Multiplexing Transceiver System FS1001M User Manual

Software Version 1.7
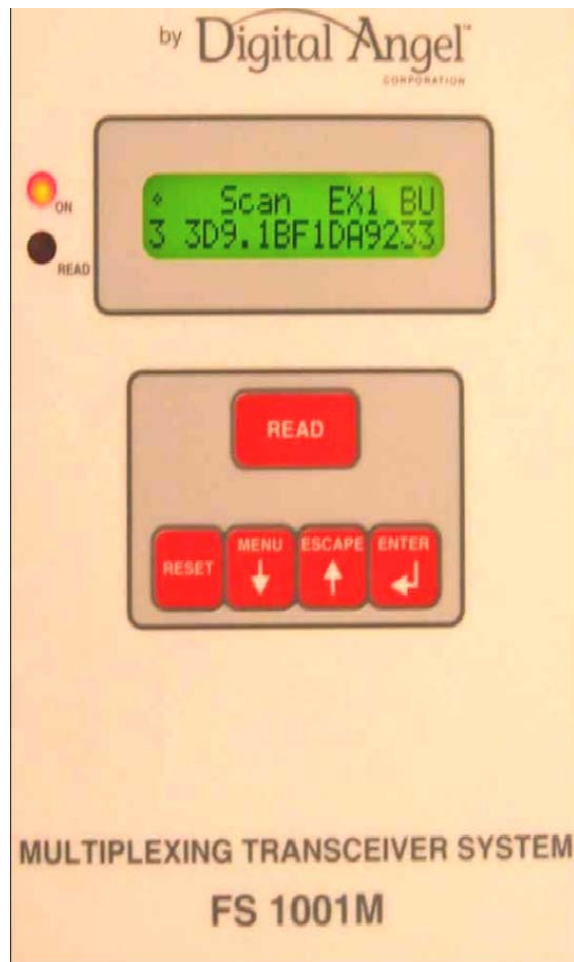
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Document History

Release Date	Doc Version	Software Version	Comments
November 2008	A - Initial release	1.7	Initial release of this manual in updated format.

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PRODUCT DESCRIPTION

The FS1001M RFID reader is a high performance auto tuning unit specifically designed for installations requiring up to 6 antennas where the environmental conditions necessitate the need for auto tuning, the antennas must be placed in close proximity to one another, or where the power budget is limited.

Features:

- Full-time auto tuning to compensate for changes in the antenna environment.

- Support for up to six antennas.

- Remote and local interface for setup, maintenance, status monitoring, and data logging.

- DC configuration

Interface:

- Two lines by 16 characters backlight LCD display

- Five key keyboard that allows local operation and reader configuration

- EIA 232 serial communication port, female DB 9 connector

- Connections for six antennas

Software:

- Field upgradeable software.

- Configurable non-volatile set-up parameters.

- Data logging memory for up to 5,350 tags with reader ID, antenna number, and data and time stamp for each tag.

- Data logging memory for up to 146 System Status Reports

- Data logging of test tag activations

Functional Description

The FS1001M is designed to drive up to six antennas and provide independent auto tuning for each antenna. It multiplexes or switches between the antennas in a user selectable sequence. Since only one antenna is activated at a time the antennas can be placed in any location and orientation without interfering with one another. The antenna switching also has the added benefit of supporting up to six antennas using approximately the same power as a single FS1001A reader.

When the unit switches to an antenna it automatically retunes to that particular antenna and makes necessary tuning adjustments due to environmental changes such as water level, temperature, etc. The unit then looks for the presence of a PIT tag. If no tag is present the unit switches to the next antenna and repeats this process. If a tag is present the unit will stay at the antenna until the tag is successfully read or the allotted scanning time expires, whichever comes first. When the last antenna in the switching sequence is reached the sequence is repeated.

The default timing for this process is 30ms for determining the presence of a tag, and up to 1000ms (user-defined parameter) to either read the tag in the field or to time out and switch to the next antenna.

Figure 1: FS1001M Reader

As an example, a four antenna installation with an antenna switching sequence of 1-2-3-4 would take 120ms (4 x 30ms) to cycle through all four antennas if no tag was detected on any of the four antennas. The system would check for the presence of a tag at each antenna every 90ms (3 x 30ms) until a tag enters the field of one of the antennas, in which case if the antenna scan time is 100ms the antenna cycle time would increase to a maximum of 220ms. This is explained in greater detail in subsequent sections.

Note: If necessary, the default switching time value of 30ms can be changed to 20, 25, or 45ms by reprogramming the reader with the appropriate software (see *Reader Software Update*).

Multiplexer Side View:

Figure 2: Side View

Multiplexer End View:

Figure 3: End View

READER OVERVIEW

The FS1001M MUX front panel is illustrated in the next figure, showing the main components:

- LCD display

- LED indicators

- Context sensitive keyboard

- Audible indicator
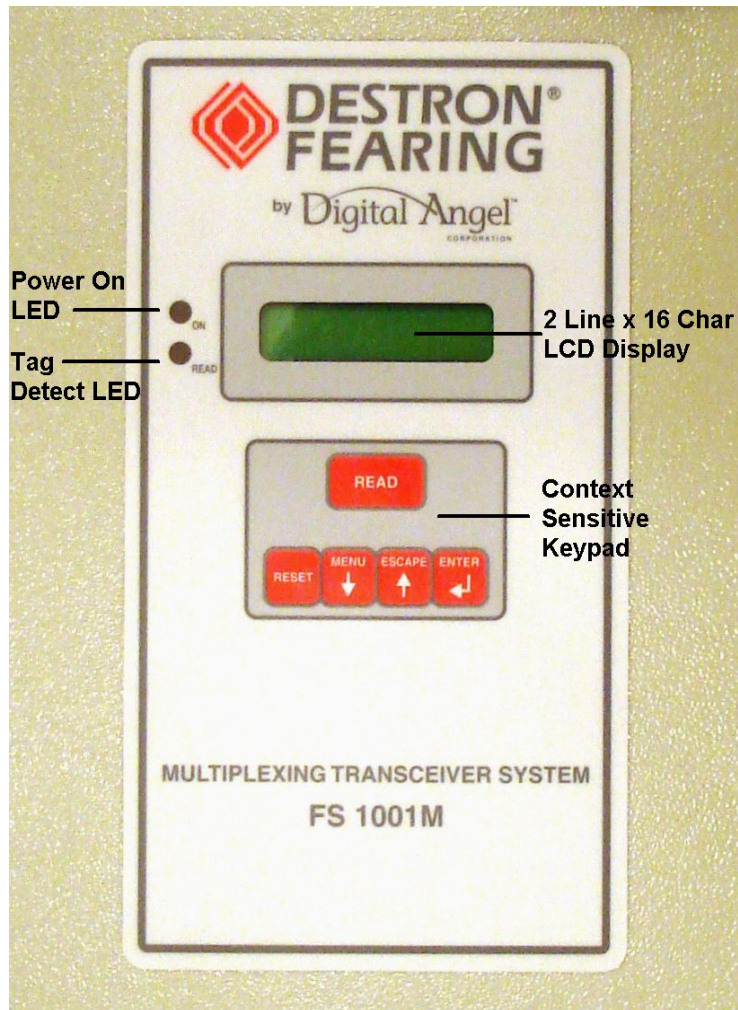
Figure 4: FS1001M front panel

In addition to the LCD and Keypad interface the FS1001M has a serial communications port for connection to a computer for both local and remote access. The FS1001M the menu structure is quite deep and complex. Users are required to use a computer for initial setup and antenna tuning.

This interface is an EIA 232 communication port with a female 9 pin DIN connector. The communication parameters are fixed at 57,600 baud, no parity, eight bits, one stop bit, (57,600,N, 8, 1) with no flow control. Use a standard straight through communication cable is required (DB-9 Female/Male connector – straight through - not null modem).

LCD Display

The LCD display is 2 lines by 16 characters. It contains a backlight and displays tag IDs and reader status information.
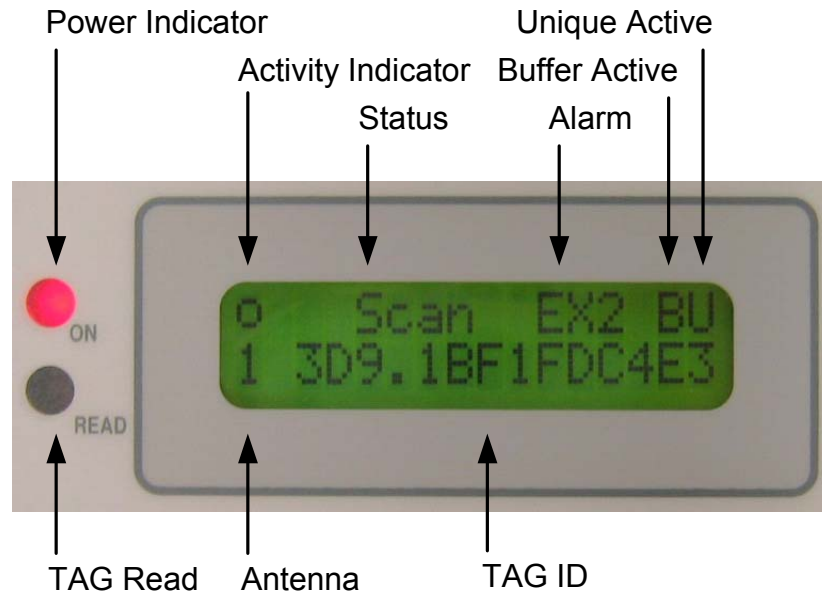
Figure 5: LCD display with LED indicators

The **ON** LED located left of the display is the reader power indicator. The bottom **READ** LED flashes each time a tag is read. The LED is turned on each time a tag message is decoded successfully, regardless of the Unique Mode setting.

Activity indicators

On the first line of the LCD, the unit features an animated antenna activity indicator that changes shape each time a new signal data buffer is acquired from the antenna.
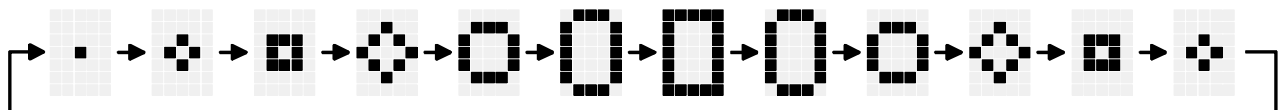
Figure 6: Activity indicator animation

Reader status

The next display field is used to display the reader activity and the tag search result. The unit can display:

Stby — The reader is inactive (standby), waiting for a user command from the keyboard or from a serial port.

Scan — The reader is active and searching for a tag.

Found — The unit has found a new tag. The tag number found by the unit is different from the previous one found by the unit.

Same — The unit has found a tag but its number is the same as the last one detected by the unit.

Alarm indicator

The next 3-character zone is used to indicate the presence of an alarm. See page 48 for a list of all possible alarms and their descriptions.

The alarm messages are also sent to the serial port as they occur. A list of alarms that have occurred can be displayed on the LCD using the system summary feature, available by pressing the Enter key from the main display. A complete alarm list is also available at the end of the Status Report sent to the serial port.

Buffer mode

Letter "B" (Buffer) on the right side of the first LCD line indicates that the Buffer mode is enabled. When enabled**,** the *Buffer* option allows tag IDs to be stored in the reader memory as they are read along with the reader ID, antenna number, and date and time of detection. This information is stored in a memory file that has an approximate capacity of 5,350 tag codes. In the case of a power outage a lithium battery will protect the memory file contents. Each tag ID in the memory is protected by a CRC (cyclic redundancy check) in order to avoid invalid information being retrieved by the computer. When the memory file is full, the oldest tag ID is erased in order to store the new tag ID found. The memory file contents can be downloaded to a computer and erased using either the front panel (Buffer menu) or the serial port connection.

Unique mode

Letter "U" (Unique) on the right side of the first LCD line indicates that the Unique mode is selected. The *Unique* option defines the reaction of the reader when the same tag is read several times. When the *Unique* option is off, the tag will be annunciated, stored and reported each time it is read. When the *Unique* option is on, the tag ID will be annunciated, stored, and reported only once for each antenna until either the Unique Delay times out or another tag is detected. See Unique and Unique Delay Mode on page 13 for additional information.

Tag number

The second line of the LCD displays the antenna number and tag ID in hexadecimal in the following form (antenna number followed by a space then manufacturer ID or country code followed by the universal identification code all in capital letters):

Figure 7: Tag ID display

Keyboard

The unit is equipped with a 5 keys context sensitive keyboard, which means that the use of the keyboard is adapted to the information being displayed on the LCD (see next figure).
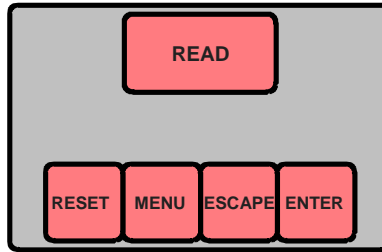
Figure 8: Keyboard

Reset key

The unit can be restarted using the RESET key. When resetting, the unit performs self-diagnostics and starts scanning for tags. Please refer to the "Power-up/reset sequence" section for more details.

Read key

The READ key is used to activate/deactivate the scanning of tags. Pushing READ toggles the unit between the scanning mode and the standby mode.

Menu, Escape and Enter keys

The MENU, ESCAPE and ENTER keys are context sensitive navigation keys used to access:

- The reader overview that provides detailed information about the reader operation.
- The file management utilities that allows creation, deletion and downloading files to a computer using the communication serial port.
- The configuration menu.

The key usage is described in the next chapter.

Audible Indicator

The audible indicator (beeper) is located on the CPU board. The audible indicator provides:

- Tactile feedback for the keyboard.
- Indication that a tag has been read (short beep).
- Indication that an abnormal condition (alarm) has been detected (2 short beeps).

Serial Communication Port

All functions and information available from the front panel is also available from the serial port and many of the operations such as antenna tuning are much easier and faster when performed from the communication port.

Reader Components

Labels on figure:
- S/N Label
- Fuses F1 - F3
- Antenna Switching Board (ASB)
- DANGER HIGH VOLTAGE
- SET -VE TO MIN (CW) PRIOR THE INSTALLATION
- Motherboard
- +VE Adj RP2
- Display
- Backup Lithium Battery
- CPU Board
- Buzzer
- Power Supply Voltage Test Points
- Receiver Adj C29
- JP4
- Analog Board
- ANT. 5   COM   ANT. 3   SENSOR   ANT. 1
- ANT. 6   ANT. 4   ANT. 2
- Ventilation Filter
- JP1 - JP3
- ACCEPTED
- DATE INSTALLED
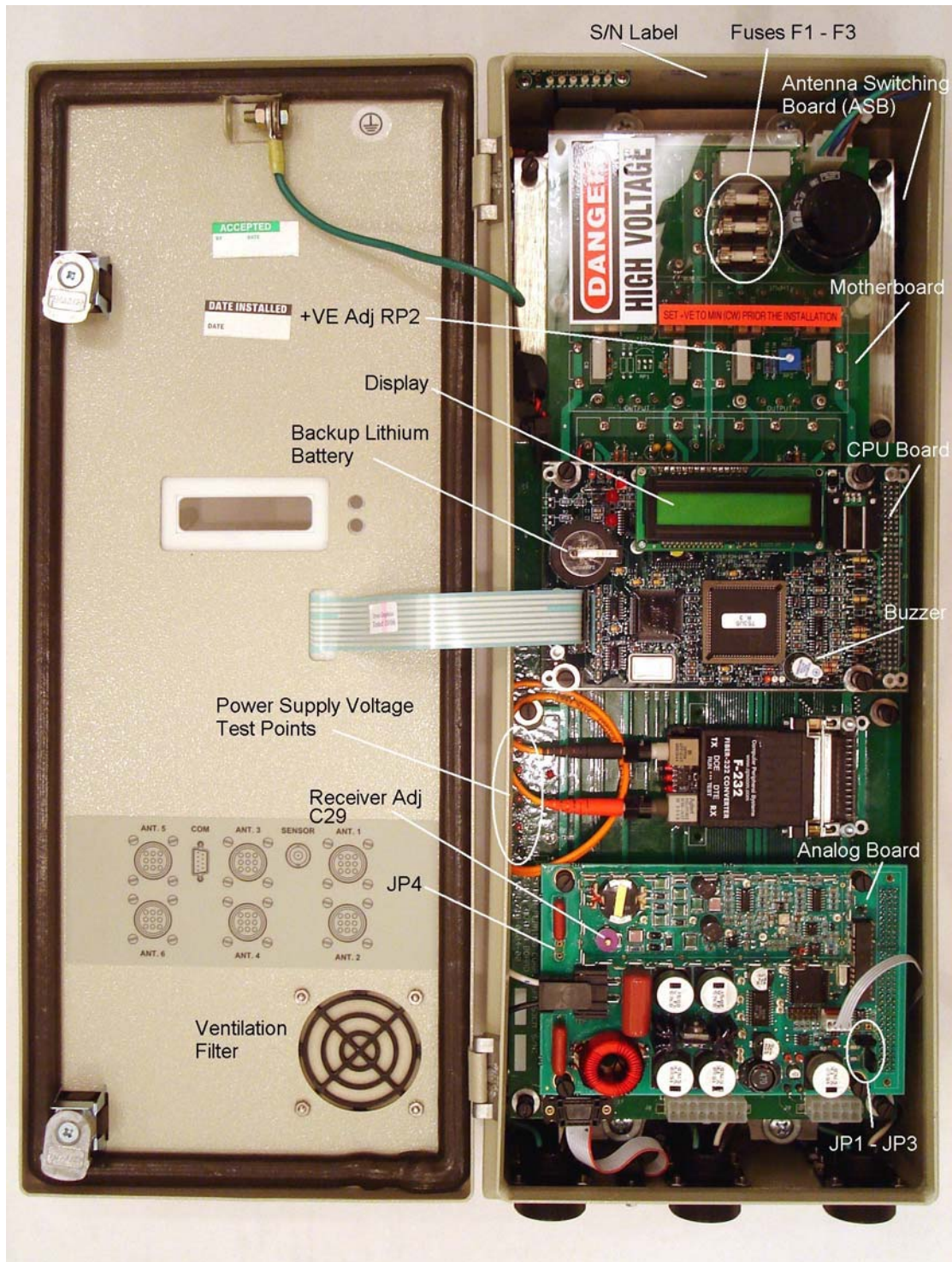
SCANNING FOR TAGS (Stby and Scan modes)

The tag scanning process can be started and stopped in different ways:

- **Manually** using the READ key

- **Remotely** using the serial port commands

Note: The reader starts up in the *Scan mode* **after a reset or power up.**

Manual Scanning

Manual scanning is done from the FS1001M front-panel keyboard using the READ key:

- In the *Standby* mode, momentarily push the READ key to *Scan* for tags.

- During the tag *Scan*, momentarily push the READ key to return to the *Standby* mode.

Remote Scanning

The RA command can be used to start and stop the scanning from a serial port. RA1 will start the *Scan* mode and RA0 will return the reader to the *Standby* mode. RAR will reset the reader. Please refer to the *Reader active (RA)* section for more details.

Tag ID Detection

When scanning, the following annunciation process occurs upon detection of a valid tag ID:

1. The antenna number and tag ID is displayed on the second LCD line (antenna number followed by a space then manufacturer ID followed by universal code all in hexadecimal format). If the tag number is different from the preceding tag found, the first line will briefly display "FOUND". If the number is the same as the preceding tag, the display will briefly show "SAME".

2. The READ LED indicator (left of the display) is turned ON each time a valid tag message is detected. Therefore, the LED will flash until the tag is removed from the antenna detection range.

3. The beeper is activated briefly if it is enabled (see Reader Buzzer, page 15). This option can be turned on or off from the keyboard menu or the serial port.

4. The tag ID message is sent on the communication port if "Send tag" is enabled. This option can be turned on or off from the keyboard menu or the serial port.

5. If the *Buffer* mode is selected, the tag ID is stored in the memory file along with the current date and time.

   Note: The above sequence is somewhat different when UNIQUE or UNIQUE DELAY is enabled. See the UNIQUE and UNIQUE DELAY command descriptions on page 13 for details.

Reader status

The system status information available from the front panel allows the user to examine detailed reader status from the display, including:

- Antenna current, relative antenna signal phase and tag/noise signal level.

- Complete list of active alarms existing in the reader.

- Number of tag codes stored.

- Date and Time.

A full system status report is available from the communication port; see Status Report on page 25 for details.

Antenna Display

The six "Antenna #" displays show the following information:

- The first value is the antenna current in amps peak-to-peak.

- The next or middle value is the relative phase. This is the difference between the actual antenna phase and the target phase for that antenna. The system uses this phase difference to adjust the tune of the antenna. This is discussed in greater detail on pages 18 and 38.

- The last value is average running noise seen on the antenna. See pages 29 and 38 for more details.

Pressing the ENTER key again will show the Alarm list, or ESCAPE will return to the main display.

Alarm List

The alarm list allows the user to see a detailed description of the alarms that have occurred. When a new alarm is detected:

- The reader beeps twice.

- A detailed alarm message is sent on both the local and the serial port.

- An abbreviated alarm message is displayed on the main screen.

The detailed alarm message can also be seen on the alarm list. On normal conditions, the following message is displayed on the alarm list screen:

```
No alarms
```

A detailed list of alarms and their descriptions can be found on page 48.

A down arrow (↓) is displayed on the right corner side of the display when more than one alarm exists. The user must then press the MENU key to see all the existing alarms.

```
Test Tag Failed ↓
```

Pressing the ENTER key again will show the Records Count, or ESCAPE will return to the main display.

Records Count

The records count displays the number of tag IDs presently stored in the buffer. The buffer can store a maximum of 5,350 tag IDs with date and time stamps.

Pressing the ENTER key again will show the Date and Time, or ESCAPE will return to the main display.

Date and Time

The Date and Time is current system clock setting used to stamp tag IDs as they are read.

At this point, pressing the MENU , ENTER or ESCAPE keys will return to the main display.

CONFIGURING THE READER

One of the exclusive features of the FS1001M Reader is its ability to be adapted to several types of operations and applications. The FS1001M operation can be tailored to the customer needs using the configuration setup operated from the front panel keyboard/display. It should also be noted that any change can be made from the serial ports using the appropriate command.

The FS1001M Reader has five primary menus and several sub-menus for selecting operating options. The following table shows the menu structure.

Table 1: Menu structure and default settings

Main menu	Sub-menu	Available settings	Default
Reader			
	Unique	On, Off, Delay	On
	Unique Delay	0001 – 1440 (unique mode delay in minutes)	0030
	ID in HEX	00 – F0	F0 (can be set when the reader is programmed)
	Buzzer	On, Off	On
	Reset params	No, Yes	No
Buffer			
	Active	On, Off	On
	Download	Pressing **Enter** will download the buffer memory to the communication port	
	Erase	No, Yes	No
	Test Tag	On**,** Off (determines if test tag IDs are stored in the buffer)	On
Local			
	Send tag	No, Yes (determines if tag IDs are sent to the communication port as they are detected)	Yes
Antenna			
	Sequence	XXXXXXXXXXXX (where X is 1 – 6)	123456000000
	1 Tuned Ph	0000 – 9999 (Antenna 1 target phase value)	0650
	2 Tuned Ph	0000 – 9999 (Antenna 2 target phase value)	0650
	3 Tuned Ph	0000 – 9999 (Antenna 3 target phase value)	0650
	4 Tuned Ph	0000 – 9999 (Antenna 4 target phase value)	0650
	5 Tuned Ph	0000 – 9999 (Antenna 5 target phase value)	0650
	6 Tuned Ph	0000 – 9999 (Antenna 6 target phase value)	0650
	Scan Time	0040 – 1000 (Antenna dwell time, in milliseconds, when a tag presence is detected)	0100
	Sleep Time	0000, 0002 – 9999 (Antenna idle time, in 10 milliseconds, before switching to the next antenna)	0000
Diag			
	Sys Temp	Displays system temperature in Celsius	
	Exciter	Displays exciter power supply voltage (+VE) in volts	
	Curr gain %	001 – 200 (antenna current calibration gain %)	103
	Alarm mA	0001 – 9999 mA (antenna current alarm threshold in milliamps)	1000 (can be set when the reader is programmed)
	Virtual Test tag	On, Off, S-S (for all antennas or for a specific antenna)	Off All
	TstTAG delay	0000 – 1440 (Test tag activation delay in minutes)	0060
	Report delay	0000 – 1440 (Status report sending delay in minutes)	0240
	Noise delay	0000 – 1440 (Noise report sending delay in minutes)	0000
	Send status	Pressing **Enter** will send the status report to the communication port	
	Noise gain %	001 – 200 (Noise level calibration gain %)	100
	Noise Alm	01 – 99 (Noise level alarm threshold %)	50

Keypad Navigation and Operation

The reader contains four different keys that can be used to configure the reader.

- The $\boxed{\text{MENU}}$ key is equivalent to a down arrow (↓) and allows you to browse the various menus and sub-menus.

- The $\boxed{\text{ESCAPE}}$ key is equivalent to an up arrow (↑) and allows you to exit the current menu and go to the preceding menu.

- The $\boxed{\text{ENTER}}$ key is equivalent to a computer enter key (↵), and allows either the selection of the currently displayed menu item for modification or the confirmation of a change you have made.

- The $\boxed{\text{RESET}}$ key allows the reader to be restarted (hardware Reset).

The following figure illustrates the operation of the keys.
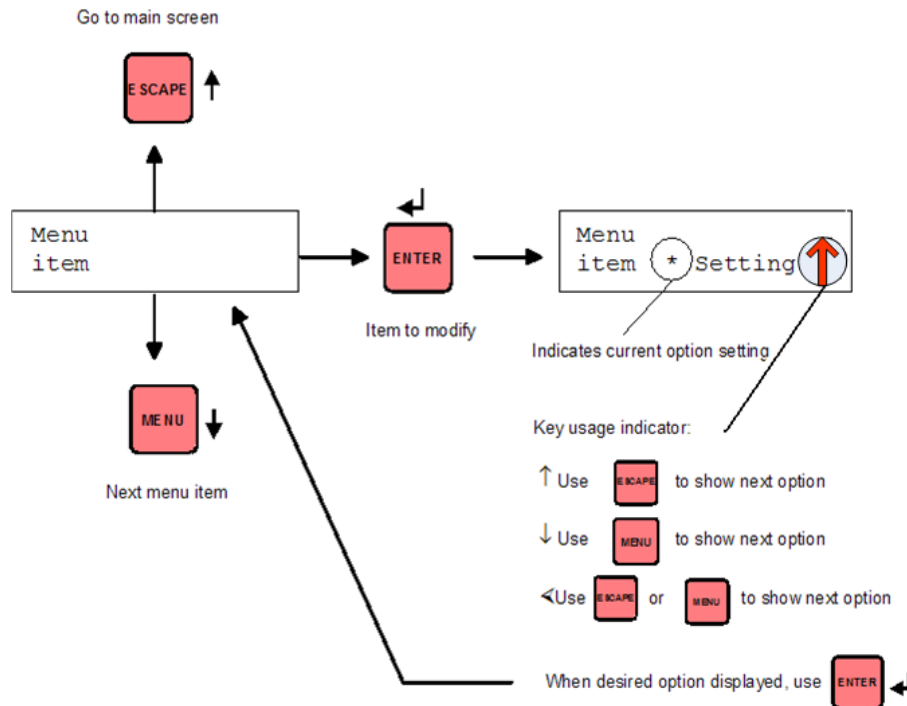
Figure 9: Key usage

From the *Standby* or the *Scan* mode, press the $\boxed{\text{MENU}}$ key to move from one primary menu to the next (*Standby/Scan* → Reader → Buffer → Local → Antenna → Diag → *Standby/Scan*...). From any menu, press the $\boxed{\text{ESCAPE}}$ key to escape back to the previous menu. Press the key to move to the sub-menus under each primary menu and then use the $\boxed{\text{MENU}}$ key to move among sub-menu options. When you want to modify an option, use the $\boxed{\text{ENTER}}$ key. Using the $\boxed{\text{MENU}}$ and the $\boxed{\text{ESCAPE}}$ keys, select the desired option and hit the $\boxed{\text{ENTER}}$ key. Press the $\boxed{\text{ESCAPE}}$ key to return to the upper level menu where you started. Pressing the $\boxed{\text{MENU}}$ key repeatedly will then cycle through the remaining primary menus until you return to the main menu. Alternatively, press the $\boxed{\text{ESCAPE}}$ key to return directly to the main menu.

Reader Menu

The Reader menu contains the following sub-menus:

- Unique Mode
- Unique Mode Delay
- Reader ID
- Reader buzzer
- Reset

Reader unique

For the following discussion, annunciated means the beeper is sounded (if enabled), the tag ID is displayed on the LCD, stored in the buffer (if active) and sent to the communication port (if enabled).

The *Unique mode* defines the reaction of the reader when the same tag is read several times sequentially on the same antenna. The *Unique mode* is antenna specific.

- When the Unique mode is *Off*, each time a tag is read it will be annunciated and the READ LED will flash.

- When the Unique mode is *On*, a tag will be annunciated only if it is different from the previous tag for a particular antenna. Therefore, the tag will only be annunciated once for each antenna even if it remains in the detection range of an antenna, unless a different tag is read. The READ LED will, however, flash every time a tag is read just as when Unique is Off.

- When the Unique mode is set to *Del*, a tag will be annunciated only if it is different from the previous tag ID detected on a particular antenna or if the unique delay has expired for that antenna. Therefore, the tag will be annunciated once when it first is read by an antenna. If the tag stays in the antenna detection range it will not be annunciated again until another tag is read on that antenna or until the *Unique delay* times out for that antenna; it would then only be annunciated once and the cycle would repeat.

Unique Mode helps minimize the amount of tag IDs stored in the buffer. This is particularly helpful in situations were a tag can remain in the detection range of antenna for extended periods of time. Unique Delay provides the researcher with an approximate length of time the tag remained in the detection range of an antenna.

To change the *Unique* setting from the front panel:

1. From the *Scan/Standby* display, press the MENU key until the "Reader…" sub-menu is displayed.

2. From the "Reader…" sub-menu, press the ENTER key to select it. The reader will then display the "Reader Unique" sub-menu.

3. From the "Reader Unique" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option (On, Off or Del), with the "*" symbol on the left and an arrow on the right (↓,↑ or ↕).

4. Use the MENU (equivalent to a down arrow "↓") or the ESCAPE key (equivalent to an up arrow "↑") as indicated on the display to select the next available setting.

5. Once the desired setting is on the display, press the ENTER key to select it.

6. You can then use the MENU key to select the next Reader sub-menu or the ESCAPE key to return to the upper level menu.

Reader unique delay

Unique Mode Delay operates the same as the Unique mode except that it also has a user selectable time out value. When the Unique mode is set to delay, a tag will be annunciated only if it is different from the previous tag ID detected on a particular antenna or if the unique delay as expired for that antenna.

For example, when new tag ID is read on an antenna and *Unique Mode Delay is enabled* the tag is annunciated once and delay timer is set for that antenna. If that tag is read again on the same antenna it is not annunciated until different tag is read on that antenna or the *Unique delay* times out for that antenna. And the cycle would repeat.

The primary intent of the Unique Delay Mode is to minimize the number of tag IDs stored in the buffer but still provide the researcher with an approximate length of time the tag remained in the detection range of an antenna.

To change the *Unique Mode* delay value:

1. From the *Scan/Standby* display, press the ⎡MENU⎤ key until the "Reader…" sub-menu is displayed.

2. From the "Reader…" sub-menu, press the ⎡ENTER⎤ key to select it. The reader will then display the "Reader Unique" sub-menu. Press the ⎡MENU⎤ key until the "Reader Unique Delay" sub-menu is displayed.

3. From the "Reader Unique Delay" sub-menu, press the ⎡ENTER⎤ key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit (↓,↑ or ↕).

4. Use the ⎡MENU⎤ (equivalent to a down arrow "↓") or the ⎡ESCAPE⎤ key (equivalent to an up arrow "↑") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the ⎡ENTER⎤ key to select it. The arrow will then move over the next digit. You can change it using the ⎡MENU⎤ or the ⎡ESCAPE⎤ key, or go to the next digit by pressing the ⎡ENTER⎤ key.

6. Once all the digits are done, you can then use the ⎡MENU⎤ key to select the next Reader sub-menu or the ⎡ESCAPE⎤ key to return to the upper level menu.

Note: To enable the Unique Mode Delay from the keypad see the Unique Mode above.

Reader ID in hex

The Reader ID is a user selectable hexadecimal number meant to uniquely identify a particular reader.

To change the *Reader ID* setting:

1. From the *Scan/Standby* display, press the ⎡MENU⎤ key until the "Reader…" sub-menu is displayed.

2. From the "Reader…" sub-menu, press the ⎡ENTER⎤ key to select it. The reader will then display the "Reader Unique" sub-menu. Press the ⎡MENU⎤ key until the "Reader ID in HEX" sub-menu is displayed

3. From the "Reader ID in HEX" sub-menu, press the ⎡ENTER⎤ key to select it. The reader will then display the current setting of the option with the "*" symbol on the left and an arrow on the right (↓,↑ or ↕).

4. Use the ⎡MENU⎤ (equivalent to a down arrow "↓") or the ⎡ESCAPE⎤ key (equivalent to an up arrow "↑") as indicated on the display to change the most significant digit. The least significant digit will always be "0".

5. Once the desired setting is on the display, press the ⎡ENTER⎤ key to select it.

6. You can then use the ⎡MENU⎤ key to select the next Reader sub-menu or the ⎡ESCAPE⎤ key to return to the upper level menu.

Note: The Reader ID default value is set up during the reader programming process. See **VBFlash program operation** on page 51 for details.

Reader buzzer

The Reader Buzzer is an audible annunciator that indicates a tag has been read, an alarm condition has occurred, a system reset has occurred, etc.

To change the *Reader Buzzer* setting:

1. From the *Scan/Standby* display, press the $\boxed{\text{MENU}}$ key until the "Reader…" sub-menu is displayed.

2. From the "Reader…" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the "Reader Unique" sub-menu. Press the $\boxed{\text{MENU}}$ key until the "Reader Buzzer" sub-menu is displayed

3. From the "Reader Buzzer" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the current setting of the option (On or Off) with the "*" symbol on the left and an arrow on the right ($\downarrow$ or $\uparrow$).

4. Use the $\boxed{\text{MENU}}$ (equivalent to a down arrow "$\downarrow$") or the $\boxed{\text{ESCAPE}}$ key (equivalent to an up arrow "$\uparrow$") as indicated on the display to select the next available setting.

5. Once the desired setting is on the display, press the $\boxed{\text{ENTER}}$ key to select it.

You can then use the $\boxed{\text{MENU}}$ key to select the next Reader sub-menu or the $\boxed{\text{ESCAPE}}$ key to return to the upper level menu.

Note: The audible alarm can interfere with reader performance when a large volume of tags is being decoded. It is recommended you turn off the buzzer during regular reader operation and use it only for set up and maintenance purposes.

Reset parameters

To restore the reader default parameters (see table 2) from the keyboard, use the following procedure:

1. From the *Scan/Standby* display, press the $\boxed{\text{MENU}}$ key until the "Reader…" sub-menu is displayed.

2. From the "Reader…" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the "Reader Unique" sub-menu. Press the $\boxed{\text{MENU}}$ key until the "Reader Reset parms" sub-menu is displayed.

3. From the "Reader Reset parms" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the current setting of the option (No), with the "*" symbol on the left and an arrow on the right ($\uparrow$).

4. Use the $\boxed{\text{ESCAPE}}$ key (equivalent to an up arrow "$\uparrow$") to select "Yes" or the $\boxed{\text{MENU}}$ key (equivalent to a down arrow "$\downarrow$") as indicated on the display to go back to the "No" setting.

5. Once the desired setting is on the display, press the $\boxed{\text{ENTER}}$ key to select it.

   A reader reset is automatically performed after this command.

Note: The Reader ID and the antenna parameters (such as antennas switching sequence and antennas target phase) will not be affected by the reset parameter command. To reset all parameters to their default you need to power down the reader and remove the back-up lithium battery from the CPU board for a few seconds; this will also reset the internal clock.

Buffer Menu

The FS1001M reader has a data-logging memory buffer with a maximum capacity of 5,350 tag IDs (with a date/time stamp, reader ID and antenna number) and up to 146 Status Reports. The data logging buffer is protected by a lithium back-up battery that prevents accidental data loss when the main power is low or turned off. This button style back-up battery is located on the CPU board and has an expected life of 5 years (Model CR2016 made by Eveready, Toshiba or equivalent).

The buffer is designed to store tag IDs in a ring configuration in 50 tag record blocks. That is, when the buffer is filled to 5,350 tag records the next tag read will cause the block of memory containing the first 50 records (the oldest ones) to be erased to make room for the new tag. This process of "out with the old and in with the new" will repeat each time the buffer reaches 5,350 records. Since the tag memory management is

performed in blocks of 50 tags when the reader indicates memory full (MMF) the actual tag records in memory will be between 5,301 and 5,350.

The buffer management utilities allow the user to enable or disable the storing of tag IDs, download the buffer contents to the communication port, and erase the contents of the buffer.

Note: The unique mode affects the manner in which tag IDs are stored when the buffer is active. See the Unique Mode and Unique Mode Delay sections on page 13 for more details.

The buffer is also designed to store reader status reports. When the Status Report Delay is set a Status Report is sent to the serial port each time the delay times out. Each time an automatic status report is sent to the serial port an abbreviated version of the report containing the volatile parameters and alarms is stored in the buffer (regardless of the Buffer Active setting) in the same round robin fashion as the tag buffer above. Once the report buffer fills up, each new report only overwrites the oldest report. See page 25 for more details on full and short Status Report contents

Note: Status Reports are cleared from the buffer each time the reader is powered down or reset. Also, status reports generated manually using the reader "Send status" sub-menu or the DRS command are not stored in the buffer

The Buffer menu contains the following sub-menus:

- Active

- Download

- Erase

- Test Tag

Buffer active

To enable or disable the buffer from the front panel:

1. From the *Ready/Standby* display, press the ⎡MENU⎤ key until the "Buffer…" sub-menu is displayed.

2. From the "Buffer…" sub-menu, press the ⎡ENTER⎤ key to select it. The reader will then display the "Buffer Active" sub-menu.

3. From the "Buffer Active" sub-menu, press the ⎡ENTER⎤ key to select it. The reader will then display the current setting of the option (Yes or No), with the "*" symbol on the left and an arrow on the right (↓ or ↑).

4. Use the ⎡MENU⎤ (equivalent to a down arrow "↓") or the ⎡ESCAPE⎤ key (equivalent to an up arrow "↑") as indicated on the display to select the next available setting.

5. Once the desired setting is on the display, press the ⎡ENTER⎤ key to select it.

6. You can then use the ⎡MENU⎤ key to select the next Buffer sub-menu or the ⎡ESCAPE⎤ key to return to the upper level menu.

Buffer download

The Buffer Download function is used to send the reader contents to a computer.

When a Buffer Download command is performed the reader dumps stored tag IDs first.

The buffered tag records consist of the following:

>   *F0 F1 3D9.29E9227BCC 01-01-1996 00:17:41

where:

- * - Asterisk indicating this is a buffered record and not a tag read in real time

- `F0` - Reader ID

- `F1` - Antenna Number

- 3D9.29E9227BCC – Tag ID

- 01-01-1996 - Date

- 00:17:41 - Time

After all the buffered tag reports have been sent to the serial port a full status report is sent followed by all buffered status reports. See page 25 for more details.

To download the buffer content from the front panel:

1. From the *Ready/Standby* display, press the MENU key until the "Buffer…" sub-menu is displayed.

2. From the "Buffer…" sub-menu, press the ENTER key to select it. The reader will then display the "Buffer Active" sub-menu. Press the MENU key until the "Buffer Download" sub-menu is displayed.

3. From the "Buffer Download" sub-menu, press the ENTER key to select it. The reader will then start downloading. The message "Sending buffer ESC to abort" will remain on the display until the download is completed. The download may take several minutes but does not affect the tag scanning. To stop the download press the ESCAPE key.

4. Once the buffer download is completed, the reader will automatically return to the "Buffer Download" menu.

5. You can then use the MENU key to select the next Buffer sub-menu or the ESCAPE key to return to the upper level menu.

Buffer erase

The Buffer Erase function allows you to delete all stored tag IDs and Status Reports from a buffer.

To erase the buffer from the front panel:

1. From the *Ready/Standby* display, press the MENU key until the "Buffer…" sub-menu is displayed.

2. From the "Buffer…" sub-menu, press the ENTER key to select it. The reader will then display the "Buffer Active" sub-menu. Press the MENU key until the "Buffer Erase" sub-menu is displayed.

3. From the "Buffer Erase" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option (No) with the "*" symbol on the left and an arrow on the right (↑).

   Use the ESCAPE key (equivalent to an up arrow "↑") to select "Yes" or the MENU key (equivalent to a down arrow "↓") as indicated on the display to go back to "No" setting if you change your mind.

4. Once the desired choice is on the display, press the ENTER key to select it.

5. You can then use the MENU key to select the next Buffer sub-menu or the ESCAPE key to return to the upper level menu.

Buffer test tag

The Buffer Test Tag option allows you to store test tag IDs in a buffer.

To enable or disable storing test tag IDs in a buffer from the front panel:

1. From the *Ready/Standby* display, press the MENU key until the "Buffer…" sub-menu is displayed.

2. From the "Buffer…" sub-menu, press the ENTER key to select it. The reader will then display the "Buffer Active" sub-menu. Press the MENU key until the "Buffer TestTag" menu is displayed.

3. From the "Buffer TestTag" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option (Yes or No) with the "*" symbol on the left and an arrow on the right (↓ or ↑).

4. Use the MENU key (equivalent to a down arrow "↓") or the ESCAPE key (equivalent to an up arrow "↑") as indicated on the display to select the next available setting;

---

5. Once the desired setting is on the display, press the ENTER key to select it.

6. You can then use the MENU key to select the next Buffer sub-menu or the ESCAPE key to return to the upper level menu.

Local Menu

The Local menu is used to set the communication port operating option. The Local menu contains one sub-menu: Send tag.

Send tag setting

When the "Send tag" is enabled, tag IDs are sent on the communication serial port as they are detected and conditioned by the *Unique* option. The tag IDs are sent in the following format (ASCII characters: manufacturer ID followed by the universal code in hexadecimal format separated by a dot):

```
3D9.1BF0DB2DF0
```

The complete message is made up of the Reader ID, Antenna #, tag ID, Date and Time Stamp. The following is an example of the same tag being read on three different antennas:

```
F0 F3 3D9.29E9227BCC 25-08-2003 15:23:26
F0 F1 3D9.29E9227BCC 25-08-2003 15:23:27
F0 F2 3D9.29E9227BCC 25-08-2003 15:23:27
```

The tag records consist of the following:

```
F0 F1 3D9.29E9227BCC 25-08-2003 15:23:26
```

F0 - Reader ID

F1 - Antenna Number

3D9.29E9227BCC – Tag ID

25-08-2003 - Date

15:23:26 - Time

To change the Send tag setting:

1. From the *Ready/Standby* display, press the MENU key until the "Local…" sub-menu is displayed.

2. From the "Local…" sub-menu, press the ENTER key to select it. The reader will then display the "Local Send tag" sub-menu.

3. From the "Local Send tag" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option (Yes or No), with the "*" symbol on the left and an arrow on the right (↓ or ↑).

4. Use the MENU (equivalent to a down arrow "↓") or the ESCAPE key (equivalent to an up arrow "↑") as indicated on the display to select the next available setting.

5. Once the desired setting is on the display, press the ENTER key to select it.

6. You can then use the ESCAPE key to return to the upper level menu.

Antenna Menu

The Antenna menu is used to set antennas operation parameters. It contains the following sub-menus:

- Antenna Sequence
- Antenna 1 Tuned Ph
- Antenna 2 Tuned Ph
- Antenna 3 Tuned Ph

- Antenna 4 Tuned Ph

- Antenna 6 Tuned Ph

- Antenna Scan Time

- Antenna Sleep Time

Antenna Sequence

The *Antenna Sequence* sub-menu is used to select which antennas will be active and what sequence they will be switched between. The reader is limited to up to six physical antennas. However, to provide additional flexibility there are up to 12 entries available in the switching sequence.

To change the Send tag setting:

1. From the *Ready/Standby* display, press the MENU key until the "Antenna…" sub-menu is displayed;

2. From the "Antenna …" sub-menu, press the ENTER key to select it. The reader will then display the "Antenna Sequence" sub-menu.

3. From the "Antenna Sequence" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option with the first digit flashing and an arrow on the right of the sequence (↕).

4. Use the MENU (equivalent to a down arrow "↓") or the ESCAPE key (equivalent to an up arrow "↑") as indicated on the display to change the first position of the sequence.

5. Once the desired setting is on the display, press the ENTER key to select it. The next digit will start flashing. You can change it using the MENU or the ESCAPE key, or go to the next digit by pressing the ENTER key.

6. Once all the digits are done press the ENTER key, the reader will display "ESC(clr)/ENT(ok)", press the ENTER key to confirm or the ESCAPE key to abort antenna sequence change.

7. Once the sequence is updated you can then use the MENU key to select the next Antenna sub-menu or the ESCAPE key to return to the upper level menu.

Note: If using only one antenna its number has to appear in the antenna sequence at least twice to ensure proper reader operation.

Antenna 1 – 6 Tuned Ph

The *Antenna 1-6 Tuned Ph* sub-menus are used to set the target phase value for each antenna. The reader then automatically selects and constantly updates the bank of tuning capacitors for each antenna to achieve the target phase.

To change the Antenna Tuned Ph setting:

1. From the *Ready/Standby* display, press the MENU key until the "Antenna…" sub-menu is displayed.

2. From the "Antenna …" sub-menu, press the ENTER key to select it. The reader will then display the "Antenna Sequence" sub-menu. Press the MENU key until "Antenna # Tuned Ph" sub-menu is displayed (where "# " is the number of desired antenna).

3. From the "Antenna # Tuned Ph" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit (↓,↑ or ↕).

4. Use the MENU (equivalent to a down arrow "↓") or the ESCAPE key (equivalent to an up arrow "↑") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the ENTER key to select it. The arrow will then move over the next digit. You can change it using the MENU or the ESCAPE key, or go to the next digit by pressing the ENTER key.

6. Once all the digits are done, you can then use the [MENU] key to select the next Antenna sub-menu or the [ESCAPE] key to return to the upper level menu.

Note: For the information on how to determine target phase value see Tuning procedure on page 49.

Scan time

The *Antenna Scan Time* sub-menu is used to define how long the reader will stay at an antenna and attempt to decode a tag if a tag presence is detected. Acceptable range is 40 to 1000ms.

To change the Scan Time setting:

1. From the *Ready/Standby* display, press the [MENU] key until the "Antenna…" sub-menu is displayed.

2. From the "Antenna …" sub-menu, press the [ENTER] key to select it. The reader will then display the "Antenna Sequence" sub-menu. Press the [MENU] key until "Antenna Scan Time" sub-menu is displayed.

7. From the "Antenna Scan Time" sub-menu, press the [ENTER] key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit ($\downarrow$,$\uparrow$ or $\updownarrow$).

8. Use the [MENU] (equivalent to a down arrow "$\downarrow$") or the [ESCAPE] key (equivalent to an up arrow "$\uparrow$") as indicated on the display to change the most significant digit.

9. Once the desired setting is on the display, press the [ENTER] key to select it. The arrow will then move over the next digit. You can change it using the [MENU] or the [ESCAPE] key, or go to the next digit by pressing the [ENTER] key.

3. Once all the digits are done, you can then use the [MENU] key to select the next Antenna sub-menu or the [ESCAPE] key to return to the upper level menu.

Note: Decreasing this parameter decreases overall switching cycle but also decreases the chance of a successful tag ID decoding.

Sleep time

The *Antenna Sleep Time* sub-menu is used to activate and set up sleep mode, which helps to conserve and extend battery life. In this mode the reader puts each antenna in an idle state prior to switching to the next one for amount of time specified by this delay. The delay can be set to 0 (disable) or from 2 - 9999 in 10ms increments.

To change the Sleep Time setting:

1. From the *Ready/Standby* display, press the [MENU] key until the "Antenna…" sub-menu is displayed.

2. From the "Antenna …" sub-menu, press the [ENTER] key to select it. The reader will then display the "Antenna Sequence" sub-menu. Press the [MENU] key until "Antenna Sleep Time" sub-menu is displayed.

3. From the "Antenna Sleep Time" sub-menu, press the [ENTER] key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit ($\downarrow$,$\uparrow$ or $\updownarrow$).

4. Use the [MENU] (equivalent to a down arrow "$\downarrow$") or the [ESCAPE] key (equivalent to an up arrow "$\uparrow$") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the [ENTER] key to select it. The arrow will then move over the next digit. You can change it using the [MENU] or the [ESCAPE] key, or go to the next digit by pressing the [ENTER] key.

6. Once all the digits are done, you can then use the [MENU] key to select the next Antenna sub-menu or the [ESCAPE] key to return to the upper level menu.

Note: While in sleep mode the antenna current is turned off so no tags can be detected. Also, activating the sleep mode will increase the amount of time it takes to cycle through all antennas in the antenna sequence.

Diagnostic Menu

The Diagnostic menu includes a variety of tools used for system installation and maintenance. It consists of the following features:

- Display the temperature inside the case.

- Display the voltage of the exciter power supply (+VE test point).

- Calibrate the antenna current.

- Set the antenna current alarm threshold.

- Control the test tag.

- Set the test tag delay (periodic system verification).

- Set the status report delay.

- Set the noise report delay.

- Send the reader status report to the computers.

- Calibrate the noise measurement.

- Set the noise alarm threshold.

System temperature

The *Sys Temp* function will display the system temperature in Celcius. For example:

```
Diag – Sys temp
  37 Celcius
```

To display system temperature:

1. From the *Ready/Standby* display, press the MENU key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the ENTER key to select it. The reader will then display the "Diag - Sys temp" sub-menu.

3. You can then use the MENU key to select the next Diag sub-menu or the ESCAPE key to return to the upper level menu.

This information is available from the communications port as part of the Status Report.

Exciter

The *Exciter* function displays the exciter power supply voltage. For example:

```
Diag – Exciter
>■■■■■■   < 12.1
```

The left portion is a horizontal bar graph with approximately 0.75V resolution (per horizontal dot). The right side shows the supply value in volts. This voltage is equivalent to the one measured between +VE and 0VE test points on the motherboard. The measurement precision is approximately ±0.2V. A higher exciter voltage translates into greater current at the antenna. The voltage can be adjusted from 14V to 24V using potentiometer RP2 located on the motherboard.

To display exciter voltage:

1. From the *Ready/Standby* display, press the MENU key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the ENTER key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the MENU key until the "Diag - Exciter" sub-menu is displayed.

You can then use the $\boxed{\text{MENU}}$ key to select the next Diag sub-menu or the $\boxed{\text{ESCAPE}}$ key to return to the upper level menu.

This information is available from the communication port as part of the Status Report.

Current gain %

The *Curr Gain %* function is used to calibrate the antenna current peak-to-peak measurement. Current gain value can be between 1 and 200%. The calibration formula is the following:

$$I_{displayed} = (I_{measured} * Curr\ gain)/100$$

The current gain has been calibrated at the factory to report the peak-to-peak amps. If the system is reporting inaccurate current values the following calibration procedure can be used to correct the inaccuracy.

1. Set the antenna sequence for selection of only one antenna (i.e. AS 1,1,0,0,0,0,0,0,0,0,0,0).

2. Connect a current probe to either wire from connector J2 on the Analog board and measure the peak-to-peak current value ($I_{measured}$).

3. Take note of the existing Curr Gain (Old gain) from the Curr Gain menu.

4. Using the Antenna Current, Phase and Noise display under the Status Menu, read the antenna current measured by the reader ($I_{displayed}$).

5. The new current gain setting should be computed as follows:

$$New\ gain = (I_{measured} * Old\ Gain) / (I_{displayed})$$

To change the current gain:

1. From the *Ready/Standby* display, press the $\boxed{\text{MENU}}$ key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the $\boxed{\text{MENU}}$ key until the "Diag Curr gain %" sub-menu is displayed.

3. From the "Diag Curr Gain" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit (↓,↑ or ↕).

4. Use the $\boxed{\text{MENU}}$ (equivalent to a down arrow "↓") or the $\boxed{\text{ESCAPE}}$ key (equivalent to an up arrow "↑") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the $\boxed{\text{ENTER}}$ key to select it. The arrow will then move over the next digit. You can change it using the $\boxed{\text{MENU}}$ or the $\boxed{\text{ESCAPE}}$ key, or go to the next digit by pressing the $\boxed{\text{ENTER}}$ key.

6. Once all the digits are done, you can then use the $\boxed{\text{MENU}}$ key to select the next Diag sub-menu or the $\boxed{\text{ESCAPE}}$ key to return to the upper level menu.

The present Current Gain value is available from the communication port as part of the Status Report.

This procedure may have to be repeated a couple of times to dial in the correct current gain value.

Alarm mA

The *Alarm mA* function is used to set the current alarm threshold from 1 to 9999 milliamps. The alarm will be generated if antenna current drops below the threshold. It can be used to indicate reader deterioration (tuning or connection problem, etc.).

To change the current alarm:

1. From the *Ready/Standby* display, press the $\boxed{\text{MENU}}$ key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the $\boxed{\text{MENU}}$ key until the "Diag Alarm mA" sub-menu is displayed.

3. From the "Diag Alarm mA" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit (↓,↑ or ↕).

4. Use the [MENU] (equivalent to a down arrow "↓") or the [ESCAPE] key (equivalent to an up arrow "↑") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the [ENTER] key to select it. The arrow will then move over the next digit. You can change it using the [MENU] or the [ESCAPE] key, or go to the next digit by pressing the [ENTER] key.

6. Once all the digits are done, you can then use the [MENU] key to select the next Diag sub-menu or the [ESCAPE] key to return to the upper level menu.

The present Current Alarm Threshold value is available from the communication port as part of the Status Report.

Note: The Current Alarm Threshold default value is set up during the reader programming process. See page 51 for details.

Virtual test tag

The Virtual Test Tag (VTT) is a device designed to verify the reader integrity and sensitivity. It generates an ISO FDX-B tag signal at pre-settable signal levels for each antenna that can be turned on/off by the reader in the following manner.

1. Automatically at user selectable intervals based on the Virtual Test Tag Delay setting. This test is done in order to verify that the reader is operating properly especially for extended periods when no PIT tags are present.

2. Manually by the user using the keyboard or a serial port connection.

When the test is performed automatically by the system (first case) or a single shot command is entered from the keypad or serial port, the following message is sent on the serial port for each antenna tested:

```
MESSAGE: Test Tag Fired on antenna 1
```

If the test is successful, the user will be notified by the following message on the serial port:

```
MESSAGE: Test Tag Found
```

If the test tag is not detected within approximately 100ms, the "TAG" alarm message will be displayed on the main screen and the following message will be sent to the serial port:

```
PROBLEM: Test Tag Failed
```

If the system detects the possible presence of a tag at the antenna in question the Test Tag firing will be aborted and the following message will appear:

```
MESSAGE: Test aborted due to system activity
```

When the test tag is turned *ON* continuously from the keypad or the serial port, the system performs a recovery efficiency evaluation, which is the percentage of the tag recovery (hit rate) over a 4 second period for each antenna enabled. The following message is sent to the serial port when antennas 1, 2, 3, and 4 are enabled every four seconds.

```
Ant1 Hit Rate : 99
Ant2 Hit Rate : 98
Ant3 Hit Rate : 100
Ant4 Hit Rate : 100
```

In order to exit from that test mode, the Test tag must be turned *Off* or the unit must be reset.

Note: The Virtual Test tag level or signal strength is adjustable and can be set to different levels for each antenna. This enables the Reader to use the VTT to determine sensitivity as well as an end-to-end system integrity test for individual antennas. However, the VTT level can only be adjusted via the serial port from the Manual Tuning Mode or using TL command. See pages 23 and 44 for details.

The test tag can be turned **On**, **Off**, or **S-S** for all antennas simultaneously or for individual antennas from the front panel:

1. From the *Ready/Standby* display, press the `MENU` key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the `ENTER` key to select it. The reader will then display the "Diag- -Sys temp" sub-menu. Press the `MENU` key until the "Diag Virtual Test tag" sub-menu is displayed.

3. From the "Diag Virtual Test tag" display, press the `ENTER` key to select it. The reader will then display "VTT State   ON↓". Press the `MENU` key to select the desired action (turn VTT " On ", " Off ", or " S-S " (single shot)) and then press the `ENTER` key to select the action.

4. The reader will then display "VTT Ant   *All↓". Use the `MENU` (equivalent to a down arrow "↓") or the `ESCAPE` key (equivalent to an up arrow "↑") as indicated on the display to select "*All " or one of the 6 antennas.

5. Once the desired selection is made press the `ENTER` to initiate the VTT action.

6. You can then use the `MENU` key to select the next Diag sub-menu or the `ESCAPE` key to return to the upper level menu.

TstTAG delay

The TstTAG delay function is used to set the virtual test tag delay period. The delay can set from 0 (disabled) to 1440 minutes (24 hours).

When the delay expires, the reader verifies the possible presence of a tag within an antenna. This is done by checking both of the following conditions for each antenna:

*   The number of signal transitions per second must be below 1024 (average signal frequency below 512 Hz).

*   The tag-decoding algorithm must not be synchronized on the incoming signal.

If one of the conditions is not met, there is a possibility that a tag is already within the antenna field and the self-test for that particular antenna is aborted.

```
MESSAGE: Test aborted due to system activity.
```

If both of these conditions are met, the probability of having a tag within the antenna is low and therefore, the reader proceeds with the self-test by activating the test tag for up to 100ms for each antenna. If the test tag is successfully read the following actions are performed by the reader:

*   It will show the tag ID on the LCD display.

*   It will store the tag ID in the memory file (if "Buffer Active" and "Buffer TestTag" are enabled).

*   It will send the tag ID (if "Send tag" is enabled) and test message to the communication port:

```
F0> MESSAGE: Test Tag Fired on antenna 1

MESSAGE: Test Tag Found

F0 F1 3E7.0000001DF0 23-01-200:12
```

If the test tag was not read within 100ms of its activation, a "TAG" (Test Tag Failed) alarm is generated and the following message is sent to the communication port:

```
F0> MESSAGE: Test Tag Fired on antenna 1

PROBLEM: Test Tag Failed
```

This process is repeated for each antenna in the antenna sequence. The delay is then rearmed and the next test will be conducted at its expiration.

To change the Test tag delay:

1. From the *Ready/Standby* display, press the MENU key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the ENTER key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the MENU key until the "Diag TstTAG Delay" sub-menu is displayed.

3. From the "Diag TstTAG Delay" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit (↓,↑ or ↕).

4. Use the MENU (equivalent to a down arrow "↓") or the ESCAPE key (equivalent to an up arrow "↑") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the ENTER key to select it. The arrow will then move over the next digit. You can change it using the MENU or the ESCAPE key, or go to the next digit by pressing the ENTER key.

6. Once all the digits are done, you can then use the MENU key to select the next Diag sub-menu or the ESCAPE key to return to the upper level menu.

Note: The test is performed right after the delay is set.

Report delay

The status report is a complete list of the current system setup and operational parameters. This report is only available from the communication port and is presented as a compressed comma delimited serial data stream. This format is difficult to read as is but was necessary due to program memory constraints. It is recommended to use the "MiniMon" program, available from the Pacific States Marine Fisheries Commission Web site at www.psmfc.org, to read this report. The MiniMon program has been designed to interface with the Multiplexer and provides data collection services, a limited command interface and breaks out the status report data stream into an easy to read format.

A status report can be requested from both the front panel and the communication port. The "Report Delay" can be set by a user so that a status report is sent to the communication port automatically at an interval of between 0 (disabled) and 1440 minutes (24 hours). In addition, status reports are stored in internal memory (see page 15 for details). Status reports stored in memory only contain variable parameters (see table below) such as Antenna Current, Internal Temperature, etc. to conserve memory. The static parameters such as Reader ID and Buffer Active are only reported once in a "Buffer Download" but are reported for each user requested and automated status report.

Below is a full status report followed by a table identifying each element in the status report:

```
$MUX1230,1,9,10,1,1,1,1,1,60,240,0,103,3000,100,50,100,0,670,36A,0,670,224,0,
670,36D,50,670,1F2,0,670,36D,0,670,22B,25,1,2,3,4,5,6,0,0,0,0,0,0,22,231,0,1,
70,1,1,1,1,1,1,455,633,455,634,457,636,-1,-1,-2,-3,-2,-3,29,54,29,54,20,47,0,
0,0,0,0,0,NL2,NL4,TAG,05-02-2007 16:21:39
```

Item Position	Item Description	Value Range	Value Above
0	Unique String Identifier	$	$
1	Firmware Name	MUX1220, MUX1225, MUX1230	MUX1230
2	Firmware Version	00 – 99	1
3	Firmware Revision	00 – 99	9
4	Reader ID	00 – F0	10
5	Unique Mode	0 – OFF, 1 – ON	1
6	Enable Beep	0 – OFF, 1 – ON	1
7	Send To Comm	0 – NO, 1 – YES	1
8	Store Tag Mode	0 – OFF, 1 – ON	1

9	Store Test Tag	0 – OFF, 1 – ON	1
10	Test Tag Fire Delay	0 – 1440 min	60
11	Status Report Delay	0 – 1440 min	240
12	Noise Report Delay	0 – 1440 min	0
13	Current Gain	1 – 200 %	103
14	Current Alarm Threshold	1 – 9999 mA	3000
15	Noise Gain	1 – 200 %	100
16	Noise Alarm Threshold	1 – 99 %	50
17	Scan Time	40 – 1000 ms	100
18	Sleep Time	0 – 9999 x 10 ms	0
19	Ant1 Target Phase	0 – 1023	670
20	Ant1 Capacitor Setting	0 – FFF (Hex Value)	36A
21	Ant1 VTT Level	0 – 99	0
22	Ant2 Target Phase	0 – 1023	670
23	Ant2 Capacitor Setting	0 – FFF (Hex Value)	224
24	Ant2 VTT Level	0 – 99	0
25	Ant3 Target Phase	0 – 1023	630
26	Ant3 Capacitor Setting	0 – FFF (Hex Value)	36D
27	Ant3 VTT Level	0 – 99	50
28	Ant4 Target Phase	0 – 1023	670
29	Ant4 Capacitor Setting	0 – FFF (Hex Value)	1F2
30	Ant4 VTT Level	0 – 99	0
31	Ant5 Target Phase	0 – 1023	670
32	Ant5 Capacitor Setting	0 – FFF (Hex Value)	36D
33	Ant5 VTT Level	0 – 99	0
34	Ant6 Target Phase	0 – 1023	670
35	Ant6 Capacitor Setting	0 – FFF (Hex Value)	22B
36	Ant6 VTT Level	0 – 99	25
37	Antenna sequence 1st position	1 – 6	1
38	Antenna sequence 2nd position	1 – 6	2
39	Antenna sequence 3rd position	1 – 6	3
40	Antenna sequence 4th position	1 – 6	4
41	Antenna sequence 5th position	1 – 6	5
42	Antenna sequence 6th position	1 – 6	6
43	Antenna sequence 7th position	1 – 6	0
44	Antenna sequence 8th position	1 – 6	0
45	Antenna sequence 9th position	1 – 6	0
46	Antenna sequence 10th position	1 – 6	0
47	Antenna sequence 11th position	1 – 6	0
48	Antenna sequence 12th position	1 – 6	0
49	Temperature	-50 – 999 °C	22

50	Exciter power	140 – 240 x 0.1 V	231
51	Lithium battery	0 – OK, 1 – LOW	0
52	Memory used	0 – 100 %	1
53	Tag stored Count	0 – 5350	70
54	Antenna 1 present	0 – NO, 1 – YES, 2 – YES, Reader in STANDBY	1
55	Antenna 2 present	0 – NO, 1 – YES, 2 – YES, Reader in STANDBY	1
56	Antenna 3 present	0 – NO, 1 – YES, 2 – YES, Reader in STANDBY	1
57	Antenna 4 present	0 – NO, 1 – YES, 2 – YES, Reader in STANDBY	1
58	Antenna 5 present	0 – NO, 1 – YES, 2 – YES, Reader in STANDBY	1
59	Antenna 6 present	0 – NO, 1 – YES, 2 – YES, Reader in STANDBY	1
60	Antenna 1 Current	0 – 800 x 0.01 A_{p-p}	455
61	Antenna 2 Current	0 – 800 x 0.01 A_{p-p}	633
62	Antenna 3 Current	0 – 800 x 0.01 A_{p-p}	455
63	Antenna 4 Current	0 – 800 x 0.01 A_{p-p}	634
64	Antenna 5 Current	0 – 800 x 0.01 A_{p-p}	457
65	Antenna 6 Current	0 – 800 x 0.01 A_{p-p}	636
66	Antenna 1 Phase	0 – ±1023	-1
67	Antenna 2 Phase	0 – ±1023	-1
68	Antenna 3 Phase	0 – ±1023	-2
69	Antenna 4 Phase	0 – ±1023	-3
70	Antenna 5 Phase	0 – ±1023	-2
71	Antenna 6 Phase	0 – ±1023	-3
72	Antenna 1 Noise	0 – 100 %	29
73	Antenna 2 Noise	0 – 100 %	54
74	Antenna 3 Noise	0 – 100 %	29
75	Antenna 4 Noise	0 – 100 %	54
76	Antenna 5 Noise	0 – 100 %	20
77	Antenna 6 Noise	0 – 100 %	47
78	Antenna 1 Relay Counter	0 – 100 %	0
79	Antenna 2 Relay Counter	0 – 100 %	0
80	Antenna 3 Relay Counter	0 – 100 %	0
81	Antenna 4 Relay Counter	0 – 100 %	0
82	Antenna 5 Relay Counter	0 – 100 %	0
83	Antenna 6 Relay Counter	0 – 100 %	0
84	Alarms active	none, one or all	NL2,NL4,TAG
85	Date	DD-MM-YYYY	05-02-2007
86	Time	HH:MM:SS (24hr format)	16:21:39

The next is a stored status report followed by a table identifying each element in the status report. This is a condensed version of the full status report and only contains the dynamic elements of the full report:

```
&1,24,231,0,1,70,455,633,456,632,456,634,1,-2,0,-4,0,-2,20,42,20,40,18,40,05-02-
2007,16:23:57
```

Item Position	Item Description	Value Range	Value Above
0	Unique String Identifier	&	&
1	Report ID	1 – 146	1
2	Temperature	-50 – 999 °C	24
3	Exciter power	140 – 240 x 0.1 V	231
4	Lithium battery	0 – OK, 1 – LOW	0
5	Memory used	0 – 100 %	1
6	Tag stored Count	0 – 5350	70
7	Antenna 1 Current	0 – 800 x 0.01 A$_{p-p}$	455
8	Antenna 2 Current	0 – 800 x 0.01 A$_{p-p}$	633
9	Antenna 3 Current	0 – 800 x 0.01 A$_{p-p}$	456
10	Antenna 4 Current	0 – 800 x 0.01 A$_{p-p}$	632
11	Antenna 5 Current	0 – 800 x 0.01 A$_{p-p}$	456
12	Antenna 6 Current	0 – 800 x 0.01 A$_{p-p}$	634
13	Antenna 1 Phase	0 – ±1023	1
14	Antenna 2 Phase	0 – ±1023	-2
15	Antenna 3 Phase	0 – ±1023	0
16	Antenna 4 Phase	0 – ±1023	-4
17	Antenna 5 Phase	0 – ±1023	0
18	Antenna 6 Phase	0 – ±1023	-2
19	Antenna 1 Noise	0 – 100 %	20
20	Antenna 2 Noise	0 – 100 %	42
21	Antenna 3 Noise	0 – 100 %	20
22	Antenna 4 Noise	0 – 100 %	40
23	Antenna 5 Noise	0 – 100 %	18
24	Antenna 6 Noise	0 – 100 %	40
25	Date	DD-MM-YYYY	05-02-2007
26	Time	HH:MM:SS (24hr format)	16:23:57

To change the Status Report delay:

1. From the *Ready/Standby* display, press the $\boxed{\text{MENU}}$ key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the $\boxed{\text{MENU}}$ key until the "Diag Report Delay" sub-menu is displayed.

3. From the "Diag Report Delay" sub-menu, press the $\boxed{\text{ENTER}}$ key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit (↓,↑ or ↕).

---

4. Use the ⌑MENU⌑ (equivalent to a down arrow "↓") or the ⌑ESCAPE⌑ key (equivalent to an up arrow "↑") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the ⌑ENTER⌑ key to select it. The arrow will then move over the next digit. You can change it using the ⌑MENU⌑ or the ⌑ESCAPE⌑ key, or go to the next digit by pressing the ⌑ENTER⌑ key.

6. Once all the digits are done, you can then use the ⌑MENU⌑ key to select the next Diag sub-menu or the ⌑ESCAPE⌑ key to return to the upper level menu.

Noise delay

The noise report provides noise statistics (such as average and peak noise measurement values) for each antenna. The noise report can be requested from both the front panel and the communication port. The "Noise Delay" can be set by a user so that a status report is sent to the communication port automatically at an interval of between 0 (disabled) and 1440 minutes (24 hours) in the following form:

Noise report for Reader ID#F0

Antenna:	1	2	3	4	5	6
Average:	2 %	3 %	2 %	2 %	2 %	1 %
Peak:	10 %	3 %	5 %	3 %	2 %	3 %

To change the Noise Report Delay:

1. From the *Ready/Standby* display, press the ⌑MENU⌑ key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the ⌑ENTER⌑ key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the ⌑MENU⌑ key until the "Diag Noise Delay" sub-menu is displayed.

3. From the "Diag Noise Delay" sub-menu, press the ⌑ENTER⌑ key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit (↓,↑ or ↕).

4. Use the ⌑MENU⌑ (equivalent to a down arrow "↓") or the ⌑ESCAPE⌑ key (equivalent to an up arrow "↑") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the ⌑ENTER⌑ key to select it. The arrow will then move over the next digit. You can change it using the ⌑MENU⌑ or the ⌑ESCAPE⌑ key, or go to the next digit by pressing the ⌑ENTER⌑ key.

6. Once all the digits are done, you can then use the ⌑MENU⌑ key to select the next Diag sub-menu or the ⌑ESCAPE⌑ key to return to the upper level menu.

Send status

You can force the immediate transmission of the status report to the communication port from the keyboard using the "Send status" sub-menu. The procedure is the following:

1. From the *Ready/Standby* display, press the ⌑MENU⌑ key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the ⌑ENTER⌑ key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the ⌑MENU⌑ key until the "Diag Send status" sub-menu is displayed.

3. From the "Diag Send status" sub-menu, press the ⌑ENTER⌑ key to select it. The reader will then send the status to the communication port ("Sending status.." displayed momentarily).

4. Once the download is done, you can then use the ⌑MENU⌑ key to select the next Diag sub-menu or the ⌑ESCAPE⌑ key to return to the upper level menu.

Noise gain %

The *Noise gain %* function is used to calibrate noise measurement. Noise measurement corresponds to peak-to-peak value of a signal at comparator input - test point TP21 on Analog board in percents, meaning that if signal at TP21 is 5V peak-to-peak (maximum possible), noise measurement should be 100%. If signal

at TP21 is 200mV peak-to-peak, noise measurement should be 4%. Noise gain value can be set between 1 and 200%.

To change the Noise gain %:

1. From the *Ready/Standby* display, press the MENU key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the ENTER key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the MENU key until the "Diag Noise gain %" sub-menu is displayed.

3. From the "Diag Noise gain %" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit ($\downarrow$,$\uparrow$ or $\updownarrow$).

4. Use the MENU (equivalent to a down arrow "$\downarrow$") or the ESCAPE key (equivalent to an up arrow "$\uparrow$") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the ENTER key to select it. The arrow will then move over the next digit. You can change it using the MENU or the ESCAPE key, or go to the next digit by pressing the ENTER key.

6. Once all the digits are done, you can then use the MENU key to select the next Diag sub-menu or the ESCAPE key to return to the upper level menu.

The present Noise Gain value is available from the communication port as part of the Status Report.

Noise Alm

The *Noise Alm* function is used to set the excessive noise level alarm threshold between 1 and 99%. The alarm will be generated if noise rises above the threshold. It can be used to indicate reader deterioration (tuning or connection problem, etc.) or ambient conditions influence.

To change the excessive noise level alarm threshold:

1. From the *Ready/Standby* display, press the MENU key until the "Diag…" sub-menu is displayed.

2. From the "Diag…" sub-menu, press the ENTER key to select it. The reader will then display the "Diag - Sys temp" sub-menu. Press the MENU key until the "Diag Noise Alm" sub-menu is displayed.

3. From the "Diag Noise Alm" sub-menu, press the ENTER key to select it. The reader will then display the current setting of the option with an arrow on top of the most significant digit ($\downarrow$,$\uparrow$ or $\updownarrow$).

4. Use the MENU (equivalent to a down arrow "$\downarrow$") or the ESCAPE key (equivalent to an up arrow "$\uparrow$") as indicated on the display to change the most significant digit.

5. Once the desired setting is on the display, press the ENTER key to select it. The arrow will then move over the next digit. You can change it using the MENU or the ESCAPE key, or go to the next digit by pressing the ENTER key.

6. Once all the digits are done, you can then use the MENU key to select the next Diag sub-menu or the ESCAPE key to return to the upper level menu.

The present noise alarm threshold value is available from the communication port as part of the Status Report.

SERIAL COMMUNCATION PORT OPERATION

The FS1001M reader can be fully operated and configured from the serial communication port. The serial communication port enables you to connect to a computer for data logging, system setup, and maintenance functions. For initial system setup when antenna tuning functions must be performed from scratch, utilizing the communication port is easier and more time efficient than working from the reader's front panel.

Hardware Description

The serial communication port connection is located on the bottom of the FS1001M enclosure and is a 9-pin "D" type female connector (DB9) configured as a DCE (Data Communication Equipment). Normally, a direct cable (pin to pin) is required to connect the communication port to a computer. The pin assignment of the connector is as follows:

Table 2: Comm. port connections (DB9 connector)

DB9 Pin number	EIA 232 signal name	Description	Reader signal direction	PC Computer connection (25 pin)	PC Computer connection (9-pin)
2	RD	Receive Data	Output	3	2
3	TD	Transmit Data	Input	2	3
5	GND	Signal Ground	None	7	5

Configuration

The serial port is configured for operation at 57,600 baud, no parity, 8 data bits, 1 stop bit, no flow control (57,600,N,8,1). The system is intended to be used in conjunction with the MiniMon program, which runs on the connected computer and provides interface and data interpretation, separation and collection tools. For instance, the status reports are presented in a compressed format and are difficult to read without the aid of the MiniMon. But since all the data is presented in ASCII format, most communication software packages such as HyperTerminal or ProComm can be used to send and capture data through the serial port.

Command/response Messages

The serial port commands are used to configure the reader parameters and to perform specific operations on the reader from a computer. The commands can be typed in ASCII format using a terminal or a PC computer running a communication software package. A majority of commands is available from within the MiniMon program, except for AS, BE, MT, RI and RP commands (see description below), so initial system setup must be performed using a communication software packages such as HyperTerminal or ProComm .

General Format

The reader commands consist of 2 or more characters followed by Enter (Carriage Return, $0d, 12d) as in the following example: RA0↵

By default, commands are echoed on the communication port as they are typed. The backspace key can be used to correct an improper command.

Command List

The following is a brief description of the commands available at the communication port ({ } - indicates a variable parameter (1 - On/Set, 0 - Off/Reset and, # - value)). Type in **bold red** indicates user entered values and a ↵ indicates "Enter." For a more detailed description of the commands refer to the preceding sections.

Help (H or ?)

The H or ? command displays the list of available commands:
H↵ or ?↵

```
F0> h↵
AS                  Antenna sequence
AT {#}              Antenna Scanning Time
BA {1|0}            Buffer Active ON|OFF
BC                  Buffer Count
BD                  Buffer Download
BE                  Buffer Erase
DA {#}              Set alarm threshold to #mA
DG {#}              Set current gain #%
DR {D#|S}           Status report DELAY|SEND
DS {1|0}            Store Test tag ON|OFF
DT {1|0|D#|S}       Test tag ON|OFF|DELAY|SEND
LT {1|0}            Send Tag codes COM1
MT                  Manual Tuning
NG {#}              Set noise gain #%
NT {#}              Set noise alarm threshold to #%
NR {D#|S}           Noise report DELAY|SEND
RA {1|0|R}          Reader Active ON|OFF|RESET
RB {1|0}            Reader Buzzer Active ON|OFF
RI {XX}             Reader Hex ID
RP                  Reset default parameters
RU {1|0|D#}         Reader Unique ON|OFF|DELAY
SM (#)              Antenna Sleep Mode Delay
TC                  Display current date and time
TE {1|0}            Test Reader Efficiency ON|OFF
TD {DD-MM-YYYY}     Reader Set date
TH {HH:MM:SS}       Reader Set time
TL {ant}{lev}       Set virtual test tag level (0 – 99)
H or ?              Displays this list of commands
```

Note: The execution of the Help command generates a heavy processor load (interrupt processing) and may cause temporary overload when scanning for tags.

Antenna sequence (AS)

The AS command is used to select which antennas will be active and what sequence they will be switched between. The reader is limited to up to 6 physical antennas. However, to provide additional flexibility there are up to 12 entries available in the switching sequence. The following text shows a 4 antenna system being set for a round robin switching sequence of 1,2,3,4,1,2,3,4,1,…:

```
F0> as↵

Valid sequence value are (0 – 6 where 0 is none)
Enter Antenna id for Sequence 1 (current: 1): 1
Enter Antenna id for Sequence 2 (current: 1): 2
Enter Antenna id for Sequence 3 (current: 1): 3
Enter Antenna id for Sequence 4 (current: 1): 4
Enter Antenna id for Sequence 5 (current: 1): 0
Enter Antenna id for Sequence 6 (current: 1): 0
Enter Antenna id for Sequence 7 (current: 1): 0
Enter Antenna id for Sequence 8 (current: 1): 0
```

```
        Enter Antenna id for Sequence 9 (current: 1): 0
        Enter Antenna id for Sequence 10 (current: 1): 0
        Enter Antenna id for Sequence 11 (current: 1): 0
        Enter Antenna id for Sequence 12 (current: 1): 0

        CONFIRM: 1 2 3 4 0 0 0 0 0 0 0 0 ? (Y/N) y
        MESSAGE: Sequence table saved in EEPROM
```

Note that the entered values are not echoed back to the computer and are therefore not displayed. When filling the sequence list the selected antennas should be entered first, any remaining entries should be filled in with "0".

The user's entries are displayed in the final "confirm" message. To select the new sequence enter a "Y" or to abort the command and make no changes enter "N."

The following text shows a four antenna system were the #1 antenna is switched to every other time to provide a higher percentage of dwell time on #1. The switching sequence for this setup will be 1,2,1,3,1,4,1,1,2,1,3,1,4,1,1,2,...:

```
        F0> as↵

        Valid sequence value are (0 – 6 where 0 is none)
        Enter Antenna id for Sequence 1 (current: 1): 1
        Enter Antenna id for Sequence 2 (current: 2): 2
        Enter Antenna id for Sequence 3 (current: 3): 1
        Enter Antenna id for Sequence 4 (current: 4): 3
        Enter Antenna id for Sequence 5 (current: 0): 1
        Enter Antenna id for Sequence 6 (current: 0): 4
        Enter Antenna id for Sequence 7 (current: 0): 1
        Enter Antenna id for Sequence 8 (current: 0): 0
        Enter Antenna id for Sequence 9 (current: 0): 0
        Enter Antenna id for Sequence 10 (current: 0): 0
        Enter Antenna id for Sequence 11 (current: 0): 0
        Enter Antenna id for Sequence 12 (current: 0): 0

        CONFIRM: 1 2 1 3 1 4 1 0 0 0 0 0? (Y/N) y
```
MESSAGE: Sequence table saved in EEPROM

Note: If using only one antenna its number has to appear in the antenna sequence at least twice to ensure proper reader operation.

Antenna scanning time (AT)

The AT command defines for how long the reader will stay at an antenna and attempt to decode a tag if a tag presence is detected. Acceptable range is 40 to 1000ms as in the following example (do not include the leading zeroes):

```
        F0> at100↵

        MESSAGE: Scanning time set to 100 ms.

        F0> MESSAGE: Reader is in standby mode

        MESSAGE: Reader is in scan mode

        F0> at25↵

        MESSAGE: Bad #. Acceptable range is 40 to 1000 ms.
```

Note: Decreasing this parameter reduces overall switching cycle but also reduces the chance of a successful tag ID decoding.

Buffer active (BA)

The BA command is used to enable or disable the storing of tag IDs in a buffer.

To enable the buffer:

```
F0> ba1↵
MESSAGE: Buffer was turned ON.
```

To disable the buffer:

```
F0> ba0↵
MESSAGE: Buffer was turned OFF.
```

Buffer count (BC)

The BC command is used to display the number of tag IDs stored in a buffer.

To see the buffer count:

```
F0> bc↵
MESSAGE: Tag count is 4610.
```

Buffer download (BD)

The BD command is used to send all information stored in a buffer to the communication port:

```
F0> bd↵
MESSAGE: Download initiated press ESC to quit
*F0 F2 3D9.1BF264C7F0 22-01-2007 10:04:16
*F0 F6 3D9.1BF264C7F0 22-01-2007 10:04:19
*F0 F1 3D9.1BF269C039 22-01-2007 10:04:20
*F0 F6 3D9.1BF269C039 22-01-2007 10:04:23
*F0 F2 3D9.1BF269C039 22-01-2007 10:04:24
*F0 F5 3D9.1BF264C7F0 22-01-2007 10:04:26
*F0 F6 3D9.1BF264C7F0 22-01-2007 10:04:29
$MUX1230,1,9,F0,1,1,1,1,1,0,5,0,103,6000,100,50,100,0,670,36A,0,670,224,0,
670,36D,0,680,1F2,0,670,36D,0,670,22B,0,1,2,3,4,5,6,0,0,0,0,0,0,26,23,0,0,
7,1,1,1,1,1,1,472,593,473,595,473,596,3,3,3,0,3,2,9,34,10,46,10,43,0,0,0,
0,0,0,EX1,EX2,EX3,EX4,EX5,EX6,22-01-2007 10:24:33
&1,26,231,0,0,7,473,595,474,595,474,596,0,-5,-2,-1,-1,1,9,20,8,27,12,23,
22-01-2007,10:05:00
&2,26,231,0,0,7,473,594,473,596,474,595,0,-4,1,-3,2,3,10,37,11,51,11,45,
22-01-2007,10:10:00
&3,26,231,0,0,7,473,595,473,596,474,595,2,-3,2,0,3,2,10,45,11,53,12,43,
22-01-2007,10:15:00
&4,26,231,0,0,7,473,593,473,595,473,596,2,-3,2,0,2,2,10,35,11,43,10,39,
22-01-2007,10:20:00

Message: Buffer download complete.
```

Buffer erase (BE)

The BE command is used to erase all information stored in a buffer:

```
F0> be↵
CONFIRM: Erase Buffer? (Y/N) y
MESSAGE: Buffer erased.
F0> be↵
CONFIRM: Erase Buffer? (Y/N) n
MESSAGE: Command cancelled.
FF>
```

Set alarm threshold (DA)

The DA command is used to set the antenna current alarm threshold. The acceptable range is 1 to 9999 in mille-Amps peak to peak, as illustrated in the following examples:

```
F0> da100↵
MESSAGE: Current alarm threshold set to 100mA.
F0> da6000↵
MESSAGE: Current alarm threshold set to 6000mA.
F0> PROBLEM: Ant2 current low
```

```
F0> da12000↵
MESSAGE: Bad #. Acceptable range is 1 to 9999mA
F0>
```

The alarm threshold can be used to indicate reader deterioration (tuning or connection problem, etc.). When the antenna current is lower than the alarm threshold, the EXL (Exc current low) alarm is generated as in the above example.

Note: The alarm threshold default value is set up during the reader programming process.

Set current gain (DG)

The DG command is used to calibrate antenna current measurement by adjusting current gain. The calibration formula is the following:

$$I_{displayed} = (I_{measured} * Curr\ gain)/100$$

The default value is 103%. The acceptable range is 1 to 200% and can be changed, as illustrated in the following example:

```
F0> dg100↵
MESSAGE: Current gain set to 100%.
F0> dg1000↵
MESSAGE: Bad #. Acceptable range is 1 to 200%
F0>
```

Status report delay (DRD)

The DRD command is used to set the automatic status report delay period. The status report is sent automatically to the communication port and provides complete status information about the reader. The automatic sending of the report can be set from 0 (disable) to 1440 minutes (24 hours). For example:

```
F0> drd1↵
MESSAGE: Report delay set to 1 minute(s).
F0> drd1440↵
MESSAGE: Report delay set to 1440 minute(s).
F0> drd5000↵
MESSAGE: Bad #. Acceptable range is 1 to 1440min.
```

Status report send (DRS)

The DRS command displays the current reader status and configuration. For example:

```
F0> drs↵
$MUX1230,1,9,F0,1,1,1,0,1,0,0,0,103,6000,100,50,100,0,670,36A,0,670,224,0,
670,36D,0,680,1F2,0,670,36D,0,670,22B,0,1,2,3,4,5,6,0,0,0,0,0,0,28,231,0,
0,0,1,1,1,1,1,1,473,593,472,595,472,594,0,1,4,-2,0,-2,11,38,10,44,11,38,0,
0,0,0,0,0,EX1,EX2,EX3,EX4,EX5,EX6,22-01-2007 12:03:30
```

Note: For more information about the status report and its contents refer to page 25.

Store Test Tag (DS)

The DS command is used to enable or disable the storing of test tag IDs in a buffer.

To enable storing test tag IDs:

```
F0> ds1↵
```

```
MESSAGE: Buffering of test Tag ID was turned ON.
```

To disable storing test tag IDs:

```
F0> ds0↵
```

```
MESSAGE: Buffering of test Tag ID was turned OFF.
```

Test tag on/off (DT)

The DT command controls the Virtual Test Tag (VTT) operation.

To turn VTT On:

```
F0> dt1↵
MESSAGE: Test Tag On for ALL Antennas
Ant1 Hit Rate : 100
Ant2 Hit Rate : 100
Ant3 Hit Rate : 100
Ant4 Hit Rate : 100
Ant5 Hit Rate : 100
Ant6 Hit Rate : 100
```

When the virtual test tag is turned on the system performs a recovery efficiency evaluation, which is the percentage of the test tag recovery (hit rate) over a four second period for each antenna. The hit rate value of 100% means that VTT was successfully read once every time an antenna was selected.

Note: It is recommended to disable the buzzer as it can interfere with reader performance by presenting audible noise, thus reducing the hit rate.

To turn VTT Off:

```
F0> dt0↵
MESSAGE: Test Tag Off for ALL Antennas
```

To single-shoot VTT (activate once for each antenna in the antenna sequence):

```
F0> dts↵
MESSAGE: Test Tag Single shot for ALL Antennas
MESSAGE: Test Tag Fired on antenna 1
MESSAGE: Test Tag Found
MESSAGE: Test Tag Fired on antenna 2
PROBLEM: Test Tag Failed
MESSAGE: Test Tag Fired on antenna 3
MESSAGE: Test aborted due to system activity
MESSAGE: Test Tag Fired on antenna 4
PROBLEM: Test Tag Failed
MESSAGE: Test Tag Fired on antenna 5
MESSAGE: Test aborted due to system activity
MESSAGE: Test Tag Fired on antenna 6
MESSAGE: Test Tag Found
```

The reader first searches for the possible presence of a real tag within the active antenna. This is done by checking both of the following conditions:

- The number of signal transitions per second must be below 1024 (average signal frequency below 512 Hz).

- The tag-decoding algorithm must not be synchronized on the incoming signal.

If one of the conditions is not met, VTT is not fired at that particular antenna and the following message is sent on the serial port:

```
MESSAGE: Test aborted due to system activity
```

The reader then switches to the next antenna in a sequence.

If no presence of a real tag is detected, the reader proceeds and fires the test tag for 100ms. If the test tag is read successfully, the following message is sent on the serial port:

```
MESSAGE: Test Tag Found
```

However, if the test tag is not detected within 100ms, the "TAG" alarm message is displayed on the main screen and the following message is sent on the serial port:

```
PROBLEM: Test Tag Failed
```

The reader then switches to the next antenna. This process repeats for each antenna in the antenna sequence.

Test tag delay (DTD)

The DTD command is used to set the automatic test tag delay period. The reader automatically performs a test tag single shot for all antennas each time the delay expires (the same way as DTS command). The delay can be set from 0 (disable) to 1440 minutes (24 hours). For example:

```
F0> dtd10↵
MESSAGE: Test tag timer set to 10 minute(s).
MESSAGE: Test Tag Fired on antenna 1
MESSAGE: Test Tag Found
MESSAGE: Test Tag Fired on antenna 2
MESSAGE: Test Tag Found
MESSAGE: Test Tag Fired on antenna 3
MESSAGE: Test Tag Found
MESSAGE: Test Tag Fired on antenna 4
MESSAGE: Test Tag Found
MESSAGE: Test Tag Fired on antenna 5
MESSAGE: Test Tag Found
MESSAGE: Test Tag Fired on antenna 6
MESSAGE: Test Tag Found


F0> dtd5000↵
MESSAGE: Bad #. Acceptable range is 0 to 1440min.
```

Send Tag IDs (LT)

The LT command is used to enable and disable the sending of real-time tag IDs to the communication port. For example:

```
F0> lt1↵
MESSAGE: Sending of tags enabled.
F0> lt0↵
MESSAGE: Sending of tags disabled.
FF>
```

Note: If Unique mode is activated, the tag ID is sent to the communication port only if it is different from the previous tag ID, or if Unique Delay expires.

Manual tuning (MT)

Note: See page 49 for additional tuning information.

The MT command is used to tune the antenna. The Manual Tuning menu contains all necessary antenna tuning commands and parameters. There are two modes in which tuning can be performed:

First mode is activated by turning Dynamic Tuning "On" by pressing the "D" key until "DynTun ON" appears. In this mode tuning is accomplished by changing the target phase (Tuned Ph 670) using the appropriate "decrement/increment" keys for Phase. The Dynamic Tuning then adjusts tuning capacitor settings automatically to achieve selected phase value.

```
Manual Tuning Function Command Key:

 + -    Change Antenna to tune

 Q W    decrement/increment by 1 Phase set point

 A S    decrement/increment by 10 Phase set point

 E R    decrement/increment by 100 Phase set point

 Z X    decrement/increment by 0.1 Phase Slope

 Y U    decrement/increment VTT Level

 T      Turn ON/OFF VTT

 D      Turn ON/OFF Dynamic Tuning

 C      Max current tune this Antenna

 N      Save PH, slope, cap setup and vtt level for this antenna

 .      QUIT


DynTun  ON VTT OFF Lev   0 Tuned Ph  670

Ant1 Cap 0x0372 Ph  -3 Slope 5.0 Cur 4.73A (580) Noi  13% Eff   0 Header  0
```

Second mode is activated by turning Dynamic Tuning "Off" by pressing the "D" key until "DynTun OFF" appears. In this mode tuning is done by manually adjusting the tuning capacitance (Ant1 Cap 0x0372) using appropriate "decrement/increment" keys for Capacitance. This is a somewhat crude method and can be confusing since a higher capacitance setting doesn't always mean more capacitance was switched in. This is because the higher capacitor values do not have the same magnitude or weight as the associated binary digit. The biggest change can be noticed when crossing the larger number boundaries, such as going from 0x04FF to 0x0500 setting. There are 12 tuning capacitors; therefore the maximum capacitance setting in hex is 0x0FFF. You can determine the actual capacitance switched into the circuit from the following table. A binary "1" indicates the capacitor is switched in and a "0" means it is switched out.

Binary Digit Position	Capacitance, pF
1	56
2	120
3	220
4	400
5	780
6	1,500
7	2,820
8	5,400
9	10,180
10	19,200

11	36,300
12	69,000

So, a hex capacitance setting of 0x0291 is binary 0000 0010 1001 0001 and, as shown above, has a capacitive value of 19,200 + 5,400 + 780 + 56 = 25,436 pF. The unit has a fixed capacitance of 12,000 pF which is added to the tuning capacitance value, thus the total capacitance of 0x0291 setting is 37,436 pF.

```
Manual Tuning Function Command Key:


 + -    Change Antenna to tune
 Q W    decrement/increment by 0x001 CAPACITOR SETUP
 A S    decrement/increment by 0x010 CAPACITOR SETUP
 E R    decrement/increment by 0x100 CAPACITOR SETUP
 Z X    decrement/increment by 0.1 Phase Slope
 Y U    decrement/increment VTT Level
 T      Turn ON/OFF VTT
 D      Turn ON/OFF Dynamic Tuning
 C      Max current tune this Antenna
 N      Save PH, slope, cap setup and vtt level for this antenna
 .      QUIT


DynTun OFF VTT OFF Lev   0 Tuned Ph  670
Ant1 Cap 0x0372 Ph   -3 Slope 5.0 Cur 4.73A (580) Noi  12% Eff   0 Header  1
```

The last two lines of the display give the real time antenna data.

The first line displays:

```
DynTun  OFF VTT OFF Lev   0 Tuned Ph  670
```

Where:

DynTun	Dynamic Tuning setting (ON or OFF)
VTT	Virtual Test Tag setting (ON or OFF)
Lev	VTT level setting (0-99, see below)
Tuned Ph	Target phase value setting (typically around 650)

The second line is continuously updated and displays:

```
Ant1 Cap 0x0372 Ph   -3 Slope 5.0 Cur 4.73A (580) Noi  12% Eff   0 Header  1
```

Where:

Ant1	Selected antenna number (1-6)
Cap	Capacitance setting in hex (0x0000 – 0x0FFF) (12,000 pF – 157,976 pF)
Ph	Relative phase difference between the last measured phase and the target phase from the above line
Slope	Slope setting (see below)

Cur	Antenna current measurement (Amperes peak-to-peak)
(580)	Analog to digital converter value of the measured antenna current (this is a hold over from the development phase of the project)
Noi	Average noise measurement (See Noise Gain % on page 29)
Eff	Reading efficiency if a tag is detected
Header	Number of tag headers seen in the last reading efficiency update (used to determine the reading efficiency (tag reads/headers x 100))

The VTT level setting (VTT … Lev) is inversely proportional to the VTT signal strength. Thus, the larger the VTT level number the weaker the VTT signal seen by the reader.

The Slope value determines how far the relative phase from line 2 must differ from the target phase of line 1 before the reader adjusts the tuning and to some degree determines how aggressively the tuning is adjusted. So, a slope of "3" means the reader will not adjust the tune (capacitance settings) until the relative phase is equal to or larger then ±3.

Remember to save any changes by pressing key "N" before going to the next antenna or exiting Manual Tuning menu.

When you exit the Manual Tuning menu, Dynamic Tuning automatically turns on.

Note: See page 49 for additional tuning information.

Set noise gain (NG)

The NG command is used to calibrate the average noise measurement by adjusting noise gain. (See *Noise Gain %* on page 29 for more details.) The default value is 100%. The acceptable range is 1 to 200% and can be changed, as illustrated in the following examples:

```
F0> ng100↵
MESSAGE: Current gain set to 100%.
F0> ng500↵
MESSAGE: Bad #. Acceptable range is 1 to 200%
F0>
```

Noise report delay (NRD)

The NRD command is used to set the automatic noise report delay period. The noise report is sent automatically to the communication port and provides noise statistics for each antenna, such as average and peak noise measurement values. The delay can be set from 0 (disable) to 1440 minutes (24 hours). For example:

```
F0> nrd60↵

MESSAGE: Noise Report delay set to 60 minute(s).

F0> Noise report for Reader ID#F0

Antenna:     1      2      3      4      5      6

Average:    10 %   51 %   10 %   52 %   11 %   45 %

Peak:       11 %   51 %   14 %   53 %   16 %   48 %


F0> nrd5000↵

MESSAGE: Bad #. Acceptable range is 0 to 1440min.

F0> Noise report for Reader ID#F0

Antenna:     1      2      3      4      5      6
```

```
Average:       12 %  62 %  12 %  59 %  12 %  53 %
Peak:          21 % 100 %  23 %  93 %  19 %  92 %
```

Noise report send (NRS)

The NRS command displays the current noise report. For example:

```
F0> nrs↵

Noise report for Reader ID#F0

Antenna:       1      2      3      4      5      6

Average:      11 %   64 %  11 %   62 %  11 %   58 %
Peak:         20 %   92 %  27 %   80 %  28 %   92 %.
```

Set noise alarm threshold (NT)

The NT command is used to set the excessive noise level alarm threshold. The acceptable range is 1 to 99%, as illustrated in the following examples:

```
F0> nt50↵
MESSAGE: Current noise alarm threshold set to 50%.
F0> nt10↵
MESSAGE: Current noise alarm threshold set to 10%.

F0> PROBLEM: Ant1 noise level
F0> nt0↵
MESSAGE: Bad #. Acceptable range is 1 to 99%
```

The alarm threshold can be used to indicate reader deterioration (tuning or connection problem, etc.). When the noise level is higher than the alarm threshold, the NL1-6 (Ant1-6 noise level) alarm is generated, as illustrated in the above example.

Reader active (RA)

The RA command is used to enable or disable scanning for tags. The command is also used to reset the reader. For example:

```
F0> ra1↵

F0> MESSAGE: Reader is in scan mode

F0> ra0↵

F0> MESSAGE: Reader is in standby mode

F0> rar↵

MESSAGE: Reader shutdown!

F0> MESSAGE: MUX1230 1.7

MESSAGE: Reader reset!

MESSAGE: Reader is in scan mode
```

Reader buzzer (RB)

The RB command is used to enable or disable the reader's buzzer:

```
F0> rb1↵

MESSAGE: Beep sound enable.

F0> rb0↵

MESSAGE: Beep sound disable.
```

Note: An audible alarm generated by the buzzer can interfere with reader performance when a large volume of tags is being decoded. It is recommended you turn off the buzzer during regular reader operation and instead use the buzzer for set up and maintenance purposes.

Reader ID (RI)

The RI command is used to set the reader ID number. It is entered in hexadecimal format, where the most significant (left) hex digit in 'xx' is in the range 0-F and the least significant (right) must be 0. This is illustrated in the following commands, which set the reader ID to E0:

```
F0> rie0↵

CONFIRM: Reader ID = E0? (Y/N)y↵

MESSAGE: Reader ID = E0.

E0> MESSAGE: Reader is in standby mode

MESSAGE: Reader is in scan mode

F0> riee↵

MESSAGE: Invalid argument.
```

Note: The reader ID default value is set up during the reader programming process.

Reset parameters (RP)

The RP command is used to reset the reader parameters to the default values. For example:

```
F0> rp↵

CONFIRM: Reset default parameters? (Y/N)y↵

MESSAGE: Reader reset to default parameters.

MESSAGE: Reader shutdown!

F0> MESSAGE: MUX1230 1.7

MESSAGE: Reader reset!

MESSAGE: Reader is in scan mode
```

A reader reset is automatically performed after this command.

Note: The Reader ID and the antenna parameters, such as antennas switching sequence and antennas target phase, will not be affected by the reset parameter command. To reset all parameters to default you need to power down the reader and remove the back-up lithium battery from the CPU board for a few seconds; this will also reset the internal clock.

For a complete list of default parameters, see page 11.

Reader unique on/off (RU)

The RU command is used to enable or disable unique mode. For example:

```
F0> ru1↵

MESSAGE: Unique mode turned ON.

F0> ru0↵

MESSAGE: Unique mode turned OFF.
```

When unique mode is disabled, the reader will annunciate and store (if the option is selected) all the tag IDs read. When unique mode is enabled, the annunciation and storage functions are only performed if the current detected tag ID is different from the previous tag ID.

Reader unique delay (RUD)

The RUD command is used to set up and enable unique mode delay. The automatic delay can be set from 1 to 1440 minutes (24 hours). For example:

```
F0> rud10↵
MESSAGE: Unique mode delay set to 10 min(s).
F0> rud0↵
MESSAGE: Bad #. Acceptable range is 1 to 1440 min(s).
```

When unique mode delay is enabled, a reader annunciates and stores the tag ID the first time it is read. If the same tag is read more than once it is not annunciated or stored until a different tag is read or until the delay expires

Antenna sleep mode delay (SM)

The SM command is used to activate and set up sleep mode, which helps to conserve and extend battery life. In this mode the reader puts each antenna in an idle state prior to switching to the next one for amount of time specified by this delay. The delay can be set to 0 (disable) or from 2 - 9999 in 10ms increments. For example:

```
F0> sm0↵
MESSAGE: Sleep set to 0 ms.
F0> MESSAGE: Reader is in standby mode
MESSAGE: Reader is in scan mode
F0>sm10↵
MESSAGE: Sleep set to 100 ms.
F0> MESSAGE: Reader is in standby mode
MESSAGE: Reader is in scan mode
F0> sm1↵
MESSAGE: Bad #. Acceptable range is 0, 2 to 9999.
```

Note: While in sleep mode the antenna current is turned off so no tags can be detected. Also, activating the sleep mode will increase the amount of time it takes to cycle through all antennas in the antenna sequence.

Display current date and time (TC)

The TC command is used to display the current date and time from the reader's internal clock. For example:

```
F0> tc↵
23-01-2007 14:54
```

Test reader efficiency (TE)

The TE command is used to activate the reader efficiency test. For example:

```
F0> te1↵
Efficiency test enabled
Ant1 Hit Rate : 100
Ant2 Hit Rate : 100
Ant3 Hit Rate : 100
Ant4 Hit Rate : 100
Ant5 Hit Rate : 100
```

```
            Ant6 Hit Rate : 100

    F0> te0↵

    Efficiency test disabled
```

This test generates a Hit Rate report for each antenna in the antenna sequence. This is the same report as the one generated when VTT is activated with a DT1 command. The only difference is that in this case real tags need to be placed into each antenna field. This option can be used to test each individual antenna's performance (field strength, shape, etc.) or to test tag performance.

Note: It is recommended that you disable the buzzer, as it can interfere with reader performance by presenting audible noise, thus reducing the hit rate.

Reader set date (TD)

The TD command is used to set the date on the reader's internal clock. The date is set using the following format: DD-MM-YYYY. For example, to set the reader date to January 23, 2007 you would enter the following:

```
    F0> td23-01-2007↵
```

Note: There is a back-up lithium battery on the CPU board that keeps the clock running when the reader power is low or turned off. This button style battery has an expected life of 5 years (Model CR2016 made by Eveready, Toshiba or equivalent). You need to set the date every time the battery gets replaced, along with the time and all other parameters that were changed from the defaults.

Reader set time (TH)

The TH command is used to set the time on the reader's internal clock. The time is set using the following 24-hour format: HH:MM:SS. For example, to set the reader time to 16 hours, 30 minutes and 30 seconds you would enter the following:

```
    F0> th16:30:30↵
```

Note: There is a back-up lithium battery on the CPU board that keeps the clock running when the reader power is low or turned off. This button style battery has an expected life of 5 years (Model CR2016 made by Eveready, Toshiba or equivalent). You need to set the time every time the battery gets replaced, along with the date and all other parameters that were changed from their defaults.

Set virtual test tag level (TL)

The TL command is used to set the VTT level for each individual antenna 1 to 6. Acceptable antenna numbers are 1 to 6 and acceptable level settings are 0 to 99. For example, to set the VTT level of antenna 6 to 25 you would enter the following:

```
    F0> tl625↵

    MESSAGE: antenna #6 Vtt Level Set.

    F0> MESSAGE: Reader is in standby mode

    MESSAGE: Reader is in scan mode

    F0> tl810↵

    MESSAGE: Unexpected or Missing argument.

    F0> tl2100↵

    MESSAGE: VttLevel must be 0-99.
```

Note: The VTT level setting is inversely proportional to the VTT signal strength. Thus, the larger the VTT level number the weaker the VTT signal seen by the reader: VTT level setting of 0 generates the strongest VTT signal and a VTT level setting of 99 generates the weakest VTT signal.

SELF TESTS AND DIAGNOSTICS

The FS1001M has integrated self-tests that are used to verify the integrity of the hardware and to perform antenna tuning and adjustments. Two types of tests are performed on the unit:

- Power-up diagnostics that are performed each time the unit is reset.

- Periodic self-tests that are performed while the unit is in operational mode.

These tests are performed automatically by the unit and can also be activated on demand by a user request.

Power-up Diagnostics

When the power is applied to the FS1001M by the main ON/OFF switch or when the RESET button is activated, the reader performs an automatic start-up procedure that includes the following self-tests:

- Flash EPROM memory

- RAM memory

- Back-up lithium battery

- Power supply

The detailed power-up sequence is illustrated in the next figure.
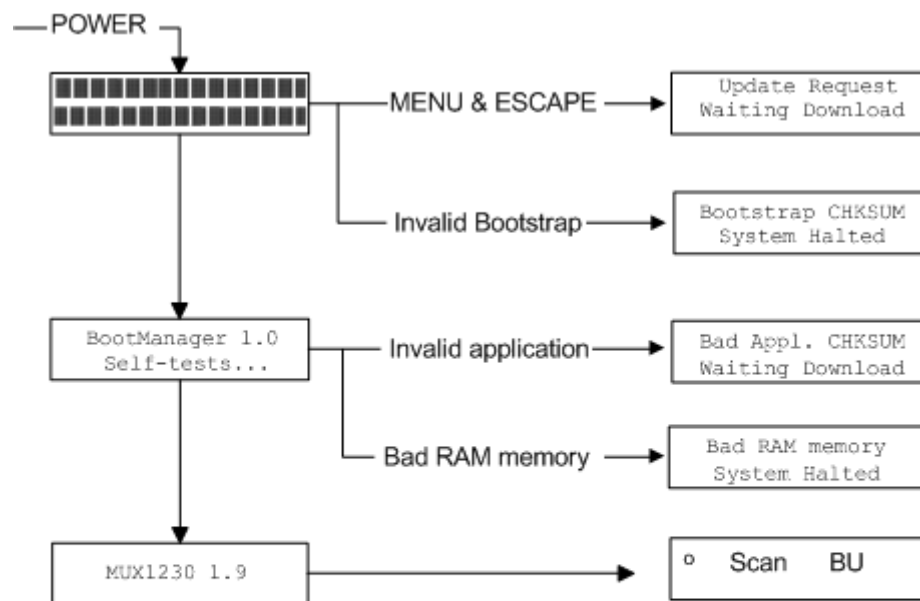
Figure 10: Power-up sequence

Startup Sequence

The FS1001M microprocessor will start as soon as the power is applied to the unit. If the input power is not at a sufficient level to start the microprocessor (11V or less), the LCD backlight will not turn on and usually a series a black squares will be displayed on the first LCD line as following:

```
■■■■■■■■■■■■
```

If this problem is encountered, check the system power supply (+12VR and 0VR test points on the motherboard). If the voltage level is 11 V or higher, this problem may indicate that the Flash EPROM is bad or that there is a severe CPU board problem. You should then replace the CPU board.

Flash EEPROM Memory Test

Once the CPU is started, the processor performs a "Boot Manager" memory verification. The "Boot Manager" is a section of program included in the Flash EEPROM memory (Electronically Erasable Programmable Read-Only Memory) that can never be erased and which initializes the reader hardware. If the "Boot Manager" program is invalid, the system is halted and the CPU board needs to be replaced.

Once this verification is completed, the unit checks if there is a valid application program. The application program governs the operation of the reader and can be updated in the field using the VBFlash program running on any PC compatible computer with Microsoft Windows. In order to start the software update process, the user must press both ｜MENU｜ and ｜ESCAPE｜ keys simultaneously immediately after pressing the ｜RESET｜ key (see page 51 for details). It should be noted that the "Boot Manager" and the application program version/revision numbers are displayed during the power-up sequence.

If there is no valid application program, the reader will automatically enter in the software update mode, waiting for a download from VBFlash.

RAM Memory Test

When the Flash EEPROM memory is verified, the reader proceeds with the RAM memory (Random-Access Memory) verification. The RAM test is a non-destructive test that performs read/write operations with known bit patterns in every memory location. Before writing in a memory location, its content is saved in one of the processors internal registers. A series of write/check back read operations are then done in that memory location before the original content is re-written. If a memory failure is detected, the beeper will be activated permanently.

Upon detection of a RAM failure, no clear message can be displayed since the CPU could lose control of the program; therefore, the beeper is used to indicate the problem. If such a failure occurs, the CPU board must be replaced.

Power Supply Verification

The next step in the power-up sequence is the power supply verification. This test is also done periodically during the normal operation of the reader unit. If the exciter supply voltage +VE drops below 12V, an alarm will be generated.

Back-up Lithium Battery Verification

The reader performs checks of the back-up lithium battery. If the battery voltage is low (under 3V), an alarm will be generated. If an error exists in the configuration set-up at power-up, default parameters will be reloaded and the following message will be sent to the serial port:

`MESSAGE: Parameters reloaded.`

The lithium battery connection should then be checked. If the connection is fine then the battery probably needed to be replaced. The back-up lithium battery has an expected shelf life of 5 years, which is reduced when the unit is powered off for a long period of time since current is drawn from it in order to preserve the RAM memory content. The back-up battery compartment is located on the CPU board. It should be replaced with a CR2032-type lithium battery (Panasonic or any other battery manufacturer with UL approval). A new battery is usually 3.25V and is weak when its voltage is under 3V. The customized reader parameters, date and time must be re-entered after battery replacement using the keyboard/display or the serial communication port.

Periodic Self-tests

When the unit is in operational mode, periodic self-tests are performed, including:

- Virtual test tag detection

- System parameter monitoring

Virtual test tag detection

The Virtual Test Tag (VTT) is a device designed to verify the reader integrity and sensitivity. It generates an ISO FDX-B tag signal at pre-settable signal levels for each antenna that can be turned on/off by the reader. It does this in the following manner:

- Automatically at user-selectable intervals based on the Virtual Test Tag Delay setting. This test is done in order to verify that the reader is operating properly, especially for extended periods when no PIT tags are present.

- Manually by the user using the keyboard or a serial port connection.

System parameter monitoring

The reader measures and monitors a list of key hardware parameters on a continuous basis. The following parameters are monitored:

- Antenna current on each antenna channel in the antenna sequence

- Average noise on each antenna channel in the antenna sequence

- Temperature inside the reader enclosure

- Communication between the Analog board and CPU board

- Communication between the ASB board and CPU board

- Exciter power supply voltage

- Back-up lithium battery voltage

Alarm Messages

Alarm messages are issued by the reader and sent to the serial communication port when abnormal conditions are detected. The messages are in ASCII format.

Code	Message	Description
ANC	Analog comm	Analog board communication problem (disconnected or failed). Also caused by a power supply voltage drop below 12V.
ASB	ASB comm	Antenna Switching Board (ASB) communication problem (improperly connected, disconnected, or failed).
EPW	Exc. Power low	Low exciter power level: the motherboard power supply should be checked (+VE).
EX1-6	Ant 1 – 6 current low	The current of the indicated antenna is below the alarm threshold level. It may be caused by an out-of-tune antenna, a bad antenna or antenna connection, reader failure, or an improper threshold parameter setting.
HTP	High temperature	The temperature level inside the casing is above the specified high temperature threshold.
LIT	Low lithium	Low voltage level at the memory/real-time clock back-up lithium battery. The back-up lithium battery has an expected shelf life of five years, which is reduced when the unit is powered off for a long period of time since current is drawn from it in order to preserve the RAM memory and the real-time clock content. The back-up battery compartment is located on the CPU board. It should be replaced with a CR2016 type lithium battery (Eveready, Toshiba or any other battery manufacturer).
LTP	Low temperature	The temperature level inside the casing is below the specified low temperature threshold.
MMF	Memory full	The used to store tag IDs is full.
MML	Memory low	The used to store tag IDs is 95% full.
NL1-6	Ant 1 – 6 noise level	The average noise level at the specified antenna is above the noise alarm threshold level. It may be caused by a noisy environnement, a tag present in the antenna field for a long time, antenna or reader failure, or an improper threshold parameter setting.
OVR	Overrun	The reader has been overcome by environmental noise and is unable to read tags.
TAG	Test Tag Failed	The test tag has not been decoded successfully.

MAINTENANCE

Maintenance of the FS1001M reader system must be done by personnel having completed the FS1001M Reader Training class presented by Digital Angel Corporation. This class explains the potential hazards and safety information associated with the installation and maintenance of the system. Call 1-800-328-0118 for information regarding this class. **The system is to be placed in a securable NEMA 4 cabinet with access restricted to trained personnel ONLY! The FS1001M Transceiver warranty is for 1 year from the date of delivery and covers parts and labor when installed by Digital Angel trained personnel.**

Battery Replacement

The lithium battery is used as an internal clock and a RAM backup. The battery has an expected shelf life of five years, which is reduced when the unit is powered off for a long period of time because current is drawn from it in order to preserve the RAM memory content. The back-up battery compartment is located on a CPU board. The battery should be replaced every three years or more often (if possible) with a CR2032 type lithium battery (Panasonic or any other battery manufacturer with UL approval).

CAUTION! There is a danger of explosion if the battery is replaced incorrectly. Replace only with Panasonic CR2032 or equivalent type. Dispose of used batteries according to the battery manufacturer's instructions.

Tuning Procedure

The following procedure will help guide *qualified personnel* in the steps necessary to tune an FS1001M PIT Tag detection system.

Tools Required
- PC or a laptop computer with communication software packages such as HyperTerminal, ProComm or other.
- Oscilloscope with the voltage probes.
- Current probe Tektronix P6021 or equivalent.
- Potentiometer adjustment tool or small flat blade screwdriver.

Procedure
1. Install and set up the Multiplexer.

   This includes hooking up all antennas and the power supply. Attach a communications cable from a PC or laptop to the COMM port of a Multiplexer and set up a connection between the two **(57600,N,8,1)**. Refer to **Serial Communications Port Operation** on page 31 for detailed information.

2. Attach the current probe to channel 1 (or A) of the oscilloscope and the voltage probe to channel 2 (or B). Attach the probe to the black antenna lead wire at the Analog board (the white wire can also be used). Remove the shield that is covering the Receiver section of the Analog board and attach the voltage probe to TP21 (input to the comparator circuit).

   Note: Adjust the scope so that both signals can be displayed and measured at the same time. Both channels need to be AC coupled and set to measure the signal peak to peak. Set trigger on channel 1 and turn **ON** the **high frequency noise reject filter**; this will make viewing the signal at TP21 easier.

3. Adjust the exciter voltage all the way down by turning potentiometer RP2 "+VE ADJ" on the motherboard clockwise (the silkscreen marking on the board is opposite, so disregard it.)

4. Preset capacitor C29 in receiver section of the Analog board to the mid-range (lift the color plastic cover to see the plates of the capacitor; the moving plates should cover the half of the static plates. **Multiplexer power must be "OFF" when you do this!**).

5. Preset potentiometer R30 in Receiver section of the Analog board to mid-range.

6. Install jumper JP4 on the Analog Board if antenna connecting cables are short (up to 30 feet) or remove it if antenna connecting cables are long (over 30 feet).

   Note: This depends on the cables properties, so both configurations should be tried to find the optimal one when lengths are less than 100 feet

7. Turn the multiplexer "ON".

8. Set the Antenna Sequence ("AS" command) to "XXXXXXXXXXXX" were "X" is the channel number of the antenna you want to tune. Enter Manual Tuning menu ("MT" command). Select the sub-menu of the antenna you are tuning by pressing the "+" or "-" key.

9. Peak the antenna current using the Automated Maximum Current command by pressing the "C" key and save new target phase (Tuned Ph) value by pressing the "N" key. Turn "ON" Dynamic Tuning by pressing the "D" key.

10. Adjust exciter voltage by turning potentiometer RP2 "+VE ADJ" on the mother board counter-clockwise to set the desired antenna current (channel 1 of the scope or second line of live antenna data in Manual Tuning menu). **Do not exceed 7A$_{p-p}$**.

11. Turn "ON" VTT by pressing the "T" key and adjust its level by pressing the "Y" or the "U" key so you get one read every few seconds.

12. Slowly adjust the target phase (Tuned Ph) value by 20 points each direction by pressing the "Q" or the "W" key to see if you can improve reading efficiency. Return the target phase to the value with the best reading efficiency.

   Note: Allow a few seconds for the dynamic tuning to retune the antenna when adjusting target phase setting or capacitor C29. This time can be reduced by decreasing the Slope value, but note that if this value is too low the Multiplexer may not be able to stay in tune and achieve target phase (this depends on the antenna, capacitors setting in the Multiplexer, etc.). If this happens increase the Slope value. The recommended value is between 3.0 and 5.0. For more information on Slope see Manual Tuning on page 38.

13. Adjust variable capacitor C29 to improve the reading efficiency. If monitoring the signal at TP21 on channel 2 of the scope, adjust C29 so that the amplitudes of the 2kHz and 4kHz components of the signal (wide and narrow waves) are as equal as possible. For this adjustment set the scope time base to 0.5msec/Div.

14. Adjust the target phase (Tuned Ph) value by 5 - 10 points each direction by pressing the "Q" or the "W" key to see if you can improve reading efficiency.

15. Repeat steps 11 and 12 while reducing the VTT level until you are unable to read it.

16. Adjust VTT level (by pressing keys "Y" or "U") so you get one read per few seconds and adjust potentiometer R30 (High Pass Filter adjustment) fully CW so that the signal at TP21 is minimized. Begin rotating R30 counter clockwise (CCW) until the best reading efficiency is achieved (should be approx. between 1/3 and 1/2 of the way).

17. Turn "OFF" VTT. Reset the slope value to its factory setting 5.0 (or increase if necessary), set desired VTT level and save these values along with adjusted target phase (Tuned Ph) value by pressing the "N" key.

18. Exit the Manual Tuning menu by pressing the "." key.

19. Repeat steps 6 through 15 for each antenna connected to the multiplexer.

   Note: Potentiometers RP2 "+VE ADJ", R30 and capacitor C29 settings might be different from channel to channel depending on the antennas properties, cables properties and cables lengths. It is recommended to have all properties as close as possible. If the antennas and the connecting cables are different, remember the C29, R30 and RP2 settings for each antenna and then optimize them.

18. If after tuning the transceiver there is still the presence of noise or instability it may be necessary to connect the digital ground to the analog ground via the jumper JP1 on the Analog board. Slight antenna tuning might be needed after the grounds are connected.

19. Set up the desired antenna switching sequence.

20. Set up the desired Multiplexer operational mode by customizing the rest of its parameters.

Reader Software Update

The reader software can be updated from the VBFlash application program running under Microsoft Windows (version 3.1 or newer).

Requirements

- MUX Version 1.7 ZIP file (extract to the folder of your choice)

- VBFlash software

- DB9 M/F RS-232 data cable

VBFlash program installation

The VBFlash program can be installed on your computer using the **Setup.exe** program on the installation disk. To install, start Setup from Windows and follow the instructions.

VBFlash program operation

The VBFlash application program can be started from the following icon:

Vbflash

Figure 11: VBFlash program icon

When started, the application program appears:

Figure 12: VBFlash program window

When opened, the File menu is as follows:
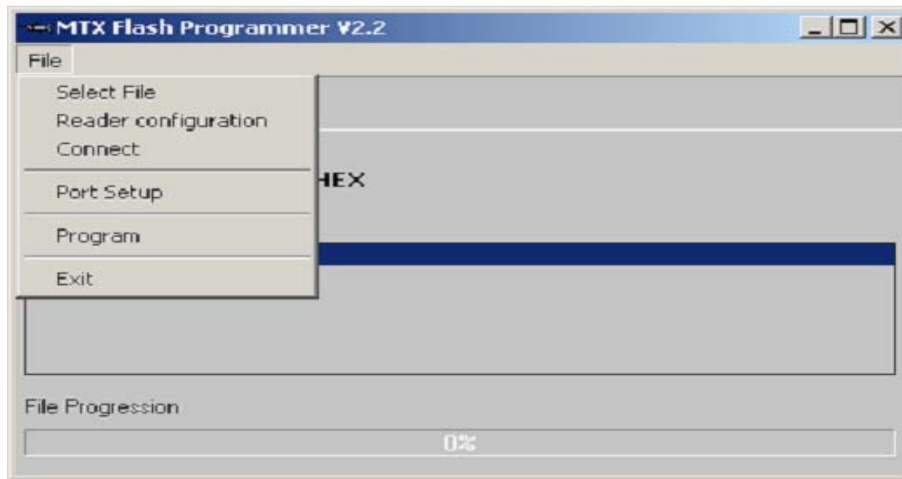
Figure 13: File menu

The commands are as follows:

Select file: Allows the user to select a file to be programmed in the reader (*.hex extension).

Reader cnfg.: Allows the user to set the default values of the reader ID (00-F0) and current alarm threshold (1- 9999mA). The values are stored permanently into the EEPROM of the reader.

Connect: Allows the PC to start the communication with the reader.

Port setup: Allows the user to select the PC communication port to which the reader is connected.

Program: Starts the software update in the reader from the selected file.

 or   **Exit :** Exit the VBFlash application program.

Reader software update procedure

The step-by-step procedure for updating the reader software is as follows:

1. Connect the communication cable between the PC communication port and the reader communication port. The PC communication port must not be attached to an application program such as HyperTerminal. Baud rate is not relevant as the reader automatically adjusts to match the computer rate.

2. Turn the reader power on or press the RESET key if the power is already on. When black squares are displayed, press and hold both the MENU and the ESCAPE keys until the following message is displayed:

> **Update request**
> **Waiting download**

3. Start the Vbflash application program.

4. From the VBFlash *Port Setup* command, select the PC communication port connected to the reader. By default, COM2 is selected.
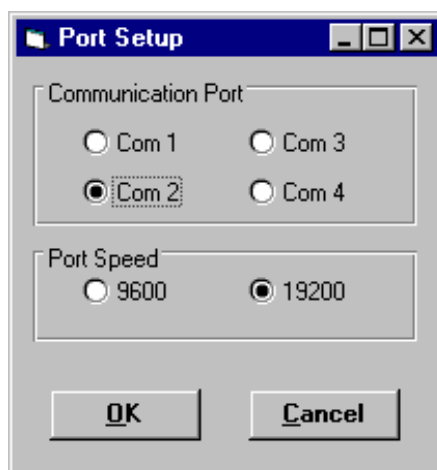
Figure 14: Port Setup Dialog

If the communication port is used by another application or is not available on the computer, the following message will appear on the screen.

Figure 15: Bad Port Selection Dialog

5. Using the ![Select file icon] *Select file* command, select the program file to be stored in the reader as follows:
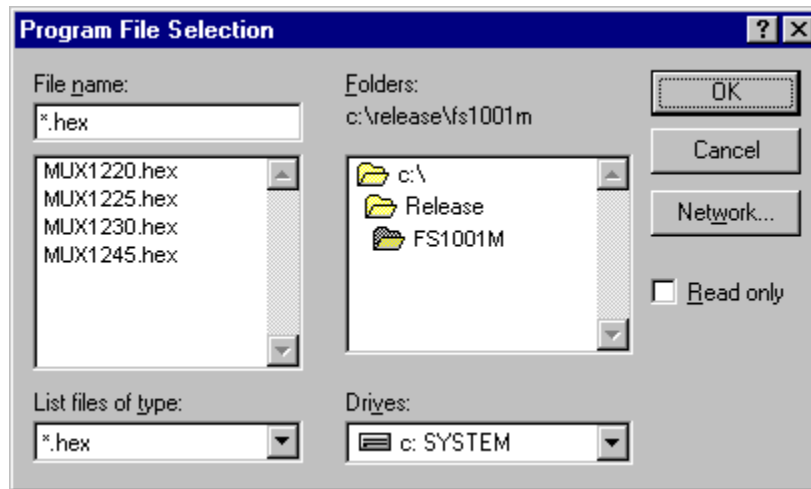

Figure 16: Program File Selection Dialog

The file must have a *.hex* extension and a name *MUX12xx*, where xx is either 20, 25, 30 or 45 and defines antennas switching time in milliseconds. Once selected, the file name will appear on the VBFlash window as follows:

Selected file
U:\VBFLASH\04742-~1.HEX

6. Using the ![Reader Configuration icon] Reader Configuration command, set up the permanent reader ID and current alarm threshold values (optional). The toolbox program will be display as follows:
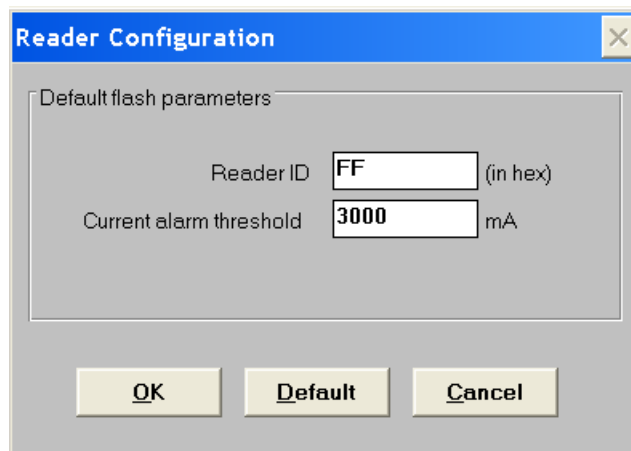

Figure 17: Reader Configuration Dialog

- Select the reader ID value field with the mouse and change it to the desired value. Valid values are from 0 to F0 (Hex). The default value is FF.

- Select the current alarm threshold value field with the mouse and enter a number from 1 to 9999. This will set the antenna current alarm in mA. The default value is 3000.

- Click OK.

7. Using the ![icon] **Connect** command establish communication between the PC and a reader. Once connected, the Status will be updated as follows:

Status log

Target Not Connected
Try to connect on COM1 19200,n,8,1
Target Connected
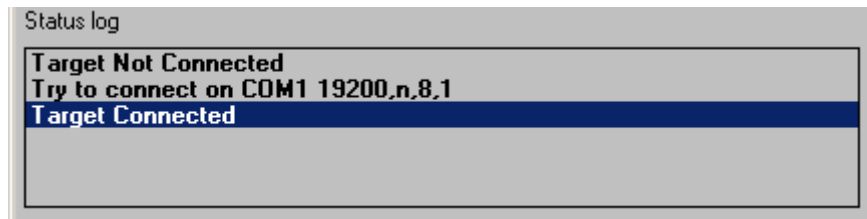
If the computer has a problem establishing the communication with the reader, the Status will be updated as follows:

Status : **Target Not Connected! (TimeOut)**

8. Using the ![icon] **Program** command, start the reader software update. The VBFlash program will:

- Calculate the program checksum

- Set the reader in program mode. The LCD display will be as follows:

```
Loading program
Please wait
```

- Erase the Flash EEPROM program memory

- Program the Flash EEPROM program memory

The completion of the software update will be indicated as follows:
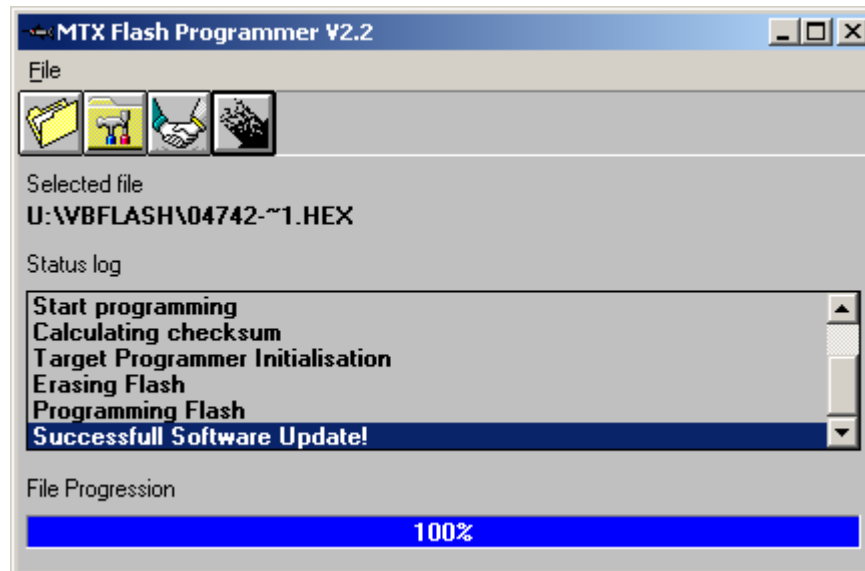
MTX Flash Programmer V2.2

File

Selected file
U:\VBFLASH\04742-~1.HEX

Status log

Start programming
Calculating checksum
Target Programmer Initialisation
Erasing Flash
Programming Flash
Successfull Software Update!

File Progression

100%

Figure 18: MTX Flash Programmer Dialog

9. The reader will automatically restart after the completion of the software update, showing the firmware revision number.

10. Close the VBFlash application using the Exit command (or).

11. Using an application such as HyperTerminal or ProComm , setup the desired reader configuration by using the appropriate commands.

Note: The Multiplexer power should not be turned off while performing a software update.

Cleaning Instructions

- The unit may be cleaned by wiping with a clean, dry cloth.

- Ventilation filter foam should be replaced as it gets old or dirty (pack of 5 supplied with the reader; Qualtek/Fan-S Division p/n: 09250-M/100 or equivalent).

ELECTRICAL AND ENVIRONMENTAL CONSIDERATIONS

Electrical Specifications

Fuses

Motherboard:

- F1 – 10A 250V HI-BRK FAST 5MM x 20MM (Littelfuse p/n: 0216010.H or equivalent)

- F2, F3 – 8A 250V HI-BRK FAST 5MM x 20MM (Littelfuse p/n: 0216008.H or equivalent)

Main Power Source

24V DC +/-25%, up to 3A

Main Power Connection

With the power switch of the unit in the off position, plug one end of the supplied power cord into the unit's power connector. Connect the other end to a 24V DC power source in polarity specified on "DC Input Only" label, either located on a side of a Multiplexer over power connector or attached to supplied power cord.

Figure 19: Power Switch and Power Connector

Environmental Recommendations

Mounting

The unit is designed for indoor use or installation into a NEMA 4 cabinet. Mounting of the unit **must** be vertical with antenna connectors facing down to ensure proper operation of the antennas switching relays.

Altitude

Sea level to 2000 meters.

Temperature range

-20°C to 70°C

Relative Humidity

0% to 80%

Pollution

Degree 2

Grounding

Warning: For safe and optimal operation, this equipment must be properly grounded.

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