RAM-200 User Manual

Embedded Iridium Proximity System

Shipped From

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Specifics

This manual version is written with respect to RAM-200 firmware build 12493. To acquire the latest firmware, contact support@xeostech.com

Version History

| Version No.	Firmware Ver.	Date	Description
1.0	1.1.12493	Feb 2025	Original Release

Table of Contents

Overview

The RAM-200 is an Iridium-fit alarm instrument, designed to transmit notifications based on user configuration of triggered sensor inputs. Utilizing the Iridium network, messages assigned to specific alarm criteria are relayed to end-users. When used with Xeos' XeosOnline web service, messages can be forwarded to a wide array of selected individuals.

The RAM-200 can be configured using Xeos' RAM-200 Console to set alarm names, sensors inputs and timing conditions which are assigned to them. Additional information such as the shared sensor trigger timeout and the non-alarm Iridium check-in rate can be configured using this software.

Templates for a user's typical alarm setups can be saved and loaded in through RAM-200 Console for more consistent configuration. The RAM-200 also accepts commands through the Iridium network to configure settings and alarms remotely to check configuration if an error occurs or operational circumstances change.

Physical Layout

Users of the previous RAM-100 will be familiar with the general layout of the RAM-200. Major differences are nevertheless present and worth noting.
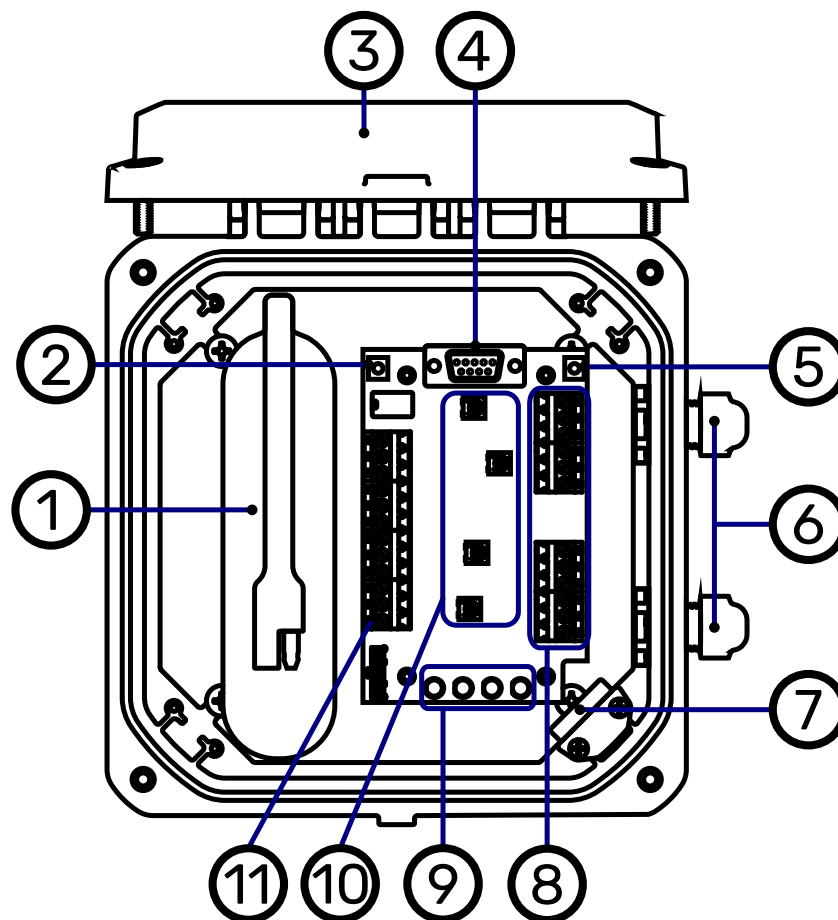
No.	Name	Function
1	Battery	Each RAM is powered by a battery of the users' preference (not included).
2	LED Enable	Press this button to re-enable sleeping diagnostics and LEDs.
3	Antenna	The Iridium antenna is mounted inside of the lid of the RAM-200 enclosure and connected to the electronics stack via cable.
4	Diagnostic Port	Access for diagnostics, configuration via RAM-200 Console, and firmware updates.
5	Iridium Test	Press this button to send an Iridium test message.
6	Cable Glands	Two cable glands (typical user application) on the front of the device allow to pass sensor cables through.
8	Sensor Inputs	Four sensor inputs (1 – 4) are labelled for use.
7	Clock Battery	Each RAM-200 holds a CR2032 coin cell for keeping time while off, **provided the battery switch is set to on.**
9	LEDs	LEDs to indicate start-up, self-test failures, sensor triggers.
10	Sensitivity Adjust	Four sensitivity potentiometers are present for adjustment for their respective sensor inputs. Use a Philips screwdriver to adjust.
11	Power Input	Power from the battery requires a connection to the **+VIN** and **GND** connections.

LED Behavior

Confirming the correct operation before deployment can save time ahead of a project. The LEDs and buttons on the RAM-200 are designed to assist in this confirmation. The LEDS are automatically on after power-up for **15 minutes** to assist with installation. LEDS can be reactivated with a push of the LED Enable button at any point.

Note: If an LED sequence begins on any LED after regular operation below, this indicates a self-test failure. See the section below on failure codes.

Power-up Sequence	
Behaviour	Meaning
Red LED	Reverse voltage applied; swap power input.
Scrollling Sensor LEDs	Initial Boot sequence.
Modem LED	Iridium self-test
Power LED ON	Self-test complete; RAM-200 in normal operation.
Flashing LED	Self-test failure

Regular Operation	
Behaviour	Meaning
Power LED on	RAM-200 in regular operation; LEDs are enabled, diagnostics are enabled
Sensor LED on	Corresponding sensor has been triggered, but an alarm has not been triggered.
Scrolling Sensor LEDs	All criteria for an alarm has been met; transmit an alarm message
Modem LED	Iridium is on for a Check-in or Alarm message transmission.
LEDs off	RAM-200 is in low-power mode; LEDs are disabled, diagnostics are disabled.

Test Buttons

Two test buttons, respectively labelled on the enclosure, provide different functions to aid in the functionality testing and configuration of the RAM-200.

Test Buttons	
Button	Action
PB1 – LED Enable	All LEDs will illuminate for a short duration, diagnostics are enabled for 15 minutes.
PB2 – Iridium Test	Triggers an Alarm Test message; Iridium modem turns on in an attempt to transmit the message; Iridium LED turns on.

Device Configuration

All of the settings on the RAM-200 can be configured either by connecting to the RS-232 diagnostic port to a PC using RAM-200 Console, or by sending configuration commands over the Iridium Satellite Network Via XeosOnline.

Diagnostic Port

The same physical port can be used to access the raw diagnostic output, and manually send commands mentioned in this document without the use of RAM-200 console. Port settings are below:

|	
Baud Rate	9600
Parity	None
Data Bits	8
Stop Bits	1

RAM-200 Console Software

RAM-200 Console is the primary interface point for configuration of the RAM-200. Through the RS-232 diagnostic port, the Console will be used to do the following:

- Query the RAM-200 for its current configuration in its entirety and display that information.
- Allow for changes to be made to its current configuration in the software
- When changes are decided, send the new configuration to the RAM-200
- Automatically set the date and time (in UTC) of the RAM-200 Console when changes are uploaded.

Connection

Upon opening the RAM-200 Console, a selection is to be made of the COM Port the RS-232/RAM-200 is connected to on the PC. Only ports that detect some sort of device or cable will be displayed.
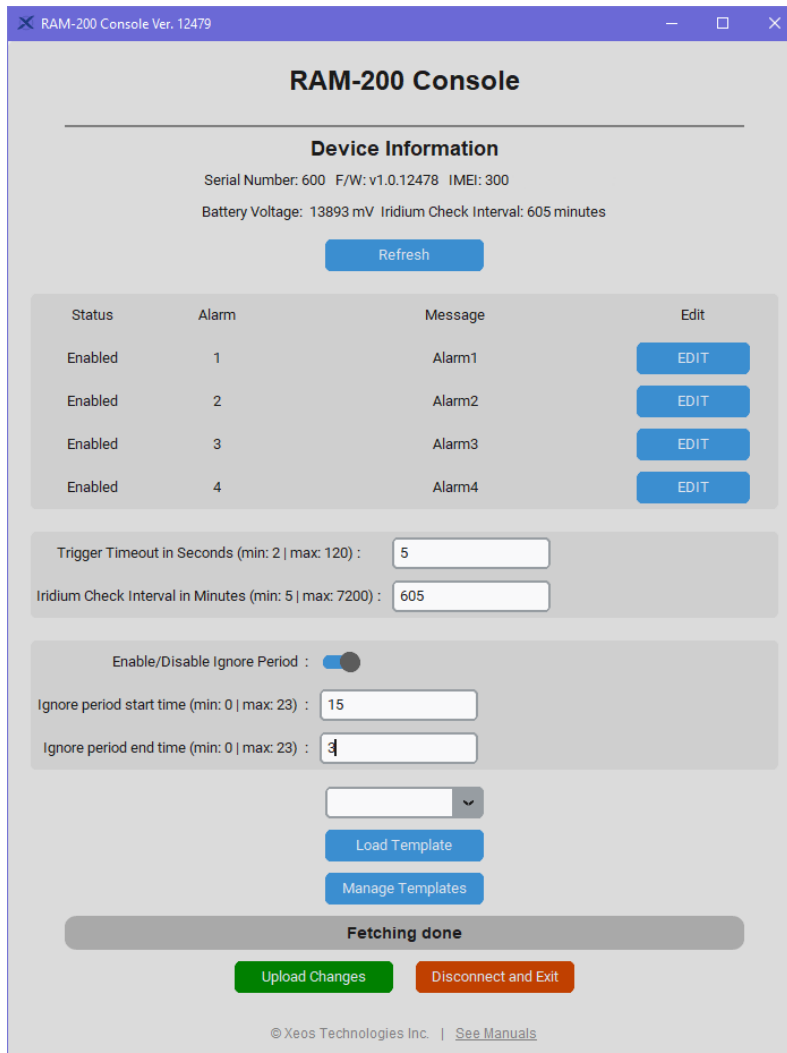
As the RAM-200's communication speed is static, no other port setup is required.
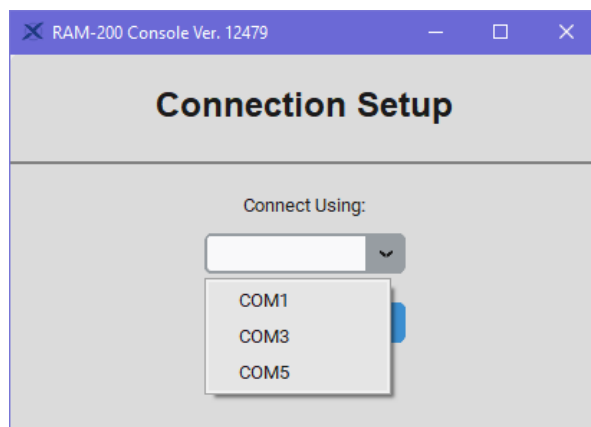
Main Page

The main page of the Console will, after several seconds, display the main settings of the RAM-200 as they are currently configured. These are:

- Device Information: Contains the Serial Number and Iridium IMEI (necessary for activation) along with the firmware version and the battery voltage.
- Alarm Status: Each of the four possible alarm setups are shown here on a basic level. To see the conditions and sensors necessary to trigger each alarm, choose the appropriate Edit button.
- Other Timeouts: The global trigger timeout and the Iridium Check Interval are displayed and configurable by changing their fields.
- Iridium Ignore Period: If this feature is not enabled, this section is collapsed. If enabled, the values for the start and end hours are displayed and configurable.
- Templates: Users can save, load and delete templates from this section.
- The buttons to push changes to the RAM-200, as well as an Exit button to close the program.

Configuring Alarms

Selecting the **EDIT** button next to an alarm on the main page opens a separate page to edit that alarm.
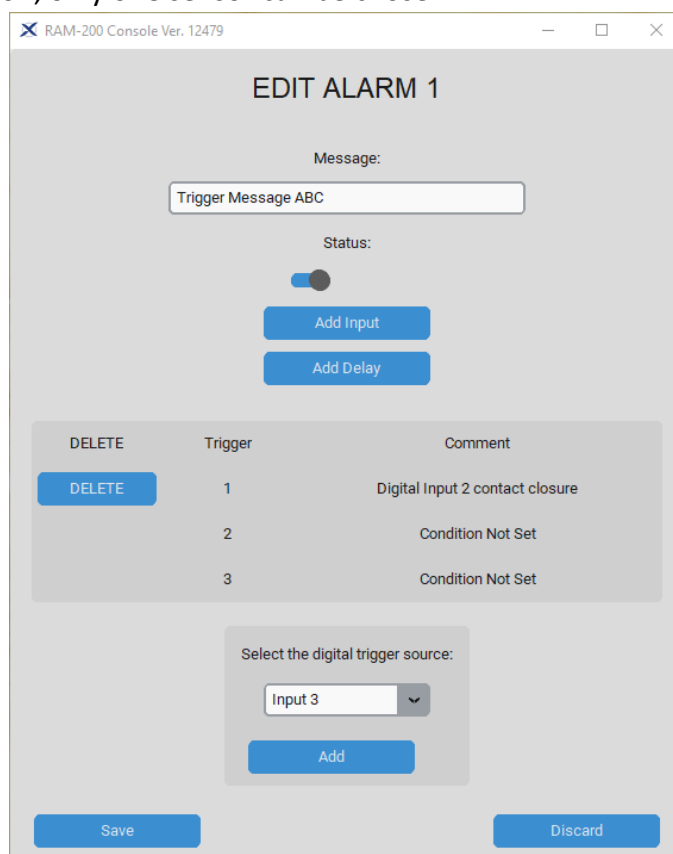
Alarms are built from three main components:

- The **Message** that is transmitted when the alarm's conditions are met.
- The **Status** of the alarm, enabled or disabled.
- The **Conditions**, created from a single, or multiple Sensor Input triggers. Three conditions can be created for a single alarm. Note however that **all** conditions have to be met to run the alarm, and transmit the message.

Note: Alarm setups are not pushed to the RAM-200 with the Save button on the Alarm page. No changes are pushed to the RAM-200 until the **Upload Changes** button on the main page is used.

Creating a Single Hit Condition

In a Single Hit Condition, only one sensor can be chosen.
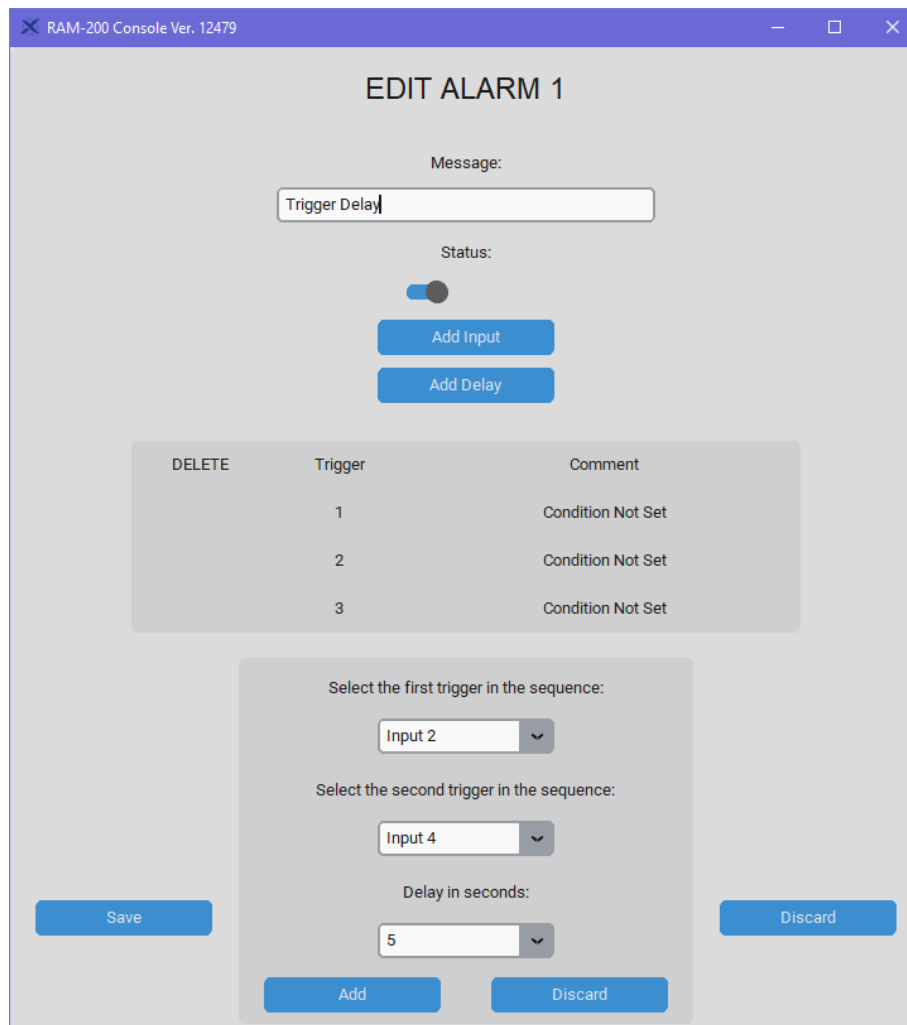
- Choose the **Add Input** option. This will open a dropdown to choose which sensor to use for this condition.
- Choose the appropriate sensor and click **Add**, or to step back, click **Discard**.
- Once created, the condition will be placed in the list of conditions with the details on what constitutes it.

- Each condition can be deleted with its appropriate **DELETE** button in its row.
- When an alarm's conditions and message have been set, and the alarm is set to enabled, click the **Save** button on the bottom of the page, or to delete these changes, click **Discard.**

Creating a 2-Sensor Delay Condition

In a Delay Condition, two sensors with a timespan are used to interpret directionality.

- Choose the **Add Delay** option. This will open a dropdown for this condition.
- Choose the **first** sensor that needs to be triggered
- Choose the **second** sensor to be triggered.
- Choose an amount of time that has to pass between sensor triggers to fulfil the condition.
- When complete click **Add**, or to step back, click **Discard**.
- Once created, the condition will be placed in the list of conditions with the details on what constitutes it.
- Each condition can be deleted with its appropriate **DELETE** button in its row.
- When an alarm's conditions and message have been set, and the alarm is set to enabled, click the **Save** button on the bottom of the page, or to delete these changes, click **Discard.**

Templates

The RAM-200 Console can load in templates for deployments that are common.

To create a template:

- Choose all the configuration values for the template, including Alarm names and conditions.
- On the Main Page, choose **Manage Templates.** A new page appears.
- Give the new template a name and click **Save**. To return to the main page without saving, click **Close.**
- The template will now be available on the main page from the dropdown.

To delete a template:

- Choose the template from the dropdown in the Delete Template section.
- Select **Delete,** and confirm the action.

Sending SBDs Using XeosOnline

Commands listed in this document can be sent to the RAM-200 while the device is deployed and active on an Iridium subscription. Responses are then transmitted from the RAM-200 after downloading said commands as a confirmation.

- Navigate to the Send Command window.
  - After logging in, choose **Menu > Send Command**
- Select the unit(s) to target with command(s) and move them over to the right-hand target list using the **->** button.
- Type the command(s) into the command box and press send.
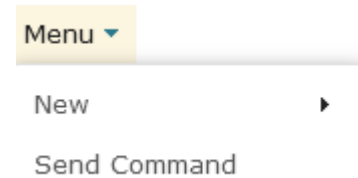
Remember to include the dollar sign (**$**) ahead of each command, and enter each command on a separate line.

Outgoing messages will appear in the Message Log for the commanded device.

Iridium Schedule

The RAM-200 has three different paths to begin sending Iridium messages:

- The regularly scheduled Iridium transmission rate set with **$setsbdreprate**
- A press of the **Iridium Test Button** (PB2)
- A trigger of an **Alarm**
    - **Note**: Alarms will not trigger during the Ignore Period.

Each of these messages contain a timestamp tied to the internal time of the RAM-200, in UTC. They also each contain the voltage of the device, which can be monitored in table or graph form on XeosOnline using the Status of Health tab.

Responses to commands received over Iridium do not contain a time or voltage and do not transmit unsolicited.

Scheduled Transmission

As laid out in the settings, the RAM-200 will transmit regularly to allow for configuration commands and to monitor its internal voltage and general consistent operation:

> Timestamp: 2024-12-06T14:53:38.000Z, Voltage Value (V): 13.50, Ascii: CHECK-IN

The CHECK-IN message is intentionally meant to not trigger alarm forwarding services.

To change the rate of the CHECK-IN message, the following command can be used.

Command	**$setsbdreprate value**
Response	**Iridium Repetition Rate: 5 Minutes**
Example	**$setsbdreprate 720**

Test Alarm

A dedicated message is transmitted when the Iridium test button is pressed. This message, like a regular trigger message, is categorized as an alarm to trigger all forwarder types. This is intended to be a useful end-to-end test for an operator with the RAM-200 in the field:

> Timestamp: 2025-01-09T17:22:25.000Z, Voltage Value (V): 13.89, Ascii: ALARM: TEST ALARM!, isAlarm: true

Alarm Message

Each time all conditions are met for an Alarm (all sensors necessary are hit in the correct amount of time), the RAM-200 will make an attempt to trigger an Alarm message. This transmission will specify which of the four possible Alarms was initiated (1 – 4) followed by the specific message input by the user to transmit:

> Timestamp: 2025-01-09T17:21:41.000Z, Voltage Value (V): 13.89, Ascii: ALARM 3: Downstream, isAlarm: true

Confirming Device Operation

Power to the RAM-200

After plugging in the power connector, the unit will flash all of its LEDs. If this is not true, but the Red LED is on, reverse the voltage supplied to the unit.

Iridium Operation

An Iridium transmission, categorized as an Alarm-type message, can be triggered by pressing the **Iridium Test** button. When pressed while the LEDs are enabled, the MDM-RF LED will illuminate for the duration of the Iridium task.

Forwarders that are set to send messages to recipients' emails on XeosOnline will send this message, regardless of it being an All-Email or Alarms Only forwarder. This confirms the end-to-end Iridium test.

Sensors

Individual sensor inputs on the RAM interface board can be tested without the need for sensors, for a basic test. It is also good practice to test that unused inputs are set to the off, or least sensitive position.

Shorting input pins A and B for a sensor input drops the sensing line of that input, triggering the mechanism. Ensure that the potentiometer is turned to the on or off position, depending on what the intended outcome is.

Note: Alarms will not trigger if the time is inside the Alarm Ignore Period.

RAM-200 Internal Time

The RAM-200 has an internal RTC (Real Time Clock) that keeps the date and time. This value is automatically set by the RAM-200 Console when uploading changes to its settings. This time is always in UTC.

When an Iridium message is transmitted, this date and time is transmitted in the content of the message, whether it be a Check-in message or an Alarm. This time is tied to the event that caused the transmission and so can vary in the amount of delay between the trigger and a successful transmission.

If the time inside the RAM-200 reads as extremely old, this will cause the failure of the self-test. It is likely that the CR2032 coin cell is either dead or turned off via the switch underneath the battery holder.

The time set in the RAM-200 can be reconfigured over Iridium if required, even if the clock battery is inoperable, with the **$settime** command. Accurate assessment of when the RAM will receive this command would be required to set the time properly in this manner. In this case, time would be kept until regular battery power is interrupted to the device.

Alarm Ignore Period

The RAM-200 uses the internal time to keep track of its set alarm ignore period. This optional feature allows users to set a start and end time (in UTC) where sensor triggers do **not** allow Iridium transmissions to occur. Regular transmissions (Iridium Check-in) set by **$setsbdreprate** will continue regardless of this setting.

To set an Ignore Period, the following command is to be used. Setting an ignore period explicitly enables this functionality.

The ignore period can only be set to a whole number. The startHour value can be greater than the endHour value, in such a way that the ignore period is overnight, for example.

Command	**$setignoreperiod startHour endHour**
Response	**Alarm Ignore Period: Enabled** **Start Hour: 15** **End Hour: 17**
Example	**$setignoreperiod 15 17**

The **$getignoreperiod** command can be used to query the current settings, which returns the response shown above or below, depending on the state.

To remove the ignore period functionality and values, the **$clrignoreperiod** command can be used.

Command	**$clrignoreperiod**
Response	**Alarm Ignore Period: Disabled**

Installing a RAM-200

As with all other Iridium-based installations, the antenna (top plate) has to have as wide a view of the sky as possible. This can still be achieved while obscuring the RAM-200 if avoiding the following:

- Metallic or other notable obstructions, such as buildings.
- Install the RAM-200 in a direct upright position
- Covering the RAM-200 in natural material lacking significant density. Sticks, grass and light earth material in a similar vein are appropriate. For best performance, minimize the amount of material covering the antenna.
- Cable bundles cannot be on top of the RAM-200 as this will negatively impact Iridium performance.

Cartell sensors should be deployed parallel to the direction of target travel and should be buried approximately 3 inches. Follow the included directions for specific installation instructions with the sensors.

Trench the cable from the sensors back to the RAM-200. Extra cable can be buried in the same hole as the unit or alternatively, can be cut down to size.

Command Index

The below list are the settings and commands a user may utilize. While main interfacing will be locally through RAM-200 Console, commands below can also be used with a terminal emulator, or remotely over Iridium via XeosOnline.

Commands and arguments are **not** case-sensitive and are only given different cases for easier readability in this document.

Arguments below as **<#>** indicates a valid range of values.

Arguments below in **[ARG]** indicates separate, required arguments after the command.

Command	Arguments	Description	Example
Generic			
$ver	---	Returns firmware version, hardware version, serial number, IMEI.	$ver
$resetNow	---	Soft reset the RAM-200, no settings changed	$resetNow
$defaults	---	Set the device back to its default settings Does **not** reset the device	$defaults
$settings	---	View all settings **except alarms**.	$settings
Iridium			
$iss	---	Displays some Iridium statistics from last reset	$iss
$isd	---	Displays information on Iridium session duration and total time	$isd
$imei	---	Displays the IMEI of the device	$imei
$setsbdreprate	[Rate, <5 – 2880>]	Set the Iridium Check-in message rate (minutes)	$setsbdreprate 720
$getsbdreprate	---	Get the Iridium Check-in message rate (minutes)	$getsbdreprate

Alarms			
$settrigto	<5 – 120>	Set the time (in seconds) before **all** sensor detection times out.	$trigto 30
$gettrigto	---	Get the trigger timeout in seconds.	$gettrigto
$setalarmname	[alarmnum] [Name]	Set the name of an alarm. Alarm Number <1 – 4> Name Maximum 30 Characters, **no spaces.**	$setalarmname 3 Northbound_123
$getalarm	<1 – 4>	View the alarm corresponding to the parameter.	$getalarm 1
$setalarm	[alarmnum] [enable]	Set an alarm to enabled (1) or disabled (0)	$setalarm 1 1

$setcond	[alarmnum] [condnum] [hit-type] [startsens] [endsens] [delay]	Setup an alarm condition.
		Alarm Number <1 – 4>
		Condition Number <1 – 3>
		Type:
		    S = Single Hit
		    D = Delay Hit
		    X = Disabled
		Start Sensor <1 – 4>
		End Sensor <1 – 4>
		Trigger Day (s) <1 – 90>
			$setcond 1 1 D 2 4 10
			
			$setcond 2 1 S 2 2 1

Time			
$settime	[DateTime]	Set the system time to the desired time, use UTC; **note space between date and time.** DateTime = yyyy-MM-dd hh:mm:ss	$settime 2024-11-21 14:31:22
$gettime	---	Show current system date and time (UTC)	$gettime
$setignoreperiod	[Start Hour, <0 – 24>] [End Hour, <0 – 24>]	Set the alarm ignore period **AND** enable it. **Note**: Time is 24-hour format in UTC.	$setignoreperiod 5 9
$getignoreperiod	---	Get the alarm ignore period and status.	$getignoreperiod
$clrignoreperiod	---	Clears **AND** disables the alarm ignore period	$clrignoreperiod

Hardware Checks			
$vbat	---	Get the current battery voltage in millivolts	$vbat
$sensecount	---	Get the total number of times each **sensor** has detected an event since powerup.	$sensecount
Local Hardware Checks (Accepted Only Over Diagnostics)			
$lflash	<0 – 7>	Flash an LED.	$lflash 3

Self-Test Failure Codes

The RAM-200 will repeatedly flash an LED code after power-up if any systems that are tested fail. In the event that there are multiple systems that meet the failure criteria, only the higher priority system's failure code will be displayed.

Failed System	Possible Cause	LED Indicator
Voltage	Voltage Too Low	PWR-OK
Iridium	Iridium Modem hardware failure or Power supply too low	MDM-RF
Clock	Clock battery dead or Clock battery switch OFF	Alarm 2
Sensor/Button Inputs	Internal Circuitry failure	Alarm 3
Multiple Systems	See above	Alarm 4

Electrical Specifications

Power Supply	
Supply Range	12 – 22 VDC
Clock Battery	3VDC (CR2032)

Electrical	
Iridium Tx Avg (mW)	50
Iridium Tx Peak (W)	1.5
Idle (mW), Sensors Connected	650

Batteries should be disconnected if the device is entering storage.

Electronics	
Digital Controller	Xeos IRDC2B
Antenna	Xeos proprietary antenna, designed to withstand high pressure environments
Iridium Transceiver	Iridium 9602

Mechanical Specifications

Mechanical Characteristics	
Antenna	Xeos proprietary Iridium patch
Housing	Polycarbonate
Connector	SubConn MCBH-8F-TI

Dimensions	6"W x 4"H x 6"D

Mass	

Environmental Characteristics	
Operating Temperature	-30° C to +50° C

Upgrading RAM-200 Firmware

Firmware updates for the RAM-200 run the same as the preceding RAM-100, using the Bootloader Console program. The latest firmware packages can be accessed from Xeos' Firmware Repository.

The Bootloader program inside the RAM-200 runs immediately on power-up, to check for incoming firmware packets to update to, before moving onto the main firmware. Due to this, power has to be applied immediately after starting the update attempt.

Requirements

- PC with Windows OS
- Serial to USB cable or equivalent for connection
- DC Power Input to RAM, 12V Nominal
- Firmware Update Package
  - Bootloader Console program
  - Update.exe
  - Firmware .enc file
- Philips Screwdriver to open the RAM-200

Software Preparation

- Open the top of the RAM-200 to access the electronics.
- Ensure power is not applied to the RAM-200 at this time.
- Connect the serial cable, used to connect the RAM-200 to the PC, to both instruments.
- Take note of the COM Port number the computer assigns to the programmer after it is plugged in, using the PC's Device Manager in the **Ports** section.
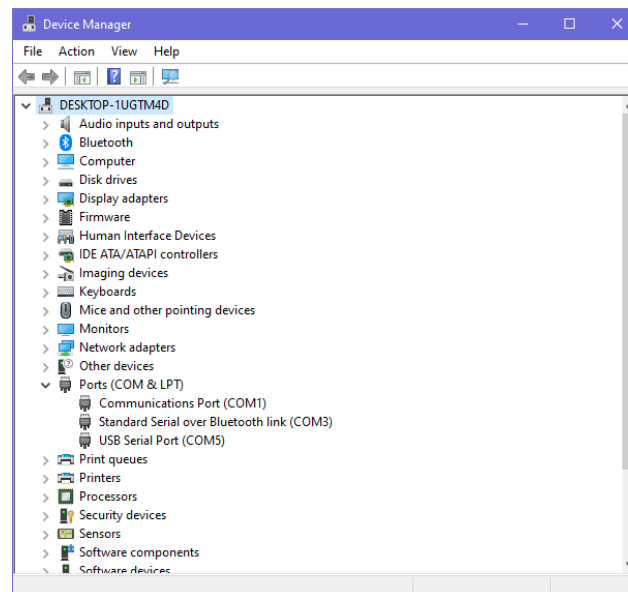
- Download the relevant firmware package.

Firmware Upload

- Open BootLoader Console. It is important to keep the update.exe file in the same directory as the Bootloader Console program.
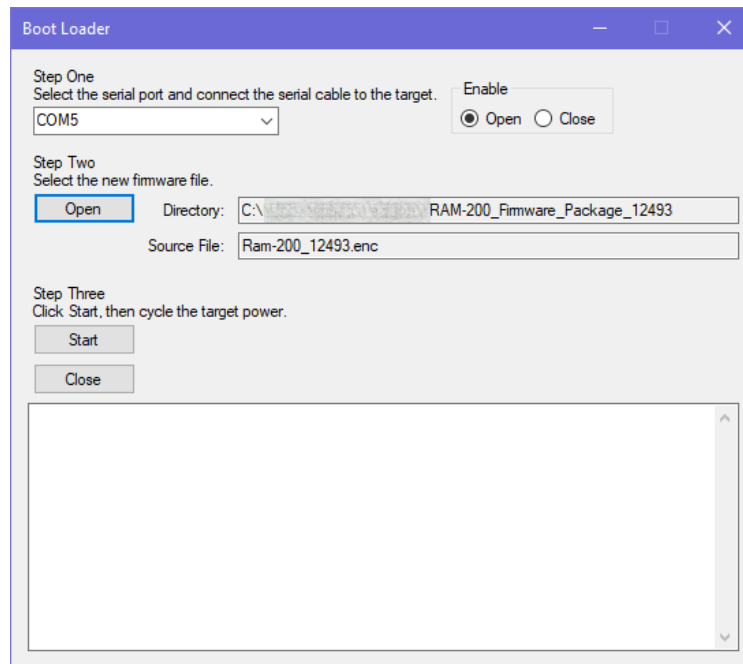
- Select the **COM port** assigned to the cable/RAM-200 (only COM Ports 1-9 supported).
- Under **Enable**, select **Open**.
- Select the new firmware .enc file by pressing the **Open** button, and navigating to the location and choosing it from the file explorer.

With the above preparations made, the following process will initiate the upload process. This requires the upload process to be started, followed immediately by powering the RAM-200. If the power is given too late or the program does not start loading, it will request the power be cycled again.

- Click on **Start**
- Connect the power source
- A command prompt window will open, displaying the progress of the firmware upload. When complete, this window will close.
- After the update is complete, the Bootloader Console will close the COM port. The RAM-200 will reboot using its normal visual indicators.

Iridium Service

If the RAM-200 comes equipped with a 9602 Iridium Transceiver which makes use of the Iridium satellite system's Short Burst Data (SBD) services.

SBD service is a global, two-way, real-time, email-based data delivery service that has a maximum outbound (from unit) message size of 340 bytes and a maximum inbound (to unit) message size of 270 bytes.

RAM-200 end users/integrators must set up an approved data delivery account with their preferred service provider. Xeos is also an Iridium VAR and can provide Iridium service.

Setting up service requires the modem's 15-digit International Mobile Equipment Identity (IMEI) number. Each IMEI number is capable of being associated with up to five (5) unique email addresses and/or IP addresses.

While any email application can be used to send and receive messages to the RAM-200, XeosOnline is the easiest way to manage and monitor the RAM-200. XeosOnline presents information in a readable format with date-filtered graphing.

Warranty, Support and Limited Liability

Xeos Technologies Inc. warranties the RAM-200 to be free of defects in material or manufacturing for a period of one year following delivery. Liability is limited to repair or replacement of the defective part and will be done free of charge.

LIMITED WARRANTY: Xeos Technologies Inc. warrants that the product will perform substantially in accordance with the accompanying written materials for a period of one year from the date of receipt.

CUSTOMER REMEDIES: Xeos Technologies Inc. entire liability and your exclusive remedy shall be at Xeos Technologies Inc. option, either (a) return of the price paid or (b) repair or replacement of the product that does not meet Xeos Technologies Inc. Limited Warranty and that is returned to Xeos Technologies Inc. with a copy of your receipt. This Limited Warranty is void if failure of the product has resulted from accident, abuse, or misapplication. Any replacement product will be warranted for the remainder of the original warranty period or ninety (90) days, whichever is longer.

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