN AND AUX-1 PORT STOP BITS

Specifies stop bits for MAIN and AUX-1 port character transmission. The factory setting is one stop bit. The N variable sets the stop bits as follows:

Command	Stop Bits	
#1010	1	*(factory setting)*
#1011	2	

#102N SELECT MAIN AND AUX-1 PORT PARITY

Selects MAIN and AUX-1 port parity setting. The factory setting is parity disabled. The N variable sets the parity as follows:

Command	Parity
#1020	disable parity *(factory setting)*
#1021	enable even parity
#1022	enable odd parity

Command #1020 provides eight data bits and parity disabled. Command #1021 provides seven data bits and even parity; command #1022 provides seven data bits and odd parity.

#103N SET MAIN AND AUX-1 PORT END-OF-LINE DELAY

Sets the delay necessary to allow slow output devices (such as printers) connected to the MAIN or AUX-1 ports to reset or perform a carriage return before receiving the next line of communication. The factory value is no delay. The delay ranges from 0 to 1500 milliseconds depending on the N variable as follows:

Command	Delay (ms)
#1030	0 *(factory setting)*
#1031	100
#1032	200
#1033	300
#1034	400
#1035	500
#1036	600
#1037	700
#1038	800
#1039	900
#103A	1000
#103B	1100
#103C	1200
#103D	1300
#103E	1400
#103F	1500

#110N CONFIGURE AUX-2 PORT BAUD RATE

Sets the AUX-2 port baud rate. The factory value is 300 baud. The N variable sets the baud rate as follows:

Command	Baud Rate	
#1100	110	
#1101	300	*(factory setting)*
#1102	1200	
#1103	2400	
#1104	4800	
#1105	9600	
#1106	19200	

#111N SET AUX-2 PORT STOP BITS

Specifies stop bits for AUX-2 port character transmission. The factory setting is one stop bit. The N variable sets the stop bits as follows:

Command	Stop Bits	
#1110	1	*(factory setting)*
#1111	2	

#112N SELECT AUX-2 PORT PARITY

Selects AUX-2 port parity setting. The factory setting is parity disabled. The N variable sets the parity as follows:

Command	Parity
#1120	disable parity *(factory setting)*
#1121	enable even parity
#1122	enable odd parity

Command #1120 provides eight data bits with parity disabled. Command #1121 provides seven data bits and even parity; command #1122 provides seven data bits and odd parity.

#113N SET AUX-2 PORT END-OF-LINE DELAY

Sets the delay necessary to allow slow output devices (such as terminals) connected to the AUX-2 port to reset or perform a carriage return before receiving the next line of communications. The factory value is no delay. The delay ranges from 0 to 1500 milliseconds (ms) depending on the N variable as follows:

Command	Delay (ms)	
#1130	0	*(factory setting)*
#1131	100	
#1132	200	
#1133	300	
#1134	400	
#1135	500	
#1136	600	
#1137	700	
#1138	800	
#1139	900	
#113A	1000	
#113B	1100	
#113C	1200	
#113D	1300	
#113E	1400	
#113F	1500	

Command Group 2 Real-Time Clock Control

Group 2 commands control the real-time clock which maintains the time and date. This time and date can be appended to IDs, error messages, and sensor input reports. See the Group 3 commands for further information.

The real-time clock is supported by an internal lithium battery, so time and date are preserved in case of power outage. The minimum life of the battery is five years, and has a typical life expectancy of 19 years.

All Group 2 commands respond with either #Done or #Error except DISPLAY TIME AND DATE (#22), which responds with the time and date.

#20 SET TIME

Sets the time. The entry format is

#20HH:MM:SS

where, HH, MM, and SS represent hours, minutes, and seconds, respectively. Values for HH (hours) range from 00 to 23; values for MM (minutes) and SS (seconds) range from 00 to 59. The time must be entered exactly as shown, as two-digit decimal entries with no spaces between characters and using colons ":" as delimiters.

#21 SET DATE

Sets the date. The entry format is

#21MM/DD/YY

where, MM, DD, and YY represent the month, day, and year, respectively. Values for MM (month) range from 01 to 12; values for DD (day) range from 01 to 31; and values for YY range from 00 to 99. The date must be entered exactly as shown, as two-digit entries with no spaces between characters and with forward slashes "/" as delimiters.

#22 DISPLAY TIME AND DATE

Displays the reader's current time and date. The reader responds:

#HH:MM:SS.hh MM/DD/YY

where, HH, MM, SS, and hh represent time as hours, minutes, seconds, and hundredths of seconds, respectively; and MM, DD, and YY represent the month, day, and last two digits of the year, respectively. There are two spaces between the time and the date output.

Command Group 3 Transmission Formats

Command Group 3 commands determine what, if any, information is appended to IDs, error messages, sensor input reports, and modem "connect" and "disconnect" messages. This information includes time, date, and auxiliary information. (Auxiliary information consists of reader number, antenna number, number of reads of the previous tag, and sensor input status.)

All Group 3 commands respond with either #Done or #Error.

#30N APPEND TIME AND DATE SELECTION

Selects the options of appending time and date to transmitted IDs, error messages, sensor input reports, and modem "connect" and "disconnect" messages. The factory setting is time and date appended. The N variable selects as follows:

Command	Selection
#300	no time and date appended
#301	time only appended
#302	time and date appended *(factory setting)*

The output to the host computer with time or time and date appended is as follows:

Time only :

#<string>&HH:MM:SS.hh<%aux>

Time and date:

#<string>&HH:MM:SS.hh MM/DD/YY<%aux>

where,

string is the tag ID number, error message, sensor input report, or modem "connect/disconnect" messages (brackets are not included in the response),

& separates the string from the time and provides a means for the host computer to determine if time or time and date are appended,

% separates any auxiliary information <aux> defined by the #31N commands and provides a means for the host computer to determine if auxiliary information is appended,

: time delimiters,

/ date delimiters.

There are two spaces that separate the time from the date. HH, MM, SS, and hh represent time as hours, minutes, seconds, and hundredths of seconds, respectively; and MM, DD, and YY represent the month, day, and the last two digits of the year, respectively. *Note:* hundredths of seconds are not appended to the error messages.

Note: These commands can execute only if the ID buffer is empty. The RESET READER (#63) command can be given first to clear the buffer (losing any buffered IDs), or the output buffer can be allowed to empty.

These commands will not apply to Error 1 - RAM error. They do apply equally to other error messages, ID output, the sensor input report, and modem "connect" messages.

#31N APPEND AUXILIARY INFORMATION SELECTION

Selects the options of appending auxiliary information to the ID output. The N variable selects as follows:

Command	Selection
#310	no auxiliary information appended
#311	auxiliary information appended *(factory setting)*

The output to the host computer with auxiliary information appended is as follows:

#<string><&time date>%xx-y-zz-q

where,

string is the tag ID code, error message, or sensor input report (brackets are not included),
& separates the string from any optional time and date information <time date> appended by the #30N commands and provides a means for the host computer to determine if time or time and date are appended,
% separates the auxiliary information and provides a means for the host computer to determine if auxiliary information is appended,
xx is the reader ID value in hex from 00 to FF,
y is the antenna number (value of 0 or 1), manual ID entry (value of M), or sensor input report or sensor status change (value of S),
zz is the number of reads of the *previous* tag in hex,
q is the sensor input status in hex from 0 to F,
- auxiliary information delimiters.

Sensor input status data represents the status of Sense0 through Sense3. The exact meaning of the sensor input status depends upon whether it is appended to a tag ID, a sensor input report, or a sensor status change report. In the case of a tag or a sensor status change report, a true status indicates that an active true state was detected and debounced at one or more of the sense inputs. In the case of a sensor input report, a true status indicates that input has completed the presence true criteria (i.e, debounced false to true transition, minimum true period, followed by a debounced true to false). See command #526 DISPLAY I/O status for further discussion of the values of "q". The values are inverted if command #6941 sense input inversion is enabled.

Note: These commands can execute only if the ID buffer is empty. The RESET READER (#63) command can be given first to clear the buffer (losing any buffered IDs), or the output buffer can be allowed to empty.

Command Group 4 ID Filter Parameters

Group 4 commands set criteria for buffering or discarding ID codes (i.e., "filtering"). These commands are useful for elimination of duplicate ID codes and filtering unwanted IDs obtained from "fringe" areas of the antenna reading range.

It should be noted that these commands utilize a "comparison register". The comparison register keeps track of IDs for filtering purposes. When an ID passes all the filtering tests, it is then stored in the reader's main buffer prior to transmission to the host computer.

All Command Group 4 commands respond with #Done or #Error.

#40 TRANSMIT ALL ID CODES

Transmits to the host computer all IDs received by the antenna. Uniqueness testing is bypassed and no data is buffered. ***The command is useful for diagnostic purposes only.*** Any IDs received by the reader during serial port transmission are lost.

#410N SELECT UNIQUE ID CODE CRITERIA FOR RF CHANNEL 0

Directs the reader to select, buffer, and transmit ID codes processed by RF channel 0 according to the following test: an ID is buffered, if, in the time interval since the new ID was last received, previously decoded IDs have changed value at least N+1 times, or uniqueness time-out has been achieved or reset. IDs that do not pass the test are lost. (See following example.) The factory setting is #4100 (N=0) separation of one ID.

Command	Output occurs only with
#4100	separation of 1 ID *(factory setting)*
#4101	separation of 2 IDs
#4102	separation of 3 IDs
#4103	separation of 4 IDs

Each time the reader receives an ID from RF channel 0, the uniqueness filter compares it with the contents of a comparison register. This register contains four items. The first item is the most recently acquired ID, but only if it differs from the second item. The second item is the second most recent ID, but only if it differs from the third item. This process applies to the third and fourth items in the register as well.

Comparison Register

Item 1	Most recently acquired ID	(different from Item 2)
Item 2	Second most recent ID	(different from Item 3)
Item 3	Third most recent ID	(different from Item 4)
Item 4	Fourth most recent ID	

When the uniqueness filter is set to separation of one ID, the newly acquired ID is transmitted only if it is different from the first item. Separation of two IDs allows transmission if the new ID is different from Items 1 and 2 in the comparison

register. Separation of three and four IDs transmit the new ID provided it is different from the first three and the first four items, respectively.

Note: A new ID can fail the filter test and not be transmitted; however, it is stored in the comparison register for comparison if it differs from Item 1.

The following table illustrates the uniqueness filter (assuming the uniqueness time-out criteria has not been met). The "√" indicates that the ID passed the filtering test and was transmitted. The "-" indicates the ID was filtered out.

Reception Sequence	ID	Separation Criteria 1	2	3	4
1	D	√	√	√	√
2	A	√	√	√	√
3	D	√	-	-	-
4	B	√	√	√	√
5	C	√	√	√	√
6	A	√	√	√	-
7	C	√	-	-	-
8	B	√	√	√	-
9	A	√	√	-	-
10	D	√	√	√	√

The uniqueness test has a time limit imposed by the SET VARIABLE TIME-OUT (#44N) commands. Expiration of the time-out clock effectively erases the comparison register. In effect, the first ID which the reader acquires after the clock expires always appears to be new and is buffered and transmitted. Freshly acquired IDs are only tested against IDs that are registered after the clock expires. This time-out clock can also be reset with the #440 RESET UNIQUENESS command.

#411N SELECT UNIQUE ID CODE CRITERIA FOR RF CHANNEL 1

Directs the reader to select, buffer, and transmit ID codes processed by RF channel 1 according to the following test: an ID is buffered if, in the time interval since the new ID was last received, previously decoded IDs have changed value at least N+1 times or uniqueness time-out has been achieved. IDs that do not pass the test are lost. The factory setting is #4110 (N=0). See the #410N commands for further information concerning selection algorithms and examples.

Command	Output occurs only with
#4110	separation of 1 ID *(factory setting)*
#4111	separation of 2 IDs
#4112	separation of 3 IDs
#4113	separation of 4 IDs

#420N SELECT VALID ID CODE CRITERIA FOR RF CHANNEL 0

Directs the reader to validate an ID received from RF channel 0 only after it has been obtained a specified number of times in sequence. Values for N are 0 - F. The factory setting is one acquisition (N=0).

Identical Code Acquisitions

Command	Valid Code Frames
#4200	1 *(factory setting)*
#4201	2
#4202	3
#4203	4
#4204	5
#4205	6
#4206	7
#4207	8
#4208	9
#4209	10
#420A	11
#420B	12
#420C	13
#420D	14
#420E	15
#420F	16

The validation procedure is executed ***before*** the unique ID test (SELECT UNIQUE ID CODE CRITERIA [#410N] commands). IDs that do not pass the validation test are lost.

For example, command #420F specifies that the same ID must be obtained from the antenna/RF module 16 times in succession before it is considered for the uniqueness test.

This feature is useful in installations where RF reflections may cause a single tag to be read multiple times or where an occasional ID might be read from fringe areas.

Note: This command has been expanded to provide a larger selection of valid code frame options than was previously available with Version 2.4 Firmware.

#421N SELECT VALID ID CODE CRITERIA FOR RF CHANNEL 1

Directs the reader to validate an ID received from RF channel 1 only after it has been obtained a specified number of times in sequence. Values for N are 0 - F. The factory setting is one acquisition (N=0).

Identical Code Acquisitions

Command	Valid Code Frames
#4210	1 *(factory setting)*
#4211	2
#4212	3
#4213	4
#4214	5
#4215	6
#4216	7
#4217	8
#4218	9
#4219	10
#421A	11
#421B	12
#421C	13
#421D	14
#421E	15
#421F	16

This validation procedure is executed ***before*** the unique ID test (SELECT UNIQUE ID CODE CRITERIA [#410N] commands). IDs that do not pass the validation test are lost.

For example, command #421F specifies that the same ID must be obtained from the antenna/RF module 16 times in succession before it is considered for the uniqueness test.

This feature is useful in installations where RF reflections may cause a single tag to be read multiple times or where an occasional ID might be read from fringe areas.

Note: This command has been expanded to provide a larger selection of valid code frame options than was previously available with Version 2.4 Firmware.

#43 BUFFER ALL ID CODES

Buffers and transmits all acquired ID codes. This command ignores any uniqueness and validation criteria set by the SELECT UNIQUE ID CODE CRITERIA (#410N) and SELECT VALID ID CODE CRITERIA (#420N) commands. ***This command is used for diagnostic purposes only.***

#440 RESET UNIQUENESS

Causes the ID filtering process set by SELECT UNIQUE ID CODE CRITERIA (#410N) to restart. It is used in conjunction with the VARIABLE TIME-OUT (#44N) commands. This command applies to both RF channels.

This command provides a one time reset at which point the previously set time-out interval resumes.

#44N SET VARIABLE TIME-OUT

Places a time limit on the uniqueness criterion set by SELECT UNIQUE ID CODE CRITERIA (#410N). The parameter N sets the number of minutes on the time-out clock. The factory setting is two minutes (N=1). Each RF channel has an independent timer. These commands set the time-out period for *both* channels, i.e, both channels are set to 2, 20, or 60 minutes.

Command	Time-Out Clock	
#441	2 minutes	*(factory setting)*
#442	20 minutes	
#443	60 minutes	

Entering these commands effectively expires the time-out clock, thus erasing all current IDs in the comparison register. In effect, the first ID which is acquired after the clock expires always appears to be new and is stored. Freshly acquired IDs are only tested against IDs that are registered after the clock resets. The reader restarts the time-out clock for an RF channel when a new ID is buffered from that RF channel. For example, when a new ID is buffered from RF1, the time-out clock is reset for RF1, but does not affect the time-out clock for RF0.

Note: The time-out clock is continually reset (does not expire) as long as the reader receives the same tag ID. For example, assume that the time-out clock is set for 2 minutes and there is a railcar parked on a siding in front of the reader. Without this reset feature, the railcar's ID would be reported every 2 minutes (each time the time-out clock expired).

Command Group 5 Reader Status

Group 5 commands provide status reports on the parameters and operation of the reader. Because of this, each command has a different response. Reader response characters may be shown in brackets <>. This indicates that the response is a value in the range of numbers in the brackets. The brackets are not part of the response. For example, the DISPLAY READER ID NUMBER (#521) command responds with a hex value ranging between 00 and FF. In the command discussion, the response is shown as:

#RDID <00-FF>

If the reader ID number is (for example) 7, the ***actual*** response would be:

#RDID 07

All spaces shown in the response are actual spaces sent from the reader. In the example above, there is one space between the letter "D" and the "07".

Commands requesting status of the AUX-2 port return #Error if the AUX-2 port (i.e., the secondary microcontroller option) is not installed.

#505 DISPLAY PRIMARY MICROCONTROLLER FIRMWARE VERSION/OPTIONS

Displays the primary microcontroller firmware version number. The reader responds:

#Model AI1200 Ver X.XX SNYYYYY

where, X.XX is the firmware version number, and YYYYY is the serial number expressed in decimal digits (i.e., 0-9), with the first two digits representing the year. Refer to the firmware version number when contacting Amtech about the firmware.

#515 DISPLAY SECONDARY MICROCONTROLLER FIRMWARE VERSION/OPTIONS

Displays the secondary microcontroller firmware version number. The reader responds:

#Model AI1200 Ver X.XX

where, X.XX is the firmware version number. Refer to the firmware version number when contacting Amtech about the firmware. ***Note:*** The reader will return #Error if the second user option is not installed (i.e., no secondary microcontroller).

#520 DISPLAY POWER OUTAGE AND RESTORE BITS

Displays the value of the reader's power outage and restore bits.

The power outage bit value changes from 0 to 1 when power to the reader is interrupted. To reset the bit, use the RESET READER (#63) command or the RESET POWER OUTAGE BIT (#65). On initial power up, one of these two commands ***must*** be used to properly initialize this bit.

The restore bit indicates the status of the automatic restoration of EEPROM parameters (see command #8000).

The reader responds:

#PWRB P<0-1> R<0-1>

where,

- P0 power to reader has been maintained since last zeroing of this bit
- P1 power to reader was lost since last zeroing of this bit
- R0 automatic restoration of EEPROM parameters is disabled
- R1 automatic restoration of EEPROM parameters is enabled

#521 DISPLAY READER ID NUMBER

Displays the reader identification number. The reader responds:

#RDID <00-FF>

This value is hex from 00 to FF and is set by the SET READER ID NUMBER (#60N) command. This number is stored in non-volatile EEPROM, and is preserved across a power interruption.

#522 DISPLAY MAIN PORT COMMUNICATION PARAMETERS

Displays the parameters set for the MAIN and AUX-1 ports communications. Values correspond to those used to set the communication parameters through the CONFIGURE COMMUNICATION LINKS (#10NN) commands. The reader responds:

#MAIN B<0-6> S<0-1> P<0-2> D<0-F>

where, B is the baud rate; S is the stop bits; P is the parity; and D is the end-of-line delay. There is one space between each value. For example, if the reader has the factory settings, the display reads:

#MAIN B1 S0 P0 D0

This corresponds to a baud rate of 300, one stop bit, parity disabled, and no end-of-line delay.

#523 DISPLAY AUX-2 PORT COMMUNICATION PARAMETERS

Displays the parameters set for the AUX-2 port communications. Values correspond to those used to set the communication parameters through the CONFIGURE COMMUNICATION LINKS (#11NN) commands. The reader responds:

#AUX2 B<0-6> S<0-1> P<0-2> D<0-F>

where, B is the baud rate; S is the stop bits; P is the parity; and D is the end-of-line delay. There is one space between each of the values. For example, if the reader has the factory settings, the display reads:

#AUX2 B1 S0 P0 D0

This corresponds to a baud rate of 300, one stop bit, parity disabled, and no end-of-line delay.

Note: The reader responds with #Error if the optional AUX-2 port is not installed.

#524 DISPLAY APPENDED INFORMATION STATUS

Displays the information being appended to reader transmissions. The information can be a combination of time, date, and auxiliary information (reader identification number, antenna number, number of times the previous tag was read, and sensor input status). The reader responds:

#IDAP T<0-1> D<0-1> X<0-1>

where,

T0	time is not appended
T1	time is appended
D0	date is not appended
D1	date is appended
X0	auxiliary information is not appended
X1	auxiliary information appended

There is one space between each of the values. For example, if the reader has the factory settings, the display reads:

#IDAP T1 D1 X1

This corresponds to time, date, and auxiliary information appended.

Note: When time and date are appended, they are appended to ID codes, error messages, sensor input reports, and modem "connect" messages.

#525 ENQUIRE COMMUNICATION PROTOCOL STATUS

Displays the communication protocol status set by the #61N command. The reader responds:

#ECPS P<0-2> T<00-FF> X<0-2> S<0-5>

where

P0	basic protocol enabled *(factory default)*
P1	error correcting protocol enabled
P2	data enquire protocol enabled
T	ECP acknowledgement timeout
X0	disable flow control
X1	enable XON/XOFF flow control *(factory default)*
X2	enable hardware flow control
S0	<som> = # (23 hex) *(factory default)*
S1	<som> = ` (60 hex)
S2	<som> = { (7B hex)
S3	<som> = | (7C hex)
S4	<som> = } (7D hex)
S5	<som> = ~ (7E hex)

If the reader has factory settings, the response will be:

#ECPS P0 T03 X1 S0

This corresponds to basic protocol enabled, time-out set to 3 (≅150 ms), with XON/XOFF flow control enabled, and # as <som> character.

#526 DISPLAY I/O STATUS

Displays the I/O status. Indicates whether the output status modules are controlled externally through the OUTPUT CONTROL (#620N) commands or internally through the PREDEFINED OUTPUT CONTROL (#621) command. If the output modules are controlled externally, it displays the current energized or deenergized states. Where RF SYNCHRONIZATION MODE is enabled (#643), this command displays the output control algorithm for synchronization. This command also displays the condition of the four sensor input circuits. The final value displayed is the output pulse duration set by the SET OUTPUT PULSE DURATION (#67N) command. The reader responds:

#IOST C<0-2> O<0-F> I<0-F> D<0-F>

where,

C0 control is external (see #620N commands)
C1 control is internal (see #621 command)
C2 RF synchronization output control algorithm (see #643)

	output stat 0	output stat 1	output stat 2	output stat 3
O0	-	-	-	-
O1	X	-	-	-
O2	-	X	-	-
O3	X	X	-	-
O4	-	-	X	-
O5	X	-	X	-
O6	-	X	X	-
O7	X	X	X	-
O8	-	-	-	X
O9	X	-	-	X
OA	-	X	-	X
OB	X	X	-	X
OC	-	-	X	X
OD	X	-	X	X
OE	-	X	X	X
OF	X	X	X	X

where, 'X' = on; "-" = off

	input sense 0	input sense 1	input sense 2	input sense 3
I0	-	-	-	-
I1	X	-	-	-
I2	-	X	-	-
I3	X	X	-	-
I4	-	-	X	-
I5	X	-	X	-
I6	-	X	X	-
I7	X	X	X	-
I8	-	-	-	X
I9	X	-	-	X
IA	-	X	-	X
IB	X	X	-	X
IC	-	-	X	X
ID	X	-	X	X
IE	-	X	X	X
IF	X	X	X	X

where, "X" = on; "-" = off

D output pulse duration. The values for D correspond to the values entered through the SET OUTPUT PULSE DURATION (#67N) commands and range from 0 (4 milliseconds) to F (752 milliseconds).

#527 DISPLAY RF STATUS

Displays the current status of the RF modules. Shows if the RF modules are controlled through external host commands, sense input, or in dual channel multiplex mode; whether the RF modules are off or on; and the uniqueness time-out setting determined by the VARIABLE TIME-OUT (#44N) commands. The reader responds:

#RFST C<0-3> O<0-2> T<1-3>

where,

C0 external control
C1 proximity sensor control
C2 dual channel multiplex mode
C3 RF synchronization mode
O0 RF signals off
O1 RF 0 signal on, RF 1 signal off
O2 RF 1 signal on, RF 0 signal off
T1 variable time-out clock set to 2 minutes
T2 variable time-out clock set to 20 minutes
T3 variable time-out clock set to 60 minutes

For example, if the reader has the factory settings, it will respond with:

#RFST C2 O<1-2> T1

This corresponds to dual channel multiplex mode, and a uniqueness time-out period of two minutes. Depending upon which RF channel is active at the time, the O parameter will respond with "1" for RF channel 0 or "2" for RF channel 1.

#528 DISPLAY MODEM CONTROL STATUS

Displays the current modem control status as set by the #68N commands. The reader responds:

#MODM C<0-1> M<1> A<0-1> T<0-F> I<0-F> Q<0-F> R<0-4>

where,

C	modem control enabled (see command #6800 or #6801)
M	modem type (see command #681)
A	algorithm number (see command #682)
T	preset tag ID count (see command #683)
I	call interval (see command #684)
Q	inactivity (quiescent) period (see command #685)
R	redial interval (see command #686)

For example, if the reader has the factory settings, it will respond with:

#MODM C0 M1 A0 I6 T1 Q1 R4

This corresponds to modem control disabled, MultiTech 224E modem (type 1) selected, enable calls if all conditions are met, call interval of one hour, one tag ID acquired, no tags acquired for 2 minutes, redial interval of 15 minutes.

#529 DISPLAY PRESENCE STATUS

Displays the parameters set for presence detector status as defined by the #69N commands. The reader returns:

#PRST P<0-1> D<0-F> A<0-2> T<0-F> I<0-1>

where,

P0	sensor input reports disabled (see command #6900)
P1	sensor input reports enabled (see command #6901)
D	presence minimum true period (see command #691)
A0	RF off on time-out only (see command #6920)
A1	RF off on time-out or tag (see command #6921)
A2	RF off on time-out or presence conditions false (see command #6922)
T	presence control time-out (see command #693)
I0	sense input energized for "true" (see command #6940)
I1	sense input deenergized for "true" (see command #6941)

For example, if the reader has the factory settings, it will respond with:

#PRST P0 D6 A0 T6 I0

which corresponds to no reporting with presence detect but no tag acquisition, presence true period of 30 milliseconds, RF control off on time-out only, presence RF control time-out of 30 milliseconds, digital sense input module energized for "true" logic.

#530 DISPLAY FILTER PARAMETER STATUS FOR RF CHANNEL 0

Displays the parameters set for the RF "0" channel input. The reader responds:

#RF0S U<0-3> V<0-F>

where, U is the uniqueness filter criteria, and V is the valid ID code criteria. Values correspond to those used to set the uniqueness and valid ID code parameters through the SELECT UNIQUE ID CODE CRITERIA (#410N) and SELECT VALID ID CODE CRITERIA (#420N) commands. For example, if the reader is set to the factory values, the display would read:

#RF0S U0 V0

This corresponds to separation of one ID for uniqueness filtering, and obtaining an ID one time to consider it valid.

#531 DISPLAY FILTER PARAMETER STATUS FOR RF CHANNEL 1

Shows the parameters set for the RF "1" channel input. The reader responds:

#RF1S U<0-3> V<0-F>

where, U is the uniqueness filter criteria, and V is the valid ID code criteria. Values correspond to those used to set the uniqueness and valid ID code parameters through the SELECT UNIQUE ID CODE CRITERIA (#411N) and SELECT VALID ID CODE CRITERIA (#421N) commands. For example, if the reader is set to the factory values, the display would read:

#RF1S U0 V0

This corresponds to separation of one ID for uniqueness filtering, and obtaining an ID one time to consider it valid.

#540 PRIMARY MICROCONTROLLER CHECKSUM

Provides primary microcontroller program code checksum and includes both the primary microcontroller and external UVPROM program code. Used for diagnostic purposes and relates directly to the version of firmware installed in the reader. The reader responds:

#PCKS Ixxxx Exxxx

where, Ixxxx is the letter "I" followed by a four character ASCII hex checksum of internal microcontroller program code; and Exxxx is the letter "E" followed by a four character ASCII hex checksum of external UVPROM program code memory.

#541	RAM SIZE	Displays external RAM size. The reader responds: #RAMS N where, N is the amount of memory in units of 8K bytes. For example, if the reader has 32K bytes of memory, the response would be: #RAMS 4
#542	SECONDARY MICROCONTROLLER CHECKSUM	Provides secondary microcontroller program code checksum. Used for diagnostic purposes and relates directly to the version of firmware installed in the reader. The reader responds: #SCKS xxxx where, xxxx is a four character ASCII hex checksum of secondary microcontroller program code. Returns #Error if the optional secondary microcontroller is not installed.
#550	SYSTEM CHECK TAG CONTROL STATUS	Displays the control parameters for the system check tag. The reader responds: #SCTS M<0-3> T<0-F> where, M0 periodic test mode disabled M1 periodic test mode enabled - RF channel 0 M2 periodic test mode enabled - RF channel 1 M3 periodic test mode enabled - both RF channels T repetitive time interval (see #813N command)

#560 REQUEST SENSOR STATUS CHANGE STATUS

Displays the sensor status change feature status. The reader responds:

#SSTC E<0-1> M<0-F>

where,

E0 sensor status change status disabled
E1 sensor status change status enabled

M value of mask for inputs enabled

	input sense 0	input sense 1	input sense 2	input sense 3
M0	-	-	-	-
M1	X	-	-	-
M2	-	X	-	-
M3	X	X	-	-
M4	-	-	X	-
M5	X	-	X	-
M6	-	X	X	-
M7	X	X	X	-
M8	-	-	-	X
M9	X	-	-	X
MA	-	X	-	X
MB	X	X	-	X
MC	-	-	X	X
MD	X	-	X	X
ME	-	X	X	X
MF	X	X	X	X

where, "X" = on; "-" = off

#561 REQUEST RF SYNCHRONIZATION STATUS

Displays the RF synchronization feature status. The reader responds:

#RSYN E<0-1> P<0-F>

where,

E0 RF synchronization disabled
E1 RF synchronization enabled

P period interval (see #643 command)

Command Group 6 Reader Control Functions

Command Group 6 commands set reader control functions such as output pulse, RF control, and modem control. ***Unless otherwise indicated, Command Group 6 commands return #Done or #Error.***

#60N SET READER ID NUMBER

Assigns an ID number (N) to the reader. Values for N are hexadecimal entries of 00-FF. The factory value is N=00. This number can be displayed by using the DISPLAY READER ID (#521) command. As a factory setting, this number is appended to the output transmissions along with other auxiliary information (see APPEND AUXILIARY INFORMATION SELECTION (#31N) commands). The reader number is stored and is preserved in case of power outages.

#61N SELECT COMMUNICATION PROTOCOL

Selects between the communication protocol options. The values for N indicate the following:

#610	enable basic protocol *(factory setting)*
#611	enable error correcting protocol (a description of error correcting protocol is available on request)
#612yy**	set error correcting protocol timeout to yy
#613	enable data enquire protocol
#6140	disable flow control
#6141	enable XON/XOFF flow control *(factory setting)*
#6142	enable *hardware* flow control (The reader controls the RTS line and monitors the readiness of the modem (or similar external device) via the CTS line. When the CTS line goes "false," the reader will halt transmission within one character.

***Note:* Values for error correcting protocol (yy above) range from 00 to FF with 03 being the default. The timeout value in milliseconds is approximated by the following formula:

$$T\ (ms) = 50 * yy\ \ (+12\% - 0)$$

The timeout value applies to both transmission and receipt of serial data over the MAIN communication port. The timeout on transmission is initiated immediately following the transmission of the last character of a message (i.e., <eom>). The timeout on receive is initiated immediately after the <som> character is received. If yy = FF, then the timeout is disabled.

In data enquire mode, the reader transmits a single ID for each <ctrl-E> character received through the MAIN and AUX-1 ports. The reader does not echo the <ctrl-E> character. The reader also does not respond to <ctrl-E> unless the buffer contains IDs available for transmission to the host computer.

The ID buffer must be empty prior to changing communication protocol. Either allow the buffer to empty or issue #63 RESET READER command which empties the buffer.

Selectable <som> character. Version 2.6 firmware introduces the #615x series commands allowing selection of <som> (start-of-message) character. Status of these commands can be accessed through the #525 (Enquire Communication Protocol Status) command. Characters available are as follows:

#6150	Select <som> character	# (23 hex) *factory default*
#6151	Select <som> character	` (60 hex)
#6152	Select <som> character	{ (7B hex)
#6153	Select <som> character	| (7C hex)
#6153	Select <som> character	} (7D hex)
#6154	Select <som> character	~ (7E hex)

#620N OUTPUT CONTROL

Sets the reader's four output sensor circuits. These commands can be used by the host computer to operate external hardware such as gates or traffic lights. Command execution disables PREDEFINED OUTPUT CONTROL (#621). *Note:* These commands are stored only in volatile memory. After a power outage or reader reset, all status output modules return to their "off" positions. The commands are as follows:

	output stat 0	**output stat 1**	**output stat 2**	**output stat 3**
#6200	-	-	-	-
#6201	X	-	-	-
#6202	-	X	-	-
#6203	X	X	-	-
#6204	-	-	X	-
#6205	X	-	X	-
#6206	-	X	X	-
#6207	X	X	X	-
#6208	-	-	-	X
#6209	X	-	-	X
#620A	-	X	-	X
#620B	X	X	-	X
#620C	-	-	X	X
#620D	X	-	X	X
#620E	-	X	X	X
#620F	X	X	X	X

where, 'X' = on, '-' = off.

Note: This command will not execute if the system is in the RF Synchronization (#643) mode.

#621 PREDEFINED OUTPUT CONTROL
(factory setting)

As a factory setting, Output Stat0 is activated for a valid tag read on RF channel 0, Stat1 is activated for a valid tag read on RF channel 1, Stat2 is activated for search success, and Stat3 is activated for full buffer error. The Stat0, Stat1, and Stat2 are activated for the amount of time defined by the SET OUTPUT PULSE DURATION (#670) commands. To override these functions, use OUTPUT CONTROL (#620N) commands. Stat3 stays activated continuously as long as the output buffer is full.

Note: This command will not execute if the system is in the RF Synchronization (#643) mode.

#63 RESET READER

Performs a software reset of the reader. All settings return to the last programmed state prior to reset, except for the power outage bit which is reset to "0"and the status output modules are set to "off". Reader responds with sign-on message:

```
#Model AI1200 Ver X.XX SNYYYYY
#Copyright 1988 AMTECH Corp.
```

where, X.XX is the firmware version number and YYYYY the hardware serial number with the first two characters representing the year.

Warning: All buffered data is lost when this command is executed.

#640N RF CONTROL

Controls the RF channel selection. The N variable controls the RF power as follows:

Command	RF Power
#6400	Both RF channels off
#6401	RF channel 0 on, RF channel 1 off
#6402	RF channel 1 on, RF channel 0 off

Note: RF channels are never on simultaneously.

Also, see SET RF BY SENSOR (#641) command.

#641 SET RF BY SENSOR

RF channel control by sense input modules. Sense0 controls RF channel 0, Sense1 controls RF channel 1. RF is controlled according to the algorithm set under the Presence RF control selection determined by the SELECT PRESENCE RF CONTROL (#692N) commands.

#642 RF CONTROL IN TWO CHANNEL MULTIPLEX MODE *(factory setting)*

Places RF power in multiplex mode. This mode switches RF power continuously between the two RF channels. The two channel RF switching algorithm is based on an intelligent onboard RF detection circuit that determines if a tag is within the range of an antenna in much less time than it would take to acquire the full tag data frame.

#643N RF SYNCHRONIZATION CONTROL MODE

Enables and disables RF synchronization control mode and sets synchronization period.

Command	Time Period Interval
#6430	Feature Disabled
#6431	64 ms
#6432	72 ms
#6433	80 ms
#6434	88 ms
#6435	96 ms
#6436	112 ms
#6437	128 ms
#6438	144 ms
#6439	160 ms
#643A	192 ms
#643B	224 ms
#643C	256 ms
#643D	320 ms
#643E	384 ms
#643F	512 ms

Note: The specified time is the total interval. Each RF channel will be powered up for a duration equal to half the total time interval. Channel 0 is active during the first half of the interval and Channel 1 is active during the second half.

When RF Synchronization mode is invoked, an output algorithm specific to this control mode is active. Under this algorithm, the Opto-22 outputs and inputs are defined as follows:

Stat0	Good tag pulse for Channel 0
Stat1	Good tag pulse for Channel 1
Stat2	Used for global bus configuration
Stat3	Full Buffer indicator
Sense0	Presence sensor for Channel 0
Sense1	Presence sensor fro Channel 1
Sense2	Used for global bus configuration
Sense3	Available for the user

To connect readers together for the RF Synchronization mode, a power supply and 100,000 ohm resistor is needed. Stat2 (Opto module 2 on the rack) and Sense2 (Opto module 6 on the rack) are used.

The "negative" terminal of Stat2 (module 2) should be connected to the ground (–) line of the power supply. The "positive" terminal of Sense2 (module 6) should be connected to the positive (+) line of the power supply.

One end of the 100,000 ohm resistor should be connected to the positive (+) line of the power supply. The other side of the resistor should connect to two points which are (1) the "positive" terminal of Stat2 (module 2) and (2) the "negative" terminal of Sense2 (module 6).

Caution should be exercised when using the #67x command while operating in this #643x mode. If a long pulse period is specified by the #67x, relative to the period specified by the 643x command, IDs may be missed. As a general rule, specify pulse period (#67x) and RF synch interval (#643x) according to the following formula:

$$\text{Pulse time (ms)} < \left(\frac{\text{RF synch interval}}{2}\right) - 30\,\text{ms}$$

Also, when in this RF control mode, the commands #620x and #621 (which affect the definitions of the output modules) may not be executed.

The reader responds with:

'#Done ' or '#Error'

#65 RESET POWER OUTAGE BIT

Resets the power outage bit to zero. The bit changes from 0 to 1 when the power to the reader is restored. On reader power up, this command or RESET READER (#63) must be executed to properly initialize this bit. To display the status of the power outage bit use the DISPLAY POWER OUTAGE BIT (#520) command.

#66 INVOKE DIAGNOSTIC MODE

Invokes the reader diagnostic mode. This is intended for troubleshooting at the component level and, therefore, is intended for use by Amtech certified service personnel. ***Note:*** Any stored IDs are lost once the Diagnostic mode is entered. *All non-volatile parameters will be restored to their factory settings if either 'EEPROM' or 'Set Defaults' are selected.*

The reader returns the Diagnostic menu as follows:

- - Diag Menu - -	
0	RAM Chk
1	EEPROM
2	Inter-uC
3	I/O
4	RTC
5	RF Detect
6	Reserved
7	Reserved
8	Reserved
9	Reserved
A	Sniff
B	Mn RS
C	Aux RS
D	SW Reset
E	Setup RTC
F	Set Defaults
Select one...	

The user selects an option by entering a character 0-F and typing the <ENTER> key. The character is not echoed to the terminal until the <ENTER> key is typed.

where,

0 - RAM Chk — Performs a write/read verify of all external data memory (i.e., 32 K bytes standard or 64 K bytes optional). The 'RAM Chk' operates in a continuous mode until the <ENTER> key is typed. After checking all memory, the routine returns a '0' followed by the '+' character for a pass or the '-' character for fail.

1 - EEPROM — Performs write/read verify of all EEPROM non-volatile data memory (i.e., 1 K bit standard). Non-volatile parameters are returned to the factory settings upon exit from this menu selection. ***Note:*** The EEPROM is rated for 10,000 write cycles and, therefore, this command should be exercised with restraint. Each invocation of this command causes two write cycles.

2 - Inter-uC	Verifies inter-microcontroller communications (only applicable if the AUX-2 option is installed in the reader).
3 - I/O	Verifies all status inputs and outputs. I/O modules and loop back connector required on digital I/O backplane.
4 - RTC	Verifies real-time clock. ***Note:*** previous time and date setting are lost and should be reset with the SET TIME (#20) and SET DATE (#21) commands.
5 - RF Detect	Verifies RF detection circuitry used to detect the presence of a tag within the range of an antenna. ***Note:*** Tag must be placed within range of antenna 0.
A - Sniff	Detailed statistical summary of RF presence detect circuitry. Used to help diagnose problems in the event the RF Detect test fails.
B- Mn RS	Verifies MAIN RS-232 operation. ***Note:*** Requires Amtech RS-232 loop back connector.
C - Aux RS	Not implemented.
D - SW Reset	Exit Diagnostic Mode and perform software reset. This option returns to the operational mode of the reader. Factory settings will be in effect if "Set Defaults" or "EEPROM" had been previously invoked.
E - Setup RTC	Reconfigures the real-time clock to enable crystal oscillator trim at factory.
F - Set Defaults	Writes factory settings to EEPROM.

#67N SET OUTPUT PULSE DURATION

Sets the output pulse duration for the PREDEFINED OUTPUT CONTROL (#621) command. The factory setting is 4 milliseconds. The variable N has a value from 0 to F and ranges from 4 to 752 milliseconds (ms):

Command	Delay (ms)	
#670	4	*(factory setting)*
#671	8	
#672	12	
#673	16	
#674	20	
#675	24	
#676	32	
#677	40	
#678	48	
#679	60	
#67A	76	
#67B	152	
#67C	228	
#67D	300	
#67E	376	
#67F	752	

Note: The durations indicated apply to both minimum energized and deenergized periods. For example, the command #67F (752 milliseconds) provides a 0.752 second energized period ***and*** a 0.752 second deenergized period to the Stat Output Modules.

Additional IDs can be acquired during either the energized or deenergized period; however, the timing will be restarted upon each successive ID acquisition. This command should be used with discretion: when the tag acquisition interval is short compared to the programmed pulse period, distinct pulses may not be generated.

Note: This command was changed as part of Version 2.5 Firmware to allow the acquisition of new tag IDs during the output pulse interval.

#6800	DISABLE MODEM CONTROL *(factory setting)*	Disables modem control. This command must be invoked twice before modem control is actually disabled to ensure against accidental loss of modem control. ***Note:*** The first attempt to disable the modem returns #Error, and the second attempt returns #Done. The reader will not respond to DCD (data carrier detect). Once this command is invoked, it is possible to remotely connect to the reader. However, the reader does not assume responsibility for initializing the modem.
#6801	ENABLE MODEM CONTROL	Enables modem control. Each time modem control is enabled, the modem is initialized. This can be used by the host to force initialization of the modem. The modem is initialized to the "auto answer" mode and goes on-hook (i.e., disconnect). Devices (such as a terminal) can be connected directly to the MAIN port even while modem control is enabled. The reader behaves normally while in Command Mode (i.e., DCD is not sensed in Command Mode). In addition, the reader transmits tag IDs while in Data Mode provided DCD is held true (i.e., the reader believes that a host-initiated call is in progress). ***Note:*** The command sequence "#+++" is not a valid command, and the host computer should NOT send this to the reader. The reader determines that this is an invalid command and continues to dump tag IDs in the event that it was in Data mode. However, the modem on the host side will respond to it as an attention sequence and may subsequently terminate the connection. The reader will then continue to dump the tag IDs into a "bit bucket" (non-existent modem connection), losing all tag ID data "transmitted" after the termination of the connection.

#6811 SELECT MODEM TYPE

Selects modem type. This command selects the MultiTech MT224E modem, initializes the modem for optimum performance with the reader, and stores the initialized parameters in the modem. ***Note:*** The MultiTech MT224E modem attached to the reader must have firmware version 6.08 or later. The ISSUE COMMAND STRING TO MODEM (#6870) command will not work on earlier versions.

When the #6811 command executes, the reader initializes the attached MT224E modem with the following commands in the order listed.

Command	Effect
AT	Clear command buffer
AT&F&W	Set factory defaults and store
AT&E7	Modem passes through XON/XOFF
AT$BA0	Baud adjust off - speed convert on
AT&E2	Reliable (error correcting) mode
AT&E5	Modem initiated XON/XOFF enabled
AT&D3	Reset on loss of DTR
AT&I1	Hang up on 10 minute inactivity
AT&W	Store parameters

In addition, switch #1 of the modem's 8 position DIP switch in must be "up" to select external DTR control. All other conditions are met by factory default, and all other DIP switches remain in factory default setting. The configuration of the modem's 8 position modem DIP switch should be as follows:

Switch	Position
1,2,4,5,6,7	Up
3,8	Down

Set the host computer modem to match the reader modem settings, except it may not be necessary or desirable to set the DIP switch #1 to the up position.

The MT224E's power up baud rate is 2400. The user must initialize the reader to 2400 Baud (CONFIGURE MAIN AND AUX-1 PORTS BAUD RATE #1003 command) prior to modem control. The host computer should also be initialized to 2400 baud. If the quality of communications between the modems deteriorates, the effective baud rate may drop due to retransmissions.

#682N SELECT CALL CRITERIA ALGORITHM

Selects the algorithm for reader initiation of a call based on certain conditions. Values for N are as follows:

6820 Enable a call if ***all*** the following conditions are met *(factory setting)*:

a. Call interval exceeds the preset call interval. This interval is set by the SELECT MODEM CALL INTERVAL (#684N) commands. If the call interval is set to 0, this condition is always satisfied.

b. Inactivity period exceeds preset inactivity period. This period is set by the SELECT TAG INACTIVITY PERIOD (#685N) commands. If the inactivity period is set to 0, this condition is always satisfied.

c. The number of IDs buffered is equal to or greater than the preset number of IDs. This number is set by the SELECT MODEM PRESET IDS (#683N) commands. If the number is set to 0, this condition is always satisfied.

6821 Enable a call if ***any*** of the conditions are met:

a. Call interval exceeds the preset call interval. This interval is set by the SELECT MODEM CALL INTERVAL (#684N) commands. If the call interval is set to F, this condition is never satisfied.

b. Inactivity period exceeds preset inactivity period. This period is set by the SELECT TAG INACTIVITY PERIOD (#685N) commands. If the inactivity period is set to F, this condition is never satisfied.

c. The number of IDs buffered is equal to or greater than the preset number of IDs. This number is set by the SELECT MODEM PRESET IDS (#683N) commands. If the number is set to F, this condition is never satisfied. The exception to this condition is the 75% full condition described below.

Call request criteria are ***unconditionally*** met when the tag ID buffer reaches 75% of capacity. This ensures that tag ID acquisition may continue even under circumstances involving inappropriate algorithm selection or extremely high tag throughput.

When the reader modem establishes a connection, the following message is transmitted:

#Connect <&time date><%aux>

Before the reader breaks a connection, the following message is transmitted:

#Disconn <&time date><%aux>

Note: Time or time and date is appended to these messages if instructed by TIME ONLY APPENDED (#301) or TIME AND DATE APPENDED (#302) commands.

#683N SELECT MODEM PRESET NUMBER OF IDS

Sets the number of tag IDs to be buffered as part of the call criteria algorithm. When the number of buffered IDs equals or exceeds this value, this part of the criteria is "true". See SELECT CALL CRITERIA ALGORITHM (#682) command for further information. Values for N range from 0 (condition always satisfied) to F (condition never satisfied) and are as follows:

Command	Value	
#6830	≥ 0	*(always true)*
#6831	≥ 1	*(factory setting)*
#6832	≥2	
#6833	≥4	
#6834	≥8	
#6835	≥16	
#6836	≥ 32	
#6837	≥ 64	
#6838	≥ 128	
#6839	≥ 256	
#683A	≥ 512	
#683F	infinite	*(never true)*

#684N SELECT MODEM CALL INTERVAL

Sets the modem call interval as part of the call criteria algorithm. When the time interval since the last call meets or exceeds this value, this part of the criteria is "true". Values for N range from 0 (condition always satisfied) to F (condition never satisfied). The call interval is reset whenever the command is invoked or when a call transaction has been completed. The algorithms, based upon time interval, have an accuracy of 1% +30 seconds. See SELECT CALL CRITERIA ALGORITHM (#682) command for further information.

Command	Value	
#6840	≥ 0 minutes	*(always true)*
#6841	≥ 2 minutes	
#6842	≥ 4 minutes	
#6843	≥ 8 minutes	
#6844	≥ 15 minutes	
#6845	≥ 30 minutes	
#6846	≥ 1 hour	*(factory setting)*
#6847	≥ 2 hours	
#6848	≥ 4 hours	
#6849	≥ 8 hours	
#684A	≥ 12 hours	
#684B	≥ 24 hours	
#684C	≥ 36 hours	
#684D	≥ 48 hours	
#684E	≥ 72 hours	
#684F	infinite	*(never true)*

#685N SELECT TAG INACTIVITY PERIOD

Sets the tag inactivity period as part of the call criteria algorithm. When the period without tag acquisition meets or exceeds this value, this part of the criteria is "true". Values for N range from 0 (condition always true) to F (condition never satisfied). The inactivity period is reset each time an ID is acquired. The algorithms, based upon time interval, have an accuracy of 1% +30 seconds.

Command	Value	
#6850	≥ 0 minutes	*(always true)*
#6851	≥ 2 minutes	
#6852	≥ 4 minutes	
#6853	≥ 8 minutes	
#6854	≥ 15 minutes	
#6855	≥ 30 minutes	
#6856	≥ 1 hour	*(factory setting)*
#6857	≥ 2 hours	
#6858	≥ 4 hours	
#6859	≥ 8 hours	
#685A	≥ 12 hours	
#685B	≥ 24 hours	
#685C	≥ 36 hours	
#685D	≥ 48 hours	
#685E	≥ 72 hours	
#685F	infinite	*(never true)*

See SELECT CALL CRITERIA ALGORITHM (#682) command for further information.

#686N SELECT MODEM REDIAL INTERVAL

Selects the redial interval used to determine the interval between attempts to establish a call once the call criteria have been met. If a connection is broken during the middle of a transmission, the redial interval is used to determine the period of time before the next attempt to reestablish the connection. Values for N range from 0 (continuous) to 4 (every 15 minutes). The algorithms, based upon time interval, have an accuracy of 1% +30 seconds.

Command	Value	
#6860	0 minutes	*(continuous)*
#6861	2 minutes	
#6862	4 minutes	
#6863	8 minutes	
#6864	15 minutes	*(factory setting)*

#6870 ISSUE COMMAND STRING TO MODEM

This command issues a string of up to 27 characters from the reader to the modem. Multiple invocations of this command are allowed. This command includes a modem-specific header and trailer which automatically switches the modem to Command Mode prior to issuing the string and then switches the modem on line after the command string is issued.

Inappropriate commands could force a disconnect. If this occurs, the reader reinitializes the modem to a predetermined auto answer configuration.

The command format is as follows:

#6870<str>

where,

<str>	ASCII string representing modem command which the reader issues to the modem
,	causes a 1 second delay if it appears in <str>

The reader returns '+++#**Done** ' or '**Error**'.

As an example, to issue the command to store a telephone number,

#6870ATDT1234567N0

where,

#6870	is the reader command
AT	is the modem "attention" code
DT	is the modem "tone dial" code
1234567	is a seven-digit phone number
N0	is the modem command to store the phone number in position "0"

#6900 DISABLE SENSOR INPUT REPORTS *(factory setting)*

Turns off reporting when presence true conditions are satisfied, but no tag acquisition occurs. (See #6901 ENABLE SENSOR INPUT REPORTS command for more information.)

#6901 ENABLE SENSOR INPUT REPORTS

Issues a report when sensor input presence 'true' condition are satisfied, but tag ID acquisition does not occur. This command issues a report when presence detectors indicate passage of a vehicle, but there was no tag ID received. This command is useful for reporting the passage of untagged vehicles. The format of the report is as follows:

#SENSOR INPUT REPORT <&time date><%aux>

where,

<&time date> is optionally appended time or time and date

<%aux> is optionally appended auxiliary information

There is one space between SENSOR INPUT REPORT and any optionally appended information. Optionally appended information is controlled through the Group 3 commands.

#691N SET MINIMUM PRESENCE TRUE PERIOD

Sets the presence sensor minimum 'true' time. Values for N range from 0 (0 ms, always true) to F (infinite, never true). This variable determines the minimum amount of time an object must be continuously detected (presence true period) in order to be considered a valid presence.

Command	True Period (ms)	
#6910	0	*(always true)*
#6911	4	
#6912	8	
#6913	12	
#6914	20	
#6915	24	
#6916	32	*(factory setting)*
#6917	48	
#6918	60	
#6919	92	
#691A	152	
#691B	300	
#691C	452	
#691D	600	
#691E	752	
#691F	infinite	*(never true)*

Note: The presence signal is debounced for 12 ms prior to applying the 'true' criteria. An additional 12 ms debounce period is applied to the presence signal transition to "no presence".

#692N SELECT PRESENCE RF CONTROL ALGORITHM

Selects the algorithm for turning RF power off when the RF power is controlled by sense input modules (#641 SET RF BY SENSOR). The factory setting (#6920) turns off RF power based on the time-out established by the #693N commands. The #6921 command allows turning off RF power either after the time-out period, or the acquisition of a tag ID, whichever occurs first. The #6922 command turns off RF power either after the time-out period, or when the sense input modules indicate the vehicle has passed, which ever occurs first. The values for N select as follows:

Command	RF Power Off
#6920	on time-out only *(factory setting)*
#6921	time-out 'OR' tag ID acquired
#6922	time-out 'OR' presence false

#693N SELECT PRESENCE RF CONTROL TIME-OUT PERIOD

Sets the time-out period used for the #692N Presence Control Algorithm. Values for N range from 0 (always expired) to F (never expired).

Command	Time-out (ms)	
#6930	0	*(always expired)*
#6931	4	
#6932	8	
#6933	12	
#6934	20	
#6935	24	
#6936	32	*(factory setting)*
#6937	48	
#6938	60	
#6939	92	
#693A	152	
#693B	300	
#693C	452	
#693D	600	
#693E	752	
#693F	infinite	*(never expires)*

#694N SELECT SENSE INPUT INVERSION

Selects either energized or deenergized digital I/O modules for the logic true algorithm. This feature allows greater flexibility in the attachment of external equipment to the reader sense inputs. For example, some proximity sensors indicate presence with a voltage drop. In this instance, command #6941 ***deenergize*** for logic true, would be utilized. All four inputs are configured by this command. The value for N selects as follows:

Command	Option
#6940	energized digital I/O modules for logic true *(factory setting)*
#6941	deenergized digital I/O modules for logic true (inverted logic)

Command Group 7
Search Control Functions

Group 7 commands control the reader's optional **Search functions**. Search mode is also supported from the optional AUX-2 port. The Search mode through the AUX-2 port is menu driven.

#70 DISABLE SEARCH MODE
(factory setting)

Disables search capability enabled by Command #71.
Returns: '#Done ' or '#Error'

#71 ENABLE SEARCH MODE

Directs the reader to begin the examination of all incoming IDs for a possible match with IDs in a user-entered list. This list is entered using ADD ENTRY TO SEARCH LIST (#730) command, and can contain up to 16 entries. When a match occurs, the reader issues the message:

*** Matched <ID>

where <ID> is the tag ID (up to 20 characters). ***Note:*** the brackets are not part of the response.

Returns: '#Done ' or '#Error'

#720N INSPECT SEARCH LIST

Displays the Nth entry in the list of IDs to be searched. The value N is a four-digit hexadecimal entry from 0000 to 000F. The reader will respond with the value N, followed by the ID code in the list. If the entry has been previously matched with an acquired ID, through the search capability, the number will have *** appended to it. For example, to inspect the twelfth ID in the list, issue the following command:

#720000B <ENTER>

The reader responds with:

#000B<ID> or #000B<ID>***

where <ID>is the ID code (up to 20 characters) in the list, and *** indicates the ID has been matched through the search capability. *Note:* the brackets are not part of the response.

Care must be taken to enter the correct value of N. Alphabetic characters must be uppercase. The commands are as follows:

Command	To Inspect
#7200000	First List Entry
#7200001	Second List Entry
#7200002	Third List Entry
•	•
•	•
•	•
#7200009	Tenth List Entry
#720000A	Eleventh List Entry
#720000B	Twelfth List Entry
#720000C	Thirteenth List Entry
#720000D	Fourteenth List Entry
#720000E	Fifteenth List Entry
#720000F	Sixteenth List Entry

#7300N ADD ENTRY TO SEARCH LIST

Allows user to add one ID number to the list of IDs to be searched. The list can contain up to 16 entries. The new entry will be placed in the first available opening in the list. The ID number can contain up to 20 alphanumeric characters. The command format is as follows:

#7300<ID>

where ID is the ID to add to the list. There should be no spaces between the command and the ID. ***Note:*** brackets should not be entered.

An error message will result if the ID entered contains more than 20 characters.

An error message will also occur if the list already has 16 entries. If this occurs, remove one of the existing entries with the DELETE SEARCH LIST ENTRY (#731) commands.

Returns '#Done ' or 'Error'.

#731N DELETE SEARCH LIST ENTRY

Removes the Nth entry from the list of IDs to be searched. Here, N is a four-digit hexadecimal number, 0000 through 000F. Removing an ID leaves the remaining IDs intact. For example, to remove the twelfth ID in the list, issue the following command:

#731000B <ENTER>

Care must be taken to enter the correct value of N. The commands are as follows:

Command	To Delete
#7200000	First List Entry
#7200001	Second List Entry
#7200002	Third List Entry
•	•
•	•
•	•
#7200009	Tenth List Entry
#720000A	Eleventh List Entry
#720000B	Twelfth List Entry
#720000C	Thirteenth List Entry
#720000D	Fourteenth List Entry
#720000E	Fifteenth List Entry
#720000F	Sixteenth List Entry

#732 DELETE ENTIRE SEARCH LIST

Erases all entries from the list of IDs to be searched. Returns '#Done ' or 'Error'.

Command Group 8 Auxiliary Reader Control

Group 8 commands provide control over the reader functions such as the system check tag. These commands control writing parameters to and restoring parameters from the EEPROM.

All Group 8 commands return #Done or "Error.

#8000	DISABLE AUTOMATIC RESTORATION OF EEPROM PARAMETERS	This command disables the automatic restoration of parameters as they are stored in the EEPROM. See command #8001 and #801 for further information.
#8001	ENABLE AUTOMATIC RESTORATION OF EEPROM PARAMETERS *(factory setting)*	When this feature is enabled, one parameter from EEPROM is restored to volatile memory every 2 minutes. ***Note: If either the #8000 or the #8001 are issued, then the #801 should be issued to save them to the EEPROM. Otherwise it is possible for the value to revert to the previous setting through the automatic restoration feature.***
#801	SAVE PARAMETERS TO EEPROM	This command writes current parameters to the EEPROM. It must be remembered that when volatile memory parameters are changed, they are not automatically saved to the EEPROM. It is therefore desirable to issue this command following changes to the reader configuration if those changes are to survive a power outage or to prevent automatic restoration of the previous values (see #8001 command).
#802	RESTORE ALL PARAMETERS FROM EEPROM	Restores reader configuration parameters as they were last saved to the EEPROM.
#810	DISABLE THE SYSTEM CHECK TAG PERIODIC MODE *(factory setting)*	This command disables the period operation of the system check tag enabled by the #812 command.

#811N PERFORM SYSTEM CHECK TAG TESTS

Performs system check tag tests as needed. This command may be executed either in Data or Command Mode. The system check tag(s) will emit a single ID from which will be acquired and stored by the reader in the normal manner. The system check tag read by RF channel 0 must have address 0 and the system check tag read by RF channel 1 must have address 1. The check tag tests are performed as follows:

Command	Test
#8110	Invoke RF channel 0 check tag
#8111	Invoke RF channel 1 check tag
#8112	Invoke both RF channel check tags

Note: This command disables the #812 ENABLE PERIODIC SYSTEM CHECK TAG MODE.

#812N ENABLE PERIODIC SYSTEM CHECK TAG TEST MODE

When this feature is enabled, a system check tag test is performed on the specified channel(s) at the time intervals specified by #813 command. These tests will continue until the #810 or either #811N command is issued. The variable N specifies the affected RF channel as follows:

Command	Test
#8120	Enable RF channel 0 periodic testing
#8121	Enable RF channel 1 periodic testing
#8122	Enable both RF channels' periodic testing

#813N SET PERIODIC CHECK TAG TESTING TIME INTERVAL

This command sets the time interval for the periodic system check tag test enabled by the #812N commands. The variable N has a value of 0 (30 seconds) to F (infinite - never true) and is set as follows:

Command	Value	
#8130	30 seconds	*(factory setting)*
#8131	2 minutes	
#8132	4 minutes	
#8133	8 minutes	
#8134	15 minutes	
#8135	30 minutes	
#8136	1 hour	
#8137	2 hours	
#8138	4 hours	
#8139	8 hours	
#813A	12 hours	
#813B	24 hours	
#813C	36 hours	
#813D	48 hours	
#813E	72 hours	
#813F	infinite	*(never true)*

#8142X SELECT SYSTEM CHECK TAG SIGNATURE CHARACTER

This command sets the "signature" character to be stored in the system check tag. The value X can be any Amtech 6-bit character. The signature character is stored in the first twelve locations of the system check tag ID code frame. (The following six locations are reserved; the 19th position identifies the system check tag address; and the last (20th) location is a frame counter used to override the reader's filtering capabilities.

Note: All check tags connected to the AUXIO0 channel receive this command and will change their signatures.

#8150 SET SYSTEM CHECK TAG ADDRESS TO 0

This command sets the system check tag's address to 0. All system check tags connected to the AUXIO0 line will set their address to 0. Therefore, the system check tag read by RF channel 1 should be disconnected prior to invocation of this command.

Note: Command #8150 is included to maintain backwards compatibility with all Amtech products and may not be effective in some system installations.

#8151 SET SYSTEM CHECK TAG ADDRESS TO 1

This command sets the system check tag's address to 1. All system check tags connected to the AUXIO0 line will set their address to 1. Therefore, the system check tag read by RF channel 0 should be disconnected prior to invocation of this command.

Note: Command #8151 is included to maintain backwards compatibility with all Amtech products and may not be effective in some system installations.

#82X SET SENSOR STATUS CHANGE MODE

This command selects the sense input lines to be monitored for status change. Selected sense inputs' status is displayed using command #560. The following commands are used to enable selected sense input lines:

Command	Enable Mask (Sense Input Selections)
#820	All disabled (feature disabled)
#821	Sense0
#822	Sense1
#823	Sense1, Sense0
#824	Sense2
#825	Sense2, Sense0
#826	Sense2, Sense1
#827	Sense2, Sense1, Sense0
#828	Sense3
#829	Sense3, Sense0
#82A	Sense3, Sense1
#82B	Sense3, Sense1, Sense0
#82C	Sense3, Sense2
#82D	Sense3, Sense2, Sense0
#82E	Sense3, Sense2, Sense1
#82F	Sense3, Sense2, Sense1, Sense0

The reader responds with:

'#Done ' or '#Error'

Note: The enabled sense input lines are monitored for any changes in their logic states. If a change is detected, a STATUS SENSOR CHANGE message is generated and treated as a tag ID. If the auxiliary information option is enabled, the sensor input status field will display the current debounced input values.

Error Messages

The reader can issue any of the following error messages to the host computer. Error messages can be sent in either Data Mode or Command Mode. Carriage return and line-feed are at the end of each error message. See the Reader Transmission Format section later in this chapter for further information on error message formats.

#Error 01. Random Access Memory (RAM) error occurred on power up or after the reader was reset. This indicates an equipment malfunction. The system halts on this error. Contact Amtech. *Note*: Time and date cannot be appended to this error message.

#Error 02. The output buffer is full and newly acquired IDs cannot be stored. This condition usually occurs when the reading of IDs takes place faster than their subsequent transmission to the host computer. It also occurs when the host issues an XOFF command for an excessively long period of time. Another cause is if the reader is left in Command Mode instead of being reset to Data Mode, preventing the reader from transmitting buffered IDs.

#Error 03. The buffer has been partially cleared and new IDs are once again being stored. This appears when the Error 02 condition is corrected.

#Error 04. The output buffer has filled to 75% full.

#Error 05. The output buffer has emptied to 50% full.

Note: Once Error 04 is given, it will not be given again until Error 05 is given. That is, once the buffer is 75% full, you will not receive this error message again until the buffer empties to 50% (producing Error 05) and then refills to 75% full.

Error 05 is only issued after Error 04. That is, once the buffer fills to 75% full (producing Error 04), then empties to 50%, Error 05 is issued. Error 05 will not be issued again until the buffer fills again to 75% full (producing Error 04) and empties to 50%.

#Error 06. EEPROM write error condition. Indicates that data could not be written to an EEPROM location. It implies that the EEPROM may have reached the maximum 10,000 write cycles. Contact Amtech.

Commands listed under the factory settings section involve writes to the EEPROM. As an example, a host computer issues command #6400 followed by the #6401 to alternately turn RF off and then on to RF channel 0. This sequence causes two writes to the EEPROM. If the host performs this sequence once every 12 hours, the EEPROM will reach the write limit in approximately 7 years.

#Error 07. Inter-micro timeout condition. Indicates that the secondary microcontroller has not responded within the allocated time. This condition is signalled because during initialization the secondary microcontroller responded to the startup messages, but it is not presently responding to messages.

#Error 08. Loss of RF synchronization pulse condition. Occurs when a reader is in the RF Synchronization (#643x) mode. This condition indicates that a reader is not receiving synchronization pulses.

This message will be issued every 5 seconds unless: (1) the reader receives synchronization pulses; or (2) the reader is taken out of RF Synchronization mode.

Reader Transmission Formats

The reader transmits the following information to the host computer:

- Tag ID codes,
- Error messages,
- Sensor input reports,
- Sign-on message, and
- Modem connect or disconnect messages.

Tag ID codes, error messages, sensor input reports, and modem connect/disconnect messages can have optional information appended to them. This information is appended through the Group 3 commands. Whenever time or time and date are appended, they apply equally to tag ID codes, error messages, sensor input reports, and modem connection messages. Auxiliary information can be appended to tag ID codes and sensor input reports, but not to error reports or modem messages. For further information see the Group 3 commands earlier in this chapter.

ID Code Only

The ID code is transmitted as a "#" sign followed by 20 characters. Spaces are legitimate characters, and if the ID code is not 20 characters long, spaces are appended to the ID code to make 20 characters. For example:

```
#12345678901234567890
#ABC 12347655 TARE
```

To transmit IDs with no appended information, enter both #300 and #310 commands.

Error Message Only

Error messages are in the format of the "#", the word "Error" and a two-digit error code. For example:

```
#Error02
#Error03
```

To transmit the error code only, enter the #300 command. This command removes the time and date.

Sensor Input Reports Only

Sensor input reports are in the format of the "#", the words "SENSOR INPUT REPORT", and a space. There are 21 characters total, including the "#" character.

Note: Sensor input reports are not automatic, but must be requested through the #6901 SENSOR INPUT REPORTS ENABLED command.

Sign-on Message

The sign-on message is in the following format:

```
#Model AI1200 Ver X.X SNYYYYY
#Copyright 1988  AMTECH Corp.
```

The sign-on message never contains any appended information.

Time Only Appended

Time can be appended to ID codes, error messages (except Error 01), sensor input reports, and modem connect/disconnect messages. The format of the transmission is as follows:

```
#<string>&HH:MM:SS.hh
```

where, <string> is the ID code, error message, or sensor input report. HH:MM:SS.hh represent hours, minutes, seconds, and hundredths of seconds, respectively. Colons (:) separate hours, minutes, and seconds; a period (.) separates hundredths of seconds. The "&" character provides a means for the host computer to determine if time is appended to the string. ***Note:*** hundredths of seconds are not appended to error messages.

Time and Date Appended

Time and date can be appended to ID codes, error messages (except Error 01), sensor input reports, and modem connect/disconnect messages. The format of the transmission is as follows:

```
#<string>&HH:MM:SS.hh MM/DD/YY
```

The format is exactly like 'time only appended' described above, except that two spaces and the date follow the time. MM, DD, and YY represent the month, day, and two-digit year, respectively. The forward slash (/) separates the month, day and year entries. ***Note:*** hundredths of seconds are not appended to error messages.

Auxiliary Information Only Appended

Auxiliary information can be appended to ID codes and sensor input reports. Auxiliary information is never appended to error or modem messages. Auxiliary information consists of reader number, antenna number, number of reads of previous tag, and sensor input status. The format is as follows:

```
#<string>%XX-Y-ZZ-Q
```

where, <string> is the ID code or sensor input report. XX represents the reader number in hex from 00 to FF; Y represents the antenna number (0 or 1 for antenna, M for manual ID entry, S for sensor input report); ZZ is the number of reads of the previous tag in hex from 00 to FF; and Q represents the sensor input status in hex from 0 to F. The "%" character provides a means for the host computer to determine if auxiliary information is appended to the string. The "-" separate the values of the auxiliary information.

Time and Auxiliary Information Appended

Time and auxiliary information can be appended to ID codes and sensor input reports. The format is as follows:

```
#<string>&HH:MM:SS.hh%XX-Y-ZZ-Q
```

The time and auxiliary information follow the formats described above.

Time, Date, and Auxiliary Information Appended

Time, date, and auxiliary information can be appended to ID codes and sensor input reports. This is the factory setting of the reader. The format is as follows:

```
#<string>&HH:MM:SS.hh MM/DD/YY%XX-Y-ZZ-Q
```

The time, date, and auxiliary information follow the formats described above.

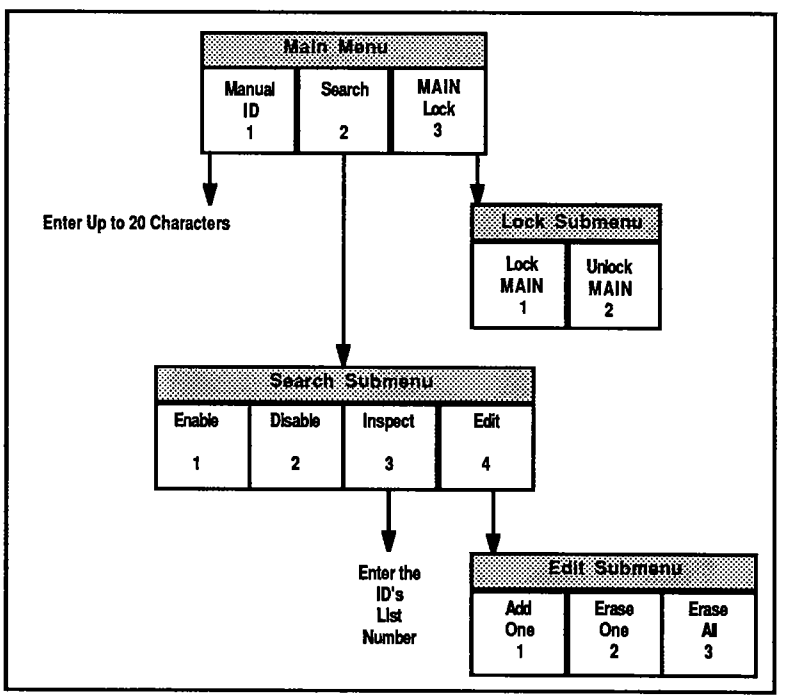
AUX-2 Port Functions

The optional AUX-2 port permits local terminal functions to be performed with the AI 1200. These include ***manually entering ID codes*** for untagged equipment or vehicles and performing ***search functions.***

Manually entering IDs is ideally suited for situations such as entrance/exit gates at terminal yards where both tagged and untagged vehicles pass. Manually entering the identification codes for untagged vehicles lets the reader process these codes just as if they were acquired by the RF channel.

Search functions permit the user to define a list of IDs for which to search. This capability is very useful, for example, with mobile inventory vehicles which search a terminal yard for a particular chassis or trailer. It is also useful at terminal yards for notification of when a particular vehicle enters or exits the yard. Search functions can also be performed through commands entered through the MAIN communication port (using the host computer).

Unlike commands given through the MAIN port, AUX-2 provides a menu. The figure below shows the basic structure of the AUX-2 menu commands. The *text* listed under each menu are the options for that menu. The *numbers* in the text are the responses to select those options. For example, on the main menu, the user selects "Manual ID" entry by typing "1". *Arrows* on the diagram indicate the next level of prompt. For example, if the user selects manual ID entry by typing "1", the next prompt is for the ID code, up to 20 characters. If the user selects the "Search" option ("2") from the main menu, the next prompts come from the search sub-menu.



"Busy" Message

Any command issued from the secondary microcontroller (AUX-2 port) may receive the "BUSY...RE-ENTER DATA" message. This message signifies that the primary microcontroller was busy and neither received nor executed the command.

Hardware Requirements

This discussion assumes that the AUX-2 option was purchased and is installed in the AI1200 reader. It also assumes that the terminal connections have been made to the reader during system installation. AUX-2 connections are made using terminals 29 through 35 on the AI1200 backplane. All connections made to the reader require entrance through the reader's NEMA enclosure. To properly secure the NEMA box, all connections should be made during system installation and/or by Amtech certified personnel.

The AUX-2 port is a standard RS-232 DTE serial port.

Communication Port Parameters

Factory settings of the AUX-2 communications parameters are as follows:

Number of data bits:	8
Parity:	Disabled
Number of stop bits:	1
Baud rate:	300

These parameters can be changed using commands #110N through #113N. These commands must be issued through the host computer or a terminal connected to the MAIN port.

Obtaining the Main Menu

The following conditions must be met to obtain the main menu:

1. Proper terminal connection to the reader (as described above);
2. Proper communication parameters set for the terminal/reader connection (as described above);
3. Power to the reader must be on; and
4. Power to the terminal must be on.

If the main menu does not appear, type the RETURN or ENTER key twice.

The main menu looks like this:

```
1>Man ID          2>Search
3>Main Lk                    Select?=>
```

The options on the main menu are:

1. Man ID - Manual entry of ID codes.
2. Search - Search functions.
3. Main Lk - Lock out the MAIN port.

Information is sent to the reader by typing the necessary information (such as a menu selection or an ID code) and typing the RETURN or ENTER key. If the information is processed correctly, the reader responds:

```
Read response, and type ENTER...
Done
```

If the information is not processed correctly, the reader responds:

```
Read response, and type ENTER...
Error
```

Type the RETURN or ENTER key after the reader responds.

It is suggested that the CAPS LOCK key be depressed. ***All alphabetic characters must be entered as uppercase.***

Lock out the MAIN Port

Locking the MAIN port insures control of the reader by the terminal attached to the AUX-2 port. This is done by selecting Choice 3 (Main Lk) on the main menu. The following submenu appears:

```
1>Lock Main
2>Unlock Main                    Select?=>
```

Enter Choice 1 (Lock Main). Then type the ENTER key to return to the main menu.

Locking the MAIN port prevents commands or other messages transmitted via this port from interfering with the reader while the AUX-2 port is active. The MAIN port can only be unlocked by reversing the above procedure, or the UNLOCK MAIN PORT (#03) command issued through the MAIN port.

Unlock the MAIN port

Unlocking the MAIN port returns the reader to normal operations controlled by the host computer. When the main menu appears on the screen, enter Choice 3 (Main Lk). The following submenu appears:

```
1>Lock Main
2>Unlock Main                    Select?=>
```

Enter Choice 2 (Unlock Main). Then type the ENTER key to return to the main menu.

Manually Entering ID Codes

Manual entry of ID codes is a three-step process as follows:

- Lock out the MAIN port to prevent commands or communications from the host computer from interfering with the manual entry.
- Manually enter the IDs.
- Unlock the MAIN port so normal operations can resume.

Lock out the MAIN Port

Lock out the MAIN port as described earlier in this section. When the reader responds with "Done", type the RETURN or ENTER key to return to the main menu.

Manually Enter the IDs

When the main menu appears on the screen:

```
1>Man ID          2>Search
3>Main Lk                    Select?=>
```

Enter Choice 1 (Man ID). This entry will display the following message:

```
Enter up to 20 Characters.
New ID: >
```

Type in the ID from the untagged object, followed by the ENTER key. The system automatically returns to the main menu after the ID is entered. An attempt to enter more than 20 characters results in an error message. Typing the ENTER key clears the error message and returns the "New ID" prompt.

To return to the main menu without entering an ID, type the ESC (escape) key.

A successful entry results in the ID being processed by the reader just as if it had been received through RF channel, except that ID filtering is bypassed. If auxiliary information has been appended to ID codes, the antenna number will indicate the letter "M" for manual entry.

Unlock the MAIN Port

Unlock the MAIN port as described earlier in this section. When the reader responds with "Done", type the RETURN or ENTER key to return to the main menu.

Search Function

The search function enables the user to locate specific IDs from among those newly acquired. The procedure is useful in locating equipment (in a terminal yard, for example).

When the search function is enabled in the reader, the reader compares every newly acquired ID with a set of user defined IDs. When a match occurs, the reader alerts the user with a bell, issues a message that a match has been made, and appends a special character to the matched ID in the search list. The search list can contain up to 16 entries.

The search function is a four step process:

- Lock out the MAIN port to prevent commands or communications from the host computer from interfering with the manual entry.
- Enter and, if necessary edit, the search list of IDs.
- Enable the search function.
- Unlock the MAIN port so normal operations can resume.

Lock out the MAIN Port

Lock out the MAIN port as described earlier in this section. When the reader responds with "Done", type the RETURN or ENTER key to return to the main menu.

Enter and Edit ID List

When the main menu appears on the screen:

```
1>Man ID          2>Search
3>Main Lk                    Select?=>
```

Enter choice 2 (Search). This entry will display the following submenu:

```
1>Enable          2>Disable
3>Inspect         4>Edit     Select?=>
```

Enter choice 4 (Edit). This entry will display the following submenu:

```
1>Add One         2>Erase One
3>Erase All                  Select?=>
```

To add IDs to the list, enter choice 1 (Add One). The following prompt will appear:

```
Enter up to 20 Characters.
New ID: >
```

Enter the tag ID, up to 20 characters, and type the RETURN or ENTER key. The reader will respond:

```
Read response, and type ENTER...
Done
```

Type the RETURN or ENTER KEY. The reader will prompt for the next New ID. Continue entering IDs following the above procedure. To return to the main menu without entering an ID, type the ESC (escape) key.

Up to 16 IDs can be added to the list. The list entries are numbered from 0 through F. IDs will be added to the first available place in the list.

Editing the ID list consists of removing and reentering the IDs in the list. To **remove (or erase) an ID** from the list, enter choice 2 (Erase One). The following prompt will appear:

```
Enter IDs list number.
Entry: (0-9, A-F)     >
```

Enter the appropriate ID's list number. The reader will respond:

```
Read response, and type ENTER...
Done
```

Erasing all IDs in the list is accomplished by entering choice 3 (Erase All). This clears the list of all existing IDs.

Enabling the Search Function

Enabling the search function starts the process of comparing newly acquired tag IDs with the list. The search function is enabled at the main menu. Enter choice 2 (Search), which brings up the Search submenu:

```
1>Enable          2>Disable
3>Inspect         4>Edit          Select?=>
```

Select choice 1 (Enable).

When an ID on the list is matched with a newly acquired ID, messages appear both on the AUX-2 port terminal and the MAIN port terminal. The message on the AUX-2 terminal will read:

```
Read response, and type ENTER...
***Matched <ID>
```

In this example, <ID> represents the matched ID.

The message on the MAIN port terminal will read:

```
#<ID><&time date><%aux>
#*** Matched <ID>
```

In this example, <ID> represents the matched ID; <time date> and <aux> represent optionally appended information.

Note: Only the first occurrence of a match is signalled.

Inspecting the ID List

From the main menu, enter choice 2 (Search), which brings up the Search submenu:

```
1>Enable          2>Disable
3>Inspect         4>Edit          Select?=>
```

Select choice 3 (Inspect). The reader displays the following prompt:

```
Enter IDs list number.
Entry: (0-9, A-F)    >
```

To inspect a single ID, enter the list number from 0-F. The reader will respond with the tag ID number. Return to the main menu by typing the ESC key.

To scroll through the ID list, enter the beginning ID list number (such as 0). Then type the RETURN or ENTER key twice after each reader response.

Disabling the Search Function

Disabling the search function ends the process of comparing newly acquired tag IDs with the list. The search function is disabled at the main menu. Enter choice 2 (Search), which brings up the Search submenu:

```
1>Enable          2>Disable
3>Inspect         4>Edit          Select?=>
```

Select choice 2 (Disable).

Unlock the MAIN Port

Unlock the MAIN port as described earlier in this section. When the reader responds with "Done", type the RETURN or ENTER key to return to the main menu.

Search Function from the MAIN Port

The search function can be controlled from the terminal or host computer attached to the MAIN port. The same procedures are followed, however, they are accomplished by using the Group 7 commands as follows:

#70	Disable Search Mode
#71	Enable Search Mode
#720000X	Inspect Search List Item
#7300<ID>	Add Entry to Search List
#731000X	Delete Search List Item Number
#732	Delete Entire Search List

Chapter 3
System Procedures

Chapter 3
System Procedures
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System Procedures

This chapter is designed to provide the user with procedures that demonstrate the function and the operating concepts of the AI1200 system.

It is assumed that the user is familiar with the previous chapters of the Guide.

Initial Test of the System

This section describes a preliminary, basic test to determine whether a system consisting of an AI1200 reader, RF module(s), and antenna(s) is able to read a tag. This is not intended as a complete operating test of the system. That test requires additional hardware and should only be performed by Amtech certified personnel.

The procedure described below applies only to readers with firmware set to factory settings. These settings are described in Appendix B of this guide. This test can be performed with either one or two antenna systems. If this test is performed with an installed, operating system, disregard the following **Hardware Requirements** section. This test requires two tags with different ID codes.

Hardware Requirements

This test assumes the reader, RF modules, and antennas have been connected in accordance with the guides accompanying the hardware shipment.

There should be several feet of clear space in front of each antenna for reading a tag. The antennas can be mounted on a post or tripod or simply laid on a sturdy surface. ***Do not lay the antennas on a metal surface or on a surface with a metal frame or metal undersurfaces.***

Avoid having overlapping reading ranges. If necessary, insert attenuation up to 10 db between the RF modules and the corresponding antenna to reduce the size of the antenna's reading range.

When all components have been connected and placed, connect the reader's power cord to a grounded source of voltage corresponding to the reader's voltage setting (110 VAC, 220 VAC, 12 VDC, 24 VDC or 72 VDC).

Test Procedure

Before turning on the reader, remove all tags in front of each antenna as well as those within a three-foot circle behind each antenna. This will keep the tags from being read when the reader is first turned on. Tags can be shielded by placing them behind a metal sheet, inside a metal box, or behind the user's body.

1. Turn on the reader using the power switch on the side of the power supply.

2. Observe that the reader's SEARCH0 and SEARCH1 display lights glow with about equal intensity. This indicates that the reader is in the multiplex mode and that RF power is rapidly switching between both antennas. (When the reader is in multiplex mode, the SEARCH lights will also respond in this way for a one-antenna system.)

   If either or both SEARCH lights fail to come on, the reader may not have the factory settings. In this case the reader will respond in one of three ways:

   The SEARCH0 light is on, the SEARCH1 light is off. This indicates that only RF Channel 0 is on.

   The SEARCH0 light is off, the SEARCH1 light is on. This indicates that only RF Channel 1 is on.

   Both SEARCH lights are off. This indicates that both RF channels are off.

   If any of the above responses was obtained, do not continue with this test. If necessary, connect a local terminal or computer to the MAIN port on the reader and continue with Testing the Reader with Communication Equipment Connected.

3. While observing the reader's two SEARCH lights and the LOCK light, bring a tag inside the reading range of either antenna. Be sure the tag is properly oriented according to antenna type. (Antenna specifications may be found in the *Amtech Product Catalog*. Also see the "polarization" section under "System Design" in Chapter 1.)

   Note that when the tag enters the reading range, one of the SEARCH lights will become brighter while the other becomes dimmer, and that both lights acquire a noticeable flicker. Note also that the LOCK light comes on to indicate that the tag has been "captured" by the reader and its ID is being decoded. The brighter of the two SEARCH lights identifies the channel reading the tag.

If the reader does not respond as described:

Be sure the tag is within the antenna reading range and is properly oriented.

Try one or two different tags.

Check that the cables to the RF modules and to the antennas are properly connected.

If the reader still does not respond as described, please contact Amtech.

4. Move the tag out of the antenna's reading range. Observe that the LOCK light goes out and that both SEARCH lights return to equal brightness.

Disregard step 5 for a one-antenna system.

5. Remove the tag from the reading range of the first antenna and bring it to the second antenna. Note that the other SEARCH light brightens while the previously bright one dims. The LOCK light will again glow to indicate that the tag has been "captured" by the reader.

This completes the basic check of the reader. If the reader responded as indicated, it may be further tested with the following procedure Testing the Reader with Communication Equipment Connected.

Testing the Reader with Communications Equipment Connected

This test verifies that the AI1200 is able to read tags in the RF multiplex mode, can accept commands from the host computer (or terminal) connected to the MAIN port, and transmit ID information to the host computer or data terminal.

Hardware Requirements

This test assumes a system configured and connected as described in the previous section Initial Test of the System. It also requires the reader be connected through the MAIN port to a host computer or local terminal. These connections are described in Chapter 2 under Component Operation. The terminal or host communication parameters should be set to match those of the reader. Default settings of the reader are included in Appendix B of this guide.

This test requires two tags with different ID codes.

Test Procedure

Disregard step 1 if working with an installed, operating system.

1. Turn on the computer/terminal and then turn on the reader. The following sign-on message is sent from the reader:

   ```
   #Model AI1200 Ver. X.X SNYYYYY
   #Copyright  1988   AMTECH Corp.
   ```

   If this message is garbled, first check the cable connections between the reader and the terminal. If this is not the problem, then the communication parameters of the terminal or host computer are not compatible with those of the reader. It is necessary to determine (primarily by trial and error) the correct match, and to reset the parameters of the terminal.

2. Issue the following commands to the reader. Enter the characters exactly as indicated, and type the ENTER or RETURN key after each command (represented by <ENTER>).

   Each character starting with the "#" sign echoes to the terminal. The reader will respond with '#Done ' after command execution. If the reader responds with '#Error', press <ENTER> and reissue the command.

   If the reader does not echo command characters, or does not respond with #Done or #Error to commands, contact Amtech.

#01<ENTER>
This command switches the reader to the Command Mode so it will respond to commands. If desired, use command #1000 to #103F to change the host-to-reader communications to more convenient values.

#610 <ENTER>
Sets basic communication protocol.

#300<ENTER>
Removes the time and date from reported IDs.

#310<ENTER>
Removes the auxiliary information from reported IDs.

#4100<ENTER>
Sets the RF0 uniqueness filter to a separation of 1 ID.

#4110<ENTER>
Sets the RF1 uniqueness filter to a separation of 1 ID.

#4200<ENTER>
Sets the valid ID criteria for RF channel 0 to 1 acquisition.

#4210<ENTER>
Sets the valid ID criteria for RF channel 0 to 1 acquisition.

#442<ENTER>
Sets the uniqueness timeout to 20 minutes.

#642<ENTER>
Selects the RF multiplex mode.

#610<ENTER>
Enable basic communication protocol.

#6800<ENTER>
Disable modem control.

#00<ENTER>
Returns the reader to Data Mode to allow transmission of IDs to the host.

3. Observe that the reader's SEARCH0 and SEARCH1 display lights glow with about equal intensity. This indicates that the reader is in the multiplex mode and the RF power is rapidly switching between both antennas. ***Note:*** A one-antenna system with the reader in the multiplex mode will also respond in this way.

4. Place a single tag inside the reading range of either antenna. Be sure it is properly oriented according to the type of antenna.

5. Watch for the tag's ID to appear on the terminal output device (screen or printer). Also check that both SEARCH lights are blinking rapidly with one glowing brighter than the other. The brighter one identifies the RF channel reading the tag.

   Check that the LOCK light is on. This indicates that the reader has "captured" the tag and is decoding the ID.

   If the lights did not function as described, or no ID was forwarded to the terminal, proceed as outlined below:

   Condition 1. The SEARCH and LOCK lights performed as outlined, but no ID was received by the terminal.

   a. make sure tag is programmed.

   b. Repeat step 4 with a different tag.

   c. Issue command **#01** followed by **#440** (Reset Uniqueness) and **#00**. Repeat step 4 with either tag.

   d. Type the control key (CTRL) and the Q key which issues an XON command to the reader.

   If the ID still does not appears on the output device, contact Amtech.

   Condition 2. The SEARCH and LOCK lights did not perform as outlined.

   a. Be sure the tag is within the reading range of the antenna, and properly aligned.

   b. Be sure the tag is of the proper type. A beam powered 915 MHz tag will not respond to a 2450 MHz system.

   b. Repeat step 4 with a different tag.

   c. Check that the cables to the antenna and the RF modules are properly connected.

   If the SEARCH and LOCK lights still do not function as described, contact Amtech.

6. Move the tag out of the antenna's reading range and watch for the LOCK light to go out. Both SEARCH lights will return to equal brightness.

7. Return the same tag to the reading range of the same antenna. The LOCK indicator will again light and the same SEARCH light will brighten. However, *the ID should not appear on the output device.* This indicates the uniqueness filter is operating as set. Remove the tag from the reading range.

8. Select a different tag and repeat steps 4 through 6. The new tag causes the LOCK light to come on, the same SEARCH light to grow bright, and the new ID to appear on the output device.

Repeat steps 4 through 8 for the second antenna.

ID Filter Command Procedures

In most applications, it is not desirable to transmit every ID that the reader decodes. The reader receives and decodes a tag's ID many times a second while the tag remains in the antenna's reading range. It is normally desirable to "filter" the duplicate reads of a single tag. It is also desirable to filter out "stray" signals from fringe areas of the reading range.

The reader can perform three different filtering functions implemented through the Command Group 4 commands.

Select Unique ID (#410N and #411N). These commands filter out repetitive IDs and only transmit a single ID to the host computer. The #410N commands set the filtering criteria for RF Channel 0, while the #411N commands set the filtering criteria for RF Channel 1. The N variable ranges from 0 to 3 and sets the depth of filter from one to four ID codes. With these commands, new ID data is not accepted for transmission unless:

1. During the time interval since an ID code was last received, received ID codes changed values N different times, or
2. The variable time-out clock has expired.

Select Valid ID (#420N and #421N). These commands instruct the reader to receive an ID a minimum number of times *in succession* before accepting it as valid. The #420N commands set the filtering criteria for RF Channel 0, while the #421N commands apply to RF Channel 1. The variable N ranges from 0 to F, corresponding to validation sequences of 1 to 16 successive reads.

The reader applies the valid ID criteria *prior* to the unique ID criteria. That is, an ID must be read the number of times specified by the before it is compared to the criteria specified by the #41NN Select Unique ID commands.

Variable Timeout Commands (#44N). These commands are used in conjunction with the Unique ID commands above. They place a time limit on the Unique ID filter. The variable N ranges from 1 to 3, corresponding to expiration times of 2 minutes, 20 minutes, or 60 minutes, respectively.

Expiration of the timeout period erases the comparison record of all recently acquired IDs. The net effect is that an ID acquired after the expiration of the timeout clock appears as new and passes the criteria of the Unique ID filter.

The timeout period starts for both channels as soon as a unique ID is acquired by either RF channel. The same tag will ***not*** be reported out again unless (a) the timeout period expires, (b) the reader receives a sufficient number of *changed* IDs to satisfy the requirements of the uniqueness filter, or (c) the timeout period is reset with the #440 Reset Uniqueness command.

Hardware Requirements

The filtering criteria procedures require an AI1200 system as configured for Testing the Reader with Communications Equipment Connected. If the system is operating only one antenna, it should be attached to RF channel 0. (Only Channel 0 is needed for these procedures.) The host computer or terminal must be connected, and be able to communicate with the reader. These tests require four tags programmed with different ID codes. These tags will be referred to as "A", "B", "C", and "D". (It may be helpful to label these tags "A", "B", "C", and "D".) The Variable Timeout procedures require a stopwatch or watch with second timer.

Initial Reader Firmware Setup

Remove all tags from the vicinity of the antenna. Enter the following commands to the reader in the order listed. These commands initialize the reader for all the filtering procedures. Commands are given without elaboration. Remember that all commands are entered with the <ENTER> or <RETURN> key. For further information on specific commands, see Chapter 2, System Operation.

#01	Switch to Command Mode
#20hh:mm:ss	Set Time (enter with desired decimal numbers)
#301	Append Time
#310	Remove Auxiliary Information
#4100	Separation of 1 ID, Channel 0
#4200	Valid ID criteria, Channel 0, 1 ID code
#440	Reset Uniqueness
#442	Set Timeout to 20 minutes
#6401	RF Channel 0 on, RF Channel 1 off
#670	Set Output Pulse Duration - 6 ms
#00	Switch to Data Mode

Be sure the SEARCH0 light is on. This indicates that RF Channel 0 is selected. If the SEARCH0 light is not lit, be sure the reader is on and the commands in the preceding step were accurately entered.

The Unique ID Filter

This procedure demonstrates the use of the "separation of one" uniqueness filter.

1. If tags have been read since the initial reader firmware setup described above, reissue those commands.

2. Hold tag A in the antenna reading range so that the LOCK light stays on. This indicates the antenna is decoding the ID. Be sure the ID code is reported on the computer output device (printer or screen).

3. Remove tag A and note that the LOCK light goes out.

4. Bring tag A back into the antenna reading range. Note that the LOCK light comes on, but the ID is not displayed again. The "separation of one" filter prevents the same ID from being reported out twice in succession. Remove tag A from the reading range.

5. Repeat steps 2 and 3 using tag B. Note that the new ID is displayed.

6. Repeat steps 2 and 3 using tag A. The filter criteria allowed tag A to be reported because the reader had received one different ID code since the last time tag A had been read.

Note: For the purposes of these tests, tag ID codes are considered "received" if the tag causes the LOCK light to come on, even if the ID is not stored in the output buffer and transmitted to the host computer. This concept is important to understand the operation of "separation of three" and "separation of four" IDs.

This procedure demonstrates the use of the "separation of two" uniqueness filter.

1. Assuming the reader is left configured from the previous procedure, issue the following reader commands:

   #01 Switch to Command Mode
   #440 Reset Uniqueness
   #4101 Separation of 2 IDs, Channel 0
   #00 Switch to Data Mode

2. Pass tags into the antenna reading range in the order below and verify the IDs are transmitted to the output device as indicated. A "y" indicates the ID is transmitted; a "n" indicates that it is not.

   Allow three seconds between passes. Make sure every tag causes the LOCK light to come on.

Tag	ID Transmitted
A	y
B	y
A	n
B	n
C	y
B	n
A	y
A	n
B	n
A	n
B	n
C	y

Note: For the purposes of these tests, tag ID codes are considered "received" if the tag causes the LOCK light to come on, even if the ID is not stored in the output buffer and transmitted to the host computer.

This procedure demonstrates the use of the "separation of three" uniqueness filter.

1. Assuming the reader is left configured from the previous procedure, issue the following reader commands:

   #01 Switch to Command Mode
   #440 Reset Uniqueness
   #4102 Separation of 3 IDs, Channel 0
   #00 Switch to Data Mode

2. Pass tags into the antenna reading range in the order below and verify the IDs are transmitted to the output device as indicated. A "y" indicates the ID is transmitted; an "n" indicates that it is not.

   Allow three seconds between passes. Make sure every tag causes the LOCK light to come on.

Tag	ID Transmitted
A	y
B	y
C	y
A	n
B	n
D	y
C	y
A	y
B	y
B	n

Remember: For the purposes of these tests, tag ID codes are considered "received" if the tag causes the LOCK light to come on, even if the ID is not stored in the output buffer and transmitted to the host computer.

This procedure demonstrates the use of the "separation of four" uniqueness filter.

1. Assuming the reader is left configured from the previous procedure, issue the following reader commands:

   #01 Switch to Command Mode
   #440 Reset Uniqueness
   #4103 Separation of 4 IDs, Channel 0
   #00 Switch to Data Mode

2. Pass tags into the antenna reading range in the order below and verify the IDs are transmitted to the output device as indicated. A "y" indicates the ID is transmitted; an "n" indicates that it is not.

   Allow three seconds between passes. Make sure every tag causes the LOCK light to come on.

Tag	ID Transmitted
A	y
B	y
C	y
D	y
A	n
B	n
A	n
C	y
B	n
D	y

Remember: For the purposes of these tests, tag ID codes are considered "received" if the tag causes the LOCK light to come on, even if the ID is not transmitted to the host computer.

Valid ID Filter

This procedure demonstrates the use of the Valid ID filter of 16 acquisitions.

1. Issue the following commands to the reader:

#01	Switch to Command Mode
#20hh:mm:ss	Set Time (enter with desired decimal numbers)
#302	Append Time and Date
#311	Append Auxiliary information
#4100	Separation of 1 ID, Channel 0
#420F	Valid ID filter of 16, Channel 0
#440	Reset Uniqueness
#442	Set Variable Time-out 20 minutes
#6401	RF Channel 0 on, RF Channel 1 off
#00	Switch to Data Mode

   The "valid ID" filter is now set for 16 IDs. This means that an ID will be reported out as soon as the reader has received it *16 consecutive* times. For the purposes of these tests, the reader is considered to be receiving IDs as long as the LOCK light is on.

2. *Quickly* pass a tag through the reading range of the antenna. Be sure the LOCK light goes quickly on and off. Note whether the ID was reported out. The ID will not be transmitted until the reader receives it at least 16 consecutive times.

3. Pass tag A through the reading range again, but more slowly. Again, be sure the LOCK light goes quickly on and off. The number of acquisitions is *cumulative.* The number of times the ID was received during the second pass is added to the number already obtained in the first pass. Repeat this step until the ID is reported.

4. Hold tag B in the reading range so that the LOCK light stays on for about 5 seconds. When tag B's ID code is reported, it will show the number of reads of tag A in hexadecimal format. Verify that this number is larger than 16 (10 hexadecimal).

5. Hold tag A in the reading range just long enough to obtain an output (about 1 second). Note the number of counts of tag B is FF (hexadecimal). This is the largest number the counter will display.

Uniqueness Timeout

This procedure demonstrates the operation of the uniqueness timeout. A stopwatch or watch with a second timer is required.

1. Set up the reader with the following commands:

   #01 Switch to Command Mode
   #301 Append Time Only
   #310 Remove Auxiliary Information
   #4100 Separation of 1 ID, Channel 0
   #4200 Valid ID of 1, Channel 0
   #440 Reset Uniqueness
   #441 Set Timeout to 2 Minutes
   #6401 RF Channel 0 on, RF Channel 1 off
   #00 Switch to Data Mode

   The reader is now set with a 2 minute timeout.

2. Move tag A into the antenna reading range and simultaneously start the stopwatch. Remove the tag from the reading range after about 3 seconds. Note the appended time on the output display. The reader's timeout clock started at this time.

3. Allow at least 2 minutes to elapse and then hold tag A in the antenna reading range so that the reader LOCK light stays on. Note that the ID is once again reported. This illustrates the primary effect of the timeout function.

4. Move tag A into the antenna reading range once again and start the stopwatch. Note the appended time on the output display. The reader's timeout clock started at this time.

5. Continue to hold tag A in the antenna reading range with the reader LOCK light on until at least 2 minutes has elapsed. Note that the ID code is not displayed again even though 2 minutes has elapsed. The ID cannot be reported again because the timer clock resets (starts over) with each successive read of tag A that occurs within the timeout period.

Note: Although the selected timeout period applies to both RF channels in a multiplex system, each RF channel maintains a separate timeout clock which functions independently.

Interfacing with a Modem

In some installations, it is necessary to install readers at remote sites where it is not feasible to place a host computer. In order to transfer tag ID information to a remote computer, it is possible to use a modem to connect the reader to the host computer over a phone line or radio link. Either the host computer or the reader can initiate calls. The host computer can establish a connection to a reader to check status, reconfigure the reader, or receive any stored data. Similarly, the reader may also originate the connection based upon user-programmable criteria.

Hardware Requirements

Modem connections are supported on the MAIN serial port of the reader. Version 2.6 of reader firmware supports Multi-Tech[1] model MT224E modem with version 6.08 firmware or later. The MT224E modem provides MNP™ Class 5[2] error correcting protocol between modems.

The MT224E modem to reader connections are as follows:

Modem Pins	Reader Terminal Number
2-SD (send data)	17-TXD1 (transmit data)
3-RD (receive data)	18-RXD1 (receive data)
20-DTR (data terminal ready)	20-RTS1 (ready to send)
8-DCD (data carrier detect)	21-CTS1 (clear to send)
7-SG (signal ground)	22-GND1 (signal ground)
cable shield wire	23-CHASS (chassis ground)

Note: This connection may require making a special cable.

In addition, switch #1 of the modem's 8 position DIP switch in must be "up" to select external DTR control. All other conditions are met by factory default or are automatically set by the reader, and all other DIP switches remain in factory default setting. The configuration of the modem's 8 position DIP switch should be as follows:

Switch	Position
1,2,4,5,6,7	Up
3,8	Down

[1]Multi-Tech Systems, Inc.; 82 Second Avenue S.E.; New Brighton, Minnesota 55112; Phone: 612-631-3550, 800-328-9717; TWX 910-563-3610.
[2]MNP™ and Microcom Networking Protocol™ are trademarks of Microcom, Inc.

Host Computer Modem Set-up

Set the host computer modem to match the reader modem settings, except it may not be necessary or desirable to set the DIP switch #1 to the up position.

The host computer modem should be initialized with commands compatible with those the reader uses to initialize its modem. The reader issues the following modem commands when modem control is enabled (#6811 Select Modem Type, followed by #6801 Enable Modem Control – *see below*):

Command	Effect
AT	Clear command buffer
AT&F&W	Set factory defaults and store
AT&E7	Modem passes through XON/XOFF
AT$BA0	Baud adjust off - speed convert on
AT&E2	Reliable (error correcting) mode
AT&E5	Modem initiated XON/XOFF enabled
AT&D3	Reset on loss of DTR
AT&I1	Hang up on 10 minute inactivity
AT&W	Store parameters

Specifically, the AT&D3 command (Reset on loss of DTR) may need to change for the host computer modem. Refer to the MultiModem224E™ Owner's Manual for a complete list of commands.

Other specific information concerning the modem (i.e., power requirements, operating temperatures, etc.) can also be found in the MultiModem224E™ Owner's Manual.

Reader Set-up

It is advantageous to configure the reader firmware with a local terminal prior to connecting the modem. This establishes the correct baud rate and enables modem control before attempting to communicate through the modem.

Most of the reader commands are given without elaboration. For further information on the individual commands, see Chapter 2.

Follow these steps to configure the reader firmware:

1. Connect a local terminal to the reader's MAIN port. If the reader is at factory settings, the terminal should be at 9600 baud.

2. Issue these commands to the reader:

#01	Switch to Command Mode
#1003	Set MAIN port baud rate to 2400

   When the reader responds with #Done, it is necessary to reset the local terminal's baud rate to 2400.

3. Issue these commands to the reader:

#6141	Enable XON/XOFF flow control
#6811	Select Multi-Tech MT224E and store parameters
#6801	Enable Modem Control

   The reader will pause, then respond with a series of modem initialization commands. This response should be ignored.

   If these commands are given once the modem is connected, hang up occurs as part of the initialization. *Each time modem control is enabled (#6801), the reader modem is initialized.* This can be used by the host to force initialization of the modem

4. At this point, call request criteria commands can be issued. Alternately, these commands can be issued once the modem is connected. For example purposes, the following commands configure the reader to call whenever one or more tag ID codes have been buffered for transmission, and to redial continuously until all data is sent.

   Note: The command to store the phone number in the modem must be issued when modem is connected, because it is actually stored in the modem (not the reader).

For specific information on these and other call criteria commands, see Chapter 2 or Appendix A. It is particularly helpful to review the #682N Set Call Algorithm commands.

#6870ATDT<string>N0	Establishes phone number for the reader to call where <string> is the number.
#6820	Set call algorithm for "all" conditions
#6831	Set number of IDs ≥1
#6840	Select call interval to 0 minutes
#6850	Set tag inactivity period to 0 minutes
#6860	Set modem redial interval to 0 minutes

5. Always leave the reader in Data Mode. Issue the following command:

#00	Switch to Data Mode.

At this point, the local terminal can be disconnected and the modem can be connected to the reader as described above.

Reader Initiated Calls

The reader determines the need to establish connection with the host computer based on call criteria commands. When the criteria have been met, the reader instructs the modem to dial the preset phone number. If the call attempt is unsuccessful, the reader waits for the time specified by the redial interval (#686N commands), and tries again.

When the connection to the host computer is made, the reader transmits '#Connect' followed by all stored IDs. (Modem connect and disconnect messages may have time or time and date appended.) After transmission of all IDs, the reader issues a '#Disconn' message and forces a disconnect by dropping the DTR line on the modem. The host computer cannot disconnect the line. Such an attempt is seen by the reader as a loss of communications. Should this occur, the reader redials the phone number and continues transmitting IDs.

Note: All call algorithms allow the reader to initiate a call when the reader buffer reaches 75% full. This feature prevents the reader buffer from filling and losing IDs.

Host Initiated Calls

The host computer can initiate calls to the reader in order to receive data, or check or change reader parameters. The following steps are used to connect to the reader:

1. The modem and the modem parameters on the host computer should correspond to the one connected to the reader. The host computer modem must be set for MNP™ error correcting protocol. (The modem command is AT&E2).

2. Have the host computer modem call the telephone number associated with the reader modem. The reader modem will answer CONNECT RELIABLE. If the response is CONNECT, then MNP™ error correcting protocol is not in effect, and transmissions from the reader will be garbled.

3. The reader should be in Data Mode, and will immediately begin transmitting any stored ID codes.

4. After all IDs have been transmitted to the host, the user may put the reader in Command Mode (#01) to check reader status or change settings. For example, changes to the call criteria parameters can be made at this time.

5. *Return the reader to Data Mode prior to disconnect (#00).*

6. The user must force a disconnect in host initiated calls, the reader will not. To force a disconnect, the user enters the command mode of the modem by issuing the +++ATH<ENTER> command.

Disabling Modem Control

Modem control can be disabled in the reader by issuing the #6800 Disable Modem Control command. After this command is invoked, the reader will not respond to DCD. It will be possible to initiate a call to the reader after this command is invoked, however, the reader will not assume responsibility for initializing the modem.

Note: The #6800 Disable Modem Control command must be invoked twice before modem control is actually disabled. This insures against accidental loss of modem control The first attempt to disable the modem will return the #Error message, and the second attempt returns #Done.

Examples

Example 1. If it is desired to acquire IDs from railcars and call the host computer *immediately* after each train passes, set the call algorithm with **#6820** (all conditions are "true"). Then set the *call interval* to zero **(#6840)** and the *inactivity period* **(#6852)** to another value, such as four minutes. When a train passes, IDs are acquired and the inactivity period time is continually reset. Once the train passed, the inactivity period would expire (after four minutes), and the reader would establish the call connection and transmit the railcars' ID codes.

Example 2. In this example, the entrance and exit gates of a container terminal are to be monitored in order to track container arrival and departure. Set the call algorithm with **(#6820)** (all conditions are "true"). Since it is impossible to predict the traffic pattern, the *call interval* **(#6846)** is set to 1 hour and the *inactivity period* **(#6850)** is set to zero. As containers pass the reader, IDs are acquired and buffered. At the end of each hour, the reader establishes the call connection and transmits the buffered tag IDs.

Example 3. If it is desired to acquire IDs from intermodal containers that arrive every few minutes, and have the reader call either after 500 reads or if the containers stop arriving, then the call algorithm should be set with **#6821** (any condition is "true"). The *call interval* should be set to never true **(#684F)**, the *inactivity period* set to 8 minutes to allow for spacing irregularity **(#6853)**, and the *number of IDs* should be set to 512 **(#683A)**.

Example 4. In this example, the reader is prevented from initiating calls; the host computer polls the reader for acquired IDs. The call algorithm is set with **#6820** (all conditions are "true"), and the call interval is set with **#684F** (infinite). These parameters keep the reader from initiating a call. The host computer can then be configured to call the reader as needed. Care should be taken to initiate calls to the reader at adequate intervals. ***Note:*** All call algorithms allow the reader to initiate a call when the reader buffer reaches 75% full. This feature prevents the reader buffer from filling and losing IDs.

Data Enquire Protocol

The AI1200 reader supports data enquire protocol. The reader transmits one ID code for each <ctrl-E> it receives, until the buffer is empty. At this point the reader ignores any further <ctrl-E> characters received.

The ID buffer must be empty before communication protocol can be altered. Allow the buffer to empty or issue the #63 Software Reset command.

Use the following steps to establish Data Enquire Protocol.

1. Be sure the reader storage buffer is cleared as described above.

2. Issue the following commands:

   #01 Switch to Command Mode
   #613 Enable Data Enquire Protocol
   #00 Switch to Data Mode

In order to test the procedure, follow these steps:

1. Read one or more tags. Note that no tag IDs are reported.

2. Type the <ctrl-E> character. Note that the first tag ID is reported. ***Note:*** the <ctrl-E> character is not echoed to the terminal.

3. Continue typing <ctrl-E> until all IDs have been reported.

System Visualization Exercises

The following exercises provide practical, hands-on experience with the effects of tag position and orientation in the reading range. These exercises are designed to illustrate the size and shape of the reading range for each antenna, and to show how those dimensions are affected by the tag. The user should be familiar with the Polarization section of Chapter 1- Introduction.

Note: These exercises are not intended for design or installation purposes. They are intended to provide a means for the user to understand both the environment and the operation of the Amtech Identification system.

These exercises may be performed either in a controlled (laboratory) setting or in a functioning installation. The exercises require two people. One person moves the tag in the reading range, and one observes the reader lights. If the system antenna is not situated close to the reader, it may be necessary to provide communication between the two people, such as a walkie-talkie.

Requirements:

- a working Amtech system including at least:
  - 1 reader,
  - 1 RF module,
  - 1 antenna, and
  - 1 tag
- chalk and/or masking tape,
- a copy of the appropriate antenna radiation pattern
- two or more people.

Note: In these exercises, the tag should be kept at a constant height. This may best be accomplished by taping the tag to a wooden pole. The height of the tag should correspond to the center of the system antenna elements.

Also note that the system should be powered on for at least five minutes prior to beginning any exercise.

Exercise #1
Read a Tag

In Exercise #1, you will move an optimally aligned tag into and out of the reading range and observe reader indications that the tag has been read.

Action

With the system powered on, and one person observing the reader lights, hold a tag about 3 feet away from and directly in front of the antenna. Align the tag properly with the antenna's polarization.

Response:
The LOCK light will come on when the tag is within range.

Action

Shield the tag behind your back.

Response:
When tag is shielded, the SEARCH lights should be on (flickering) and the LOCK light should be off.

Action

Move tag in front of antenna in the optimally oriented position.

Response:
The LOCK light should come on again when the tag is moved back into the antenna's range.

Exercise #2
Map Antenna Reading Range (Optimum)

In Exercise #2, you will define the area covered by the antenna field using an optimally oriented tag held at a constant distance from the ground, level with the antenna main beam. You will move the tag away from the antenna (in various directions), and mark the outermost points where a tag identification code may be obtained.

Action

With the system powered on, and one person observing reader lights, hold tag **about 3 feet away from and directly in front of the antenna.** Align the tag properly with the antenna's polarization (*optimal orientation).* Continue holding tag at this orientation and at the same height while slowly backing away from the antenna.

Response:

The LOCK light should come on and remain on while tag is in range. The LOCK light will begin to flicker when the tag reaches the outer edge of the reading range, and will go off completely when the tag is outside the range. Make a chalk or tape mark on the ground at the outermost point where the LOCK light flickered (*range boundary*).

Action

Holding the tag at the same height, facing the center of the antenna, take one step to the right. Move closer or further from the antenna until the range boundary is located.

Response:

Mark the range boundary with chalk or tape.

Action

Repeat the above process, taking one step to the right, until you are directly behind the antenna. Then repeat the process from the first mark in front of the antenna, stepping left each time.

Response:

Mark the range boundary with chalk or tape.

Action

Return tag to optimal orientation in front of the antenna; confirm LOCK light flicker. Slowly raise the tag above your head. Slowly lower the tag to the ground.

Response:

The LOCK light may continue to flicker (approaching range boundary); it may go off (outside range); or it may light steadily (inside range).

Discussion

This exercise maps the the general contours of the reading range for optimal tag orientation. The edges of the range are approximate. Factors such as weather changes and movement of RF reflectors through the area may have a temporary affect on the reading range.

Exercise #3
Tag/Antenna Orientation Effects

Exercise #3 illustrates the effects of tag/antenna orientation. This exercise requires that the reading range boundary be marked as described in Exercise #2. In this exercise, an optimally oriented tag is moved to the range boundary and misoriented in various directions.

Action

Standing at first range boundary mark (Exercise #2) hold tag directly in front of the antenna, at optimal height, with tag aligned to antenna polarization. Move toward or away from antenna until the LOCK light flickers. With the tag in the outermost point at which a solid LOCK was obtained, rotate the tag 90° clockwise. Note the effect on LOCK and SEARCH lights. Rotate tag 90° counterclockwise and note the effect.

Response:

The LOCK light may continue to flicker, or will go off when the tag is misaligned by 90° in either direction. This is the maximum misalignment.

Action

Return the tag to optimal orientation; confirm LOCK light flicker. Rotate tag 180° (flip front to back).

Response:

Depending upon the type of tag used, the LOCK light may maintain a steady condition. Optimal orientation may be true whether the tag faces forward or backward. However, all recommended installation guidelines require that the tag face is toward the antenna for best system performance.

Action

Return the tag to optimal orientation; confirm LOCK light flicker. Rotate tag until its smallest side (end) is facing the antenna.

Response:

The LOCK light may continue to flicker, or will go off. Although the tag remains aligned with the antenna's polarization, this end-on orientation somewhat reduces the effective range.

Discussion

Tags may be oriented up to 15° in any direction away from optimal orientation with no appreciable degradation of performance.

Exercise #4
Map Antenna Reading Range (Limited)

Exercise #4 illustrates the size and shape of the reading range as modified by tag misorientation. Compare the results of this exercise with those of Exercise #2.

Action

Using the range boundary established using Exercise #2, map the reading ranges defined by holding the tag at 90°, using end-on alignment, and front-to-back orientation.

Response:

Maximum tag misalignment (90° from antenna polarization) should produce the smallest reading range. End-on alignment should produce a larger range (somewhat smaller than optimal), and front-to-back orientation should produce a range essentially identical to that mapped in Exercise #2.

Discussion

Misaligned tags can return a signal to the system, but less effectively than those within the optimal tolerances.

Exercise #5
Explore Lobes and Nulls

In Exercise #5 you will explore an antenna's reading range looking for lobes and nulls in the field. Some antennas have very prominent lobes, while others have virtually none. Although null regions may exist in the "valleys" between lobes, they may also appear anywhere within the antenna's main field as a result of multipath effects.

Action Holding tag in optimal orientation about five feet away from the antenna, slowly move to one side of the antenna.

Response:

Note changes to the LOCK light status.

Action Continue moving around to the back, and then to the other side of the antenna.

Response:

Note changes to the LOCK light status.

Action Holding tag in optimal orientation, about three feet from the antenna, move from the left to the right perimeter of the reading range mapped in Exercise #2.

Response:

Note any changes to LOCK light status. Nulls in the field may be indicated by a flickering or extinguished LOCK light where otherwise a strong signal would be returned.

Action Continue moving back and forth across the main field, increasing sightly the distance from the antenna each time, until you have explored the entire main field.

Response:

Note any changes to the LOCK light status which may indicate the presence of a null region.

Discussion Lobes and nulls in the standard antenna reading range are factored into the installation configuration. The significance of incidental nulls in the antenna's main field depends primarily upon the size, shape, and location of the null region relative to the tag path, and on the speed at which a tagged object passes through the reading range.

Appendix A
Reader Commands

AI1200 Reader Command List

Following is a list of AI1200 reader commands supported by version 2.6 of the reader firmware. All commands are listed, however some commands may only be useful to Amtech certified personnel.

The reader accepts commands from the host computer or a terminal when in Command Mode. Default Mode for the reader is Data Mode which allows the transmission of IDs to the host computer. The only commands accepted in Data Mode are #00, #01, #8110, #8111, and #8112.

Software commands are divided into nine groups according to their main function. The first character of the command determines the group to which it belongs.

Command Group	Function
0	Data and Command Mode Control
1	Communication Port Control
2	Real-Time Clock Control
3	Format ID (Append Information)
4	ID Filter Parameters
5	Reader Status
6	Reader Control Functions
7	Search Functions
8	Auxiliary Reader Control

Commands are preceded by the # character, and are completed by the "ENTER" or "RETURN" key. For example, the SWITCH TO COMMAND MODE (#01) command would be typed as follows:

#01<ENTER>

where, <ENTER> is the "ENTER" or "RETURN" key.

Default values are printed in bold, italic type. An expanded listing of reader commands is included in the System Operation chapter of this guide.

COMMAND NUMBER	COMMAND NAME/ACTION *(factory settings are in bold, italic type)*
#00	***SWITCH TO DATA MODE***
#01	SWITCH TO COMMAND MODE
#02	LOCK OUT MAIN PORT
#03	***UNLOCK MAIN PORT***
#1000	CONFIGURE MAIN AND AUX-1 PORTS RATE - 110 BAUD
#1001	***" " - 300 BAUD***
#1002	" " - 1200 BAUD
#1003	" " - 2400 BAUD
#1004	" " - 4800 BAUD
#1005	" " - 9600 BAUD
#1006	" " - 19200 BAUD
#1010	***SET MAIN AND AUX-1 PORTS STOP BITS TO ONE***
#1011	" " TO TWO
#1020	***DISABLE MAIN AND AUX-1 PORTS PARITY***
#1021	SET MAIN AND AUX-1 PORTS PARITY TO EVEN
#1022	SET MAIN AND AUX-1 PORTS PARITY TO ODD
#1030	***SET MAIN AND AUX-1 PORTS END-OF-LINE DELAY - 0 MILLISECONDS (MS)***
#1031	" " - 100 MS
#1032	" " - 200 MS
#1033	" " - 300 MS
#1034	" " - 400 MS
#1035	" " - 500 MS
#1036	" " - 600 MS
#1037	" " - 700 MS
#1038	" " - 800 MS
#1039	" " - 900 MS
#103A	" " - 1000 MS
#103B	" " - 1100 MS
#103C	" " - 1200 MS
#103D	" " - 1300 MS
#103E	" " - 1400 MS

#103F " " - 1500 MS

#1100 CONFIGURE AUX-2 PORT BAUD RATE - 110 BAUD

#1101 ***" " - 300 BAUD***

#1102 " " - 1200 BAUD

#1103 " " - 2400 BAUD

#1104 " " - 4800 BAUD

#1105 " " - 9600 BAUD

#1106 " " - 19200 BAUD

#1110 ***SET AUX-2 PORT STOP BITS TO ONE***

#1111 " " TO TWO

#1120 **DISABLE AUX-2 PORT PARITY**

#1121 SET AUX-2 PORT PARITY TO EVEN

#1122 SET AUX-2 PORT PARITY TO ODD

#1130 ***SET AUX-2 PORT END-OF-LINE DELAY - 0 MILLISECONDS (MS)***

#1131 " " - 100 MS

#1132 " " - 200 MS

#1133 " " - 300 MS

#1134 " " - 400 MS

#1135 " " - 500 MS

#1136 " " - 600 MS

#1137 " " - 700 MS

#1138 " " - 800 MS

#1139 " " - 900 MS

#113A " " - 1000 MS

#113B " " - 1100 MS

#113C " " - 1200 MS

#113D " " - 1300 MS

#113E " " - 1400 MS

#113F " " - 1500 MS

#20 SET TIME

#21 SET DATE

#22 DISPLAY TIME AND DATE

#300 NO TIME AND DATE APPENDED

#301 TIME ONLY APPENDED

#302 ***TIME AND DATE APPENDED***

#310 NO AUXILIARY INFORMATION APPENDED

#311 ***AUXILIARY INFORMATION APPENDED***

#40 TRANSMIT ALL ID CODES

#4100 ***UNIQUE ID CODE CRITERIA – RF CHANNEL 0 - SEPARATION OF 1 ID***

#4101 " " - SEPARATION OF 2 IDS

#4102 " " - SEPARATION OF 3 IDS

#4103 " " - SEPARATION OF 4 IDS

#4110 ***UNIQUE ID CODE CRITERIA – RF CHANNEL 1 - SEPARATION OF 1 ID***

#4111 " " - SEPARATION OF 2 IDS

#4112 " " - SEPARATION OF 3 IDS

#4113 " " - SEPARATION OF 4 IDS

#4200 ***VALID ID CODE CRITERIA – RF CHANNEL 0 - 1 CONSECUTIVE ACQUISITION***

#4201 " " - 2 CONSECUTIVE ACQUISITIONS

#4202 " " - 3 CONSECUTIVE ACQUISITIONS

#4203 " " - 4 CONSECUTIVE ACQUISITIONS

#4204 " " - 5 CONSECUTIVE ACQUISITIONS

#4205 " " - 6 CONSECUTIVE ACQUISITIONS

#4206 " " - 7 CONSECUTIVE ACQUISITIONS

#4207 " " - 8 CONSECUTIVE ACQUISITIONS

#4208 " " - 9 CONSECUTIVE ACQUISITIONS

#4209 " " - 10 CONSECUTIVE ACQUISITIONS

#420A " " - 11 CONSECUTIVE ACQUISITIONS

#420B " " - 12 CONSECUTIVE ACQUISITIONS

#420C " " - 13 CONSECUTIVE ACQUISITIONS

#420D " " - 14 CONSECUTIVE ACQUISITIONS

#420E " " - 15 CONSECUTIVE ACQUISITIONS

#420F " " - 16 CONSECUTIVE ACQUISITIONS

#4210 ***VALID ID CODE CRITERIA – RF CHANNEL 1 - 1 CONSECUTIVE ACQUISITION***

#4211 " " - 2 CONSECUTIVE ACQUISITIONS

#4212 " " - 3 CONSECUTIVE ACQUISITIONS

#4213 " " - 4 CONSECUTIVE ACQUISITIONS

#4214 " " - 5 CONSECUTIVE ACQUISITIONS

#4215 " " - 6 CONSECUTIVE ACQUISITIONS

#4216 " " - 7 CONSECUTIVE ACQUISITIONS

#4217 " " - 8 CONSECUTIVE ACQUISITIONS

#4218 " " - 9 CONSECUTIVE ACQUISITIONS

#4219 " " - 10 CONSECUTIVE ACQUISITIONS

#421A " " - 11 CONSECUTIVE ACQUISITIONS

#421B " " - 12 CONSECUTIVE ACQUISITIONS

#421C " " - 13 CONSECUTIVE ACQUISITIONS

#421D " " - 14 CONSECUTIVE ACQUISITIONS

#421E " " - 15 CONSECUTIVE ACQUISITIONS

#421F " " - 16 CONSECUTIVE ACQUISITIONS

#43 BUFFER ALL ID CODES

#440 RESET UNIQUENESS

#441 ***SET VARIABLE TIME-OUT - 2 MINUTES***

#442 " " - 20 MINUTES

#443 " " - 60 MINUTES

#505 DISPLAY FIRMWARE VERSION - MICRO-1

#515 " " - MICRO 2

#520 DISPLAY POWER OUTAGE AND RESTORE BITS

#521 DISPLAY READER ID NUMBER

#522 DISPLAY COMMUNICATION PARAMETERS - MAIN AND AUX-1 PORTS

#523 " " - AUX-2 PORT

#524 DISPLAY APPENDED INFORMATION STATUS

#525 ENQUIRE COMMUNICATION PROTOCOL STATUS

#526 DISPLAY I/O STATUS

#527 DISPLAY RF STATUS

#528 DISPLAY MODEM CONTROL STATUS

#529 DISPLAY PRESENCE INPUT STATUS

#530 DISPLAY FILETER PARAMETER STATUS - RF CHANNEL 0

#531 " "- RF CHANNEL 1

#540 PRIMARY MICROCONTROLLER CHECKSUM

#541 DISPLAY EXTERNAL RAM SIZE

#542 SECONDARY MICROCONTROLLER CHECKSUM

#550 REQUEST SYSTEM CHECK TAG CONTROL STATUS

#560 REQUEST SENSOR STATUS CHANGE STATUS

#561 REQUEST RF SYNCHRONIZATION STATUS

#60N SET READER ID NUMBER

#610 ***ENABLE BASIC COMMUNICATION PROTOCOL***

#611 ENABLE ERROR CORRECTING PROTOCOL

#612N SET ERROR CORRECTING PROTOCOL TIMEOUT

#613 ENABLE DATA ENQUIRE PROTOCOL

#6140 DISABLE FLOW CONTROL

#6141 ***ENABLE XON/XOFF FLOW CONTROL***

#6142 ENABLE HARDWARE FLOW CONTROL

#6150 ***SELECT <SOM> CHARACTER = # (23 HEX)***

#6151 SELECT <SOM> CHARACTER = ` (60 HEX)

#6152 SELECT <SOM> CHARACTER = { (7B HEX)

#6153 SELECT <SOM> CHARACTER = | (7C HEX)

#6154 SELECT <SOM> CHARACTER = } (7D HEX)

#6155 SELECT <SOM> CHARACTER = ~ (7E HEX)

#6200 ALL OUTPUT STATUS LINES OFF

#6201 OUTPUT STATUS LINES ON = STAT0

#6202 " " = STAT1

#6203 " " = STAT0, STAT1

#6204 " " = STAT2

#6205 " " = STAT0, STAT2

#6206 " " = STAT1, STAT2

#6207 " " = STAT0, STAT1, STAT2

#6208 " " = STAT3

#6209 " " = STAT0, STAT3

#620A " " = STAT1, STAT3

#620B " " = STAT0, STAT1, STAT3

#620C " " = STAT2, STAT3

#620D " " = STAT0, STAT2, STAT3

#620E " " = STAT1, STAT2, STAT3

#620F " " = ALL

#621 ***PREDEFINED OUTPUT CONTROL***

#63 RESET READER

#6400 RF CONTROL-OFF FOR BOTH CHANNELS

#6401 " "-CHANNEL 0 ON, CHANNEL 1 OFF

#6402 " "-CHANNEL 1 ON, CHANNEL 0 OFF

#641 SET RF BY SENSOR

#642 ***SET RF CONTROL IN 2 CHANNEL MULTIPLEX MODE***

#6430 DISABLE RF SYNCHRONIZATION CONTROL MODE

#6431 SET RF SYNCHRONIZATION PERIOD - 64 MS

#6432 " " - 72 MS

#6433 " " - 80 MS

#6434 " " - 88 MS

#6435 " " - 96 MS

#6436 " " - 112 MS

#6437 " " - 128 MS

#6438 " " - 144 MS

#6439 " " - 160 MS

#643A " " - 192 MS

#643B " " - 224 MS

#643C " " - 256 MS

#643D " " - 320 MS

#643E " " - 384 MS

#643F " " - 512 MS

#65 RESET POWER OUTAGE BIT

#66 INVOKE DIAGNOSTIC MODE

#670 ***SET OUTPUT PULSE DURATION - 4 MS***

#671 " " - 8 MS

#672 " " - 12 MS

#673 " " - 16 MS

#674 " " - 20 MS

#675 " " - 24 MS

#676 " " - 32 MS

#677 " " - 40 MS

#678 " " - 48 MS

#679 " " - 60 MS

#67A " " - 76 MS

#67B " " - 152 MS

#67C " " - 228 MS

#67D " " - 300 MS

#67E " " - 376 MS

#67F " " - 752 MS

#6800 ***DISABLE MODEM CONTROL***

#6801 ENABLE MODEM CONTROL

#6811 ***SELECT MODEM TYPE: MULTITECH MODEL 224E MODEM***

#6820 ***ENABLE CALL IF ALL CONDITIONS ARE SATISFIED***

#6821 ENABLE CALL IF ANY CONDITIONS ARE SATISFIED

#6830 SELECT MODEM PRESET NUMBER OF IDS ≥ 0 (ALWAYS TRUE)

#6831 ***" " ≥ 1***

#6832 " " ≥ 2

#6833 " " ≥ 4

#6834 " " ≥ 8

#6835 " " ≥ 16

#6836 " " ≥ 32

#6837 " " ≥ 64

#6838 " " ≥ 128

#6839 " " ≥ 256

#683A " " ≥ 512

#683F " " INFINITE (NEVER TRUE)

#6840 SELECT MODEM CALL INTERVAL - 0 MINUTES (ALWAYS TRUE)

#6841 " " - 2 MINUTES

#6842 " " - 4 MINUTES

#6843 " " - 8 MINUTES

#6844 " " - 15 MINUTES

#6845 " " - 30 MINUTES

#6846 " " - 1 HOUR

#6847 " " - 2 HOURS

#6848 " " - 4 HOURS

#6849 " " - 8 HOURS

#684A " " - 12 HOURS

#684B " " - 24 HOURS

#684C " " - 36 HOURS

#684D " " - 48 HOURS

#684E " " - 72 HOURS

#684F " " - INFINITE (NEVER TRUE)

#6850 SELECT TAG INACTIVITY PERIOD - 0 MINUTES (ALWAYS TRUE)

#6851 " " - 2 MINUTES

#6852 " " - 4 MINUTES

#6853 " " - 8 MINUTES

#6854 " " - 15 MINUTES

#6855 " " - 30 MINUTES

#6856 " " - 1 HOUR

#6857 " " - 2 HOURS

#6858 " " - 4 HOURS

#6859 " " - 8 HOURS

#685A " " - 12 HOURS

#685B " " - 24 HOURS

#685C " " - 36 HOURS

#685D " " - 48 HOURS

#685E " " - 72 HOURS

#685F " " - INFINITE (NEVER TRUE)

#6860 SELECT MODEM REDIAL INTERVAL - 0 MINUTES (ALWAYS TRUE)

#6861 " " - 2 MINUTES

#6862 " " - 4 MINUTES

#6863 " " - 8 MINUTES

#6864 *" "- 15 MINUTES*

#6870 <str> ISSUE COMMAND TO MODEM FROM READER

#6900 *DISABLE "PRESENCE WITHOUT TAG " REPORTING*

#6901 ENABLE "PRESENCE WITHOUT TAG" REPORTING

#6910 SET MINIMUM PRESENCE TRUE PERIOD - 0 MS (ALWAYS TRUE)

#6911 " " - 4 MS

#6912 " " - 8 MS

#6913 " " - 12 MS

#6914 " " - 20 MS

#6915 " " - 24 MS

#6916 *" "- 32 MS*

#6917 " " - 48 MS

#6918 " " - 60 MS

#6919 " " - 92 MS

#691A " " - 152 MS

#691B " " - 300 MS

#691C " " - 452 MS

#691D " " - 600 MS

#691E " " - 752 MS

#691F " " - INFINITE (NEVER TRUE)

#6920 *PRESENCE RF CONTROL - OFF ON TIME-OUT ONLY*

#6921 PRESENCE RF CONTROL - OFF ON TIME-OUT 'OR' TAG

#6922 PRESENCE RF CONTROL - OFF ON TIME-OUT 'OR' PRESENCE "FALSE"

#6930 PRESENCE RF CONTROL TIME-OUT PERIOD - 0 MS (ALWAYS TRUE)

#6931 " " - 4 MS

#6932 " " - 8 MS

#6933 " " - 12 MS

#6934 " " - 20 MS

#6935 " " - 24 MS

#6936 *" "- 32 MS*

#6937 " " - 48 MS

#6938 " " - 60 MS

#6939 " " - 92 MS

#693A	" " - 152 MS
#693B	" " - 300 MS
#693C	" " - 452 MS
#693D	" " - 600 MS
#693E	" " - 752 MS
#693F	" " - INFINITE (NEVER TRUE)
#6940	***SENSE INPUT ENERGIZED FOR LOGIC TRUE***
#6941	SENSE INPUT DE-ENERGIZED FOR LOGIC TRUE

#70	***DISABLE SEARCH MODE***
#71	ENABLE SEARCH MODE
#720000N	INSPECT SEARCH LIST ITEM NUMBER N (0-F)
#7300	ADD ENTRY TO SEARCH LIST
#731000N	DELETE SEARCH LIST ITEM NUMBER N (0-F)
#732	DELETE ENTIRE SEARCH LIST

#8000	DISABLE THE AUTOMATIC RESTORATION OF EEPROM PARAMETERS
#8001	***ENABLE AUTOMATIC RESTORATION OF EEPROM PARAMETERS***
#801	SAVE PARAMETERS TO EEPROM
#802	RESTORE PARAMETERS FROM EEPROM
#810	***DISABLE THE SYSTEM CHECK TAG PERIODIC MODE***
#8110	INVOKE SYSTEM CHECK TAG - RF CHANNEL 0
#8111	" " - RF CHANNEL 1
#8112	" " - BOTH RF CHANNELS
#812	ENABLE PERIODIC SYSTEM CHECK TAG TEST MODE
#8130	***SELECT SYSTEM CHECK TAG PERIODIC TIME INTERVAL = 30 SECONDS***
#8131	" " = 2 MINUTES
#8132	" " = 4 MINUTES
#8133	" " = 8 MINUTES
#8134	" " = 15 MINUTES
#8135	" " = 30 MINUTES
#8136	" " = 1 HOUR
#8137	" " = 2 HOURS

#8138 " " = 4 HOURS

#8139 " " = 8 HOURS

#813A " " = 12 HOURS

#813B " " = 24 HOURS

#813C " " = 36 HOURS

#813D " " = 48 HOURS

#813E " " = 72 HOURS

#813F " " = INFINITE (NEVER TRUE)

#8142X SELECT THE SYSTEM CHECK TAG SIGNATURE CHARACTER

#8150 SET SYSTEM CHECK TAG ADDRESS TO 0

#8151 " " TO 1

#820 ***DISABLE SENSOR STATUS CHANGE MODE***

#821 SET SENSOR STATUS CHANGE FEATURE - SENSE0

#822 " " - SENSE1

#823 " " - SENSE1, SENSE0

#824 " " - SENSE2

#825 " " - SENSE2, SENSE0

#826 " " - SENSE2, SENSE1

#827 " " - SENSE2, SENSE1, SENSE0

#828 " " - SENSE3

#829 " " - SENSE3, SENSE0

#82A " " - SENSE3, SENSE1

#82B " " - SENSE3, SENSE1, SENSE0

#82C " " - SENSE3, SENSE2

#82D " " - SENSE3, SENSE2, SENSE0

#82E " " - SENSE3, SENSE2, SENSE1

#82F " " - SENSE3, SENSE2, SENSE1, SENSE0

Appendix B
Reader Default Settings

Reader Default Settings

Following is a list of the default factory settings of the AI1200 Reader supporting firmware version 2.6. Each setting is given with its corresponding Reader firmware command. These settings may be modified through Reader firmware commands.

If the following values are changed, they must be saved with the #801 command to survive a power failure or Reader reset. Also, if the changed parameters are not saved, they will be restored to their previous values by the automatic restoration feature of the firmware.

To restore the Reader to the factory default settings, select the F option (set defaults) from the Diagnostic menu (see command #66). When the factory defaults are set, select D (software reset) to return to the Reader operational mode.

> *Note:* The Reader is always in Data Mode upon power-up.

Command	Description
Mode:	
#00	Data Mode
#03	MAIN port unlocked
Communications:	
#1001	MAIN & AUX-1 ports 300 Baud
#1101	AUX-2 port 300 Baud
#1020	MAIN & AUX-1 ports parity disabled
#1120	AUX-2 port parity disabled
#1010	MAIN & AUX-1 ports 1 stop bit
#1110	AUX-2 port 1 stop bit
#1030	MAIN & AUX-1 ports 0 ms EOL delay
#1130	AUX-2 port 0 ms EOL delay
ID Format:	
#302	Append time and date
#311	Append auxiliary information
ID Filter:	
#4100	RF0 - Uniqueness separation 1 ID
#4110	RF1 - Uniqueness separation 1 ID
#4200	RF0 - Valid code 1 code
#4210	RF1 - Valid code 1 code
#441	Uniqueness time-out 2 minutes

Command	Description
Control:	
#6000	Set Reader ID to 00
#610	Enable basic communication protocol
#61203	Set ECP time-out to 03 (150 ms)
#6141	Enable XON/XOFF flow control
#6150	Select <som> character # (23 hex)
#621	Predefined status output control
#642	Two channel RF multiplex mode
#670	Set output pulse duration 4 ms
#6800	Disable modem control
#6811	Select modem type #1
#6820	Select modem call algorithm #0
#6831	Select one or more IDs
#6846	Select call interval = 1 hour
#6851	Select inactivity period = 2 minutes
#6864	Select redial interval = 15 minutes
#6900	Disable presence without Tag reporting
#6916	Set minimum presence true = 32 ms
#6920	Set RF presence control to RF off on time-out
#6936	Select RF presence time-out = 32 ms
#6940	Select non-inverted sense input logic
Search:	
#70	Disable search mode
Auxiliary control:	
#8001	Enable auto-restoration of EEPROM parameters
#810	Disable system check Tag periodic mode
#8130	Select system check Tag interval = 30 seconds
#820	Disable the Sensor Status Change feature

Other Settings:

The power outage bit is set to "1" on Reader power-up.

Appendix C
User Troubleshooting Guide

User Troubleshooting Guide

Below is a list of conditions and the actions the user can take to correct them.

Power light does not come on

1. Verify the Reader on/off switch is turned on.
2. Verify Reader power cord is properly connected to the power source.
3. Verify the circuit to the power source is active (check circuit breaker).
4. Verify Reader fuse is intact. Replace the Reader fuse.
5. *Contact Amtech.*

Search lights do not come on

1. Verify Reader power as described above.
2. Verify that #6400 (RF Control Off) command has not been issued.
3. *Contact Amtech.*

One search light does not come on

1. Verify that neither #6401 nor #6402 (RF Control Off one channel) have been issued.
2. *Contact Amtech.*

LOCK light does not come on with Tag in designated range

1. Verify that the Search light for the proper Antenna is lit.
2. Verify proper Tag-Antenna polarization orientation.
3. Test for LOCK light with known operating Tag.
4. Verify Reader to RF Module connections.
5. Verify RF Module to Antenna connections.
6. *Contact Amtech.*

System not receiving/transmitting IDs of Tags in range

1. Verify Search lights are on.
2. Verify LOCK light comes on with Tag in Range.
3. Verify proper Tag-Antenna polarization orientation.
4. Check monitor for "#Error02" (output buffer full message).
5. Verify Reader is not in Command Mode.
6. Enter <ctrl-Q>.
7. Try a different Tag known to work.
8. If LOCK light comes on, and #620 (Predefined Output Control) is in effect, set #670 (Set Output Pulse Duration) to a shorter time.
9. *Contact Amtech.*

System reading Tags outside of range

1. Check for and remove transient RF reflective surfaces.
2. *Contact Amtech.*

Tags being read more than once in a single pass through the range

1. Verify that neither command #40 (Transmit all ID Codes) nor #43 (Buffer all ID Codes) have been issued.
1. Select higher value Valid ID acquisition requirement (Reader commands #41NN).
2. *Contact Amtech.*

Output function (lights/gates) not operating on valid read

1. Verify output module parameters set correctly (#620N commands).
2. Verify power to output-controlled equipment.
3. Verify equipment connections to Reader.
4. *Contact Amtech.*

Tag IDs garbled

1. Make sure MAIN port communication parameters correspond to host computer settings.
2. *Contact Amtech.*

Objects not turning on RF Module through proximity sensor

1. Verify that #642 (Set RF by Sensor) command is in effect.
2. Verify power to proximity sensor.
3. Verify Reader-RF Module connection.
4. *Contact Amtech.*

Commands are not echoed to the monitor

1. Check MAIN port communication parameters.
2. *Contact Amtech.*

All commands respond with "#Error"

1. Verify Reader is in Command Mode.
2. Verify Reader's MAIN port is unlocked.
3. *Contact Amtech.*

#Error01 condition (RAM error)

1. Repower the Reader.
2. *Contact Amtech.*

#Error02 condition (Output buffer full)

1. Exit Command Mode to allow transmission of IDs.
2. Type <ctrl-Q>.
3. Unlock MAIN port and exit Command mode to allow transmission of IDs.

#Error03 condition (Output buffer restart)

1. No action required.

#Error04 condition (Output buffer above 75%)

1. Exit Command Mode to allow transmission of IDs.
2. Type <ctrl-Q>.
3. Unlock MAIN port and exit Command mode to allow transmission of IDs.

#Error05 condition (Output buffer below 50%)

1. No action required.

#Error06 condition (EEPROM write error)

1. *Contact Amtech.*

#Error07 condition (Inter-micro communication time-out)

1. *Contact Amtech.*