Portable Anchor Alarm

User's Guide

Version 1.3

Last Revised: 18-Dec-14

Mountain States Consulting, LLC
970 W Broadway #471
PO Box 30000
Jackson, Wyoming 83002 U.S.A.
307-733-1442 • www.msc-lims.com

Portable Anchor Alarm

User's Guide
Version 1.3

Mountain States Consulting, LLC
970 W Broadway #471
PO Box 30000
Jackson, Wyoming 83002 U.S.A.
307-733-1442
info@msc-lims.com
http://www.msc-lims.com

Table of Contents

CHAPTER 1: INTRODUCTION 1

Overview 1
Unpacking 3

CHAPTER 2: GETTING STARTED 5

The Front Panel 5
The Back Panel 6
Quick Start 6

CHAPTER 3: USING THE ANCHOR ALARM 9

Connecting External Power 9
Connecting the GPS Antenna 9
Marking the Anchor Position 9
Setting the Alarm Distance 10
Enabling the Alarm 11
Using the LCD Backlight 11
Understanding the Display Screen 12
Understanding the Audible Alerts 13
Rechargeable Battery Care 14

APPENDIX A: DISTANCES 15

APPENDIX B: SPECIFICATIONS 17

Physical 17
GPS Receiver 17
GPS Antenna 18
External Power 18
Internal Battery 19
Buzzer 19

List of Figures

Figure 1 Circle of Swing....1
Figure 2 Contents....3
Figure 3 Front Panel....5
Figure 4 Back Panel....6
Figure 5 Display Screen....12

Chapter 1: Introduction

Thank you for purchasing the Portable Anchor Alarm. We hope you will find this GPS-based instrument useful as an early warning device should your anchor's location change. The Portable Anchor Alarm is only intended to provide an audible alarm should certain variables exceed the parameters set by the User. The Anchor Alarm is no substitute for skillful seamanship, proper anchoring techniques, safe boating practices, and secure anchor tackle.

Overview

The Portable Anchor Alarm is a GPS-based instrument you may find helpful to have onboard your boat if you frequently spend time at anchor. When used properly, the Anchor Alarm is designed to warn you if your boat moves unexpectedly. By marking the position of your anchor then setting a radius for the boat's circle of swing, the User instructs the Anchor Alarm to sound a warning if the device (and its attached boat) moves beyond that radius. The Anchor Alarm is not a cure for poor ground tackle or improper anchoring techniques but it does provide a bit of insurance in the form of an early warning should your anchor drag.

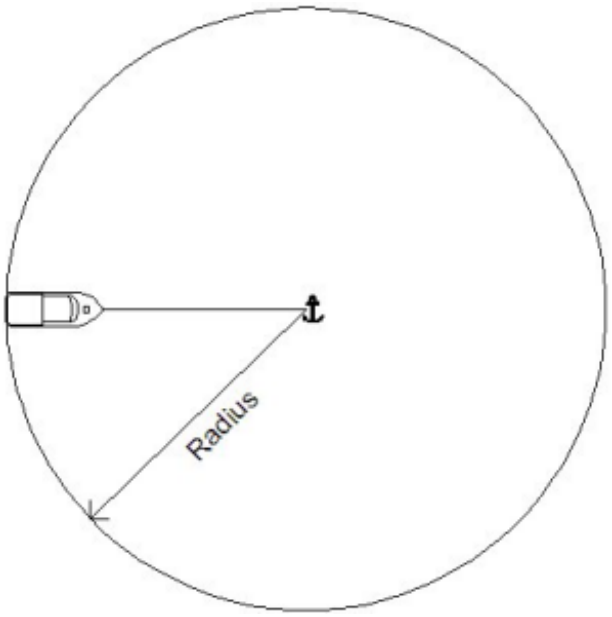


Figure 1 Circle of Swing

To understand how the Anchor Alarm works, you must first understand the concept of *Circle of Swing*, illustrated in the sketch above. The position of your anchor is the center of the circle. The circle's radius is calculated as the sum of the length of anchor rode plus boat length (or distance from the bow

to the activated Portable Anchor Alarm aboard) plus GPS position error. Now it is easy to see that if the Alarm's distance from the center of the circle exceeds the circle's radius then the anchor must have moved from its original position.

The simple geometry depicted in Figure 1 demonstrates that using the position of the anchor is the best solution for an anchor drag alarm. Your boat can swing through a 360-degree arc and the alarm will only sound if the boat moves outside the circle whose center point is the anchor.

To use the Anchor Alarm, you simply move the device to your boat's foredeck and mark the position as you lower the anchor. After anchoring place the Anchor Alarm in your stateroom, set its alarm distance to the radius of your swing circle then activate the alarm. It's that simple!

See Chapter 2: Getting Started (page 5) for a brief tutorial on getting started with the Anchor Alarm. Chapter 3: Using the Anchor Alarm (page 9) includes more detailed information on using the Anchor Alarm. For more information on how the Anchor Alarm was conceived and constructed see our article *"Anchor Alarm: A Stand-Alone Portable GPS-Based Anchor Alarm"*, at http://www.boathooked.com/articles/anchoralarm.html.

The most recent version of this User's Guide can be found at http://www.boathooked.com/download.

Unpacking

The Anchor Alarm includes the following components:

- Anchor Alarm with GPS Receiver and Internal 9V Rechargeable Battery
- GPS Antenna with 15-Foot Cable
- 12VDC minimum 300 mA Switching Power Supply with 6-Foot Cable
- 6-Foot DC Power Cable with 2.1mm Plug

Figure 2 Contents

Chapter 2: Getting Started

See the descriptions of the device's front and back panels then follow the Quick Start tutorial below for the fastest way to start using the Portable Anchor Alarm.

The Front Panel

Figure 3 Front Panel

LCD Screen

The liquid crystal display (LCD) screen lists the following information. See Understanding the Display Screen (page 12) for more information.

Row 1: Current position of the anchor alarm (boat) in degrees and minutes Latitude followed by Longitude.

Row 2: Anchor position in degrees and minutes Latitude followed by Longitude.

Row 3: Current distance between the anchor alarm and anchor positions in nautical miles and current UTC time.

Row 4: Alarm distance setting in nautical miles set by the User, number of satellites for the last position fix, and alarm on/off state.

LCD Backlight

Use the Brightness button to change the brightness of the LCD screen's backlight.

Distance Set

Use the green up and down distance set buttons to set the anchor alarm distance in 0.001 nautical mile increments.

Mark Anchor

Press the green up and down distance set buttons simultaneously to mark the anchor position.

Alarm On/Off

Use the Alarm on/off button to enable or disable the alarm.

Status LED

The red alarm status LED is lit when the alarm is enabled.

The Back Panel

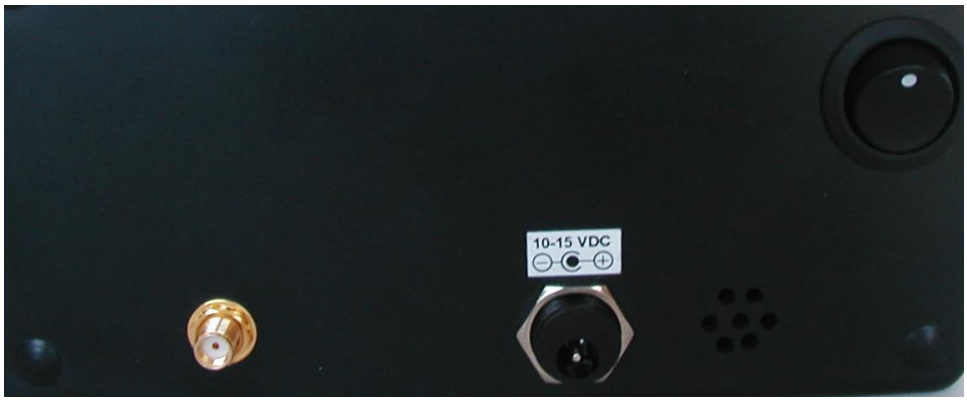
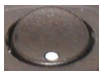


Figure 4 Back Panel



Power Switch

Use the power switch to turn the Anchor Alarm on or off.

External Power

Connect a 10 to 15 volt DC power supply.

GPS Antenna

Connect an external GPS antenna for best satellite reception.

Quick Start

Follow the steps below to start using the Anchor Alarm.

1. Connect the Anchor Alarm to a 10-12 VDC power source for at least 24 hours to charge the internal battery.
2. Turn on the device and allow the GPS receiver to locate satellites and obtain a position fix.
3. Disconnect the Anchor Alarm from the external power source and carry the device to your foredeck just prior to anchoring.
4. After your boat has stopped and either just before lowering the anchor or as soon as the anchor touches the bottom, press the two green buttons simultaneously to mark the anchor's position. Three short beeps will confirm the anchor position has been saved.
5. After paying out your anchor rode watch the **Dist:** value on the LCD display in addition to landmarks to ensure your anchor is set. The

Distance in nautical miles (0.001 NM is about 6 feet) should be close to the length of rode.

6. After your anchor is set, place the Anchor Alarm in a suitable indoor location preferably close to where you will sleep, and position the GPS antenna for best satellite reception.
7. Calculate the radius of your "circle of swing" as the sum of the length of anchor rode deployed, plus the current distance from the Anchor Alarm to the bow, plus 30 feet for GPS error.
8. Convert the radius of your circle of swing to nautical miles and use the green up and down SET buttons to set your alarm distance. See Appendix A: Distances (page 15) to convert feet or meters to nautical miles.
9. Use the ALARM button to activate the anchor alarm.

See Chapter 3: Using the Anchor Alarm (page 9) for more detailed information on the Anchor Alarm's operation.

Chapter 3: Using the Anchor Alarm

This chapter includes more detailed information on the operation of the portable anchor alarm.

Connecting External Power

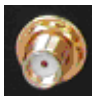
The Anchor Alarm requires a 10 to 15 volt external direct current (DC) power source to operate. The internal 9V battery is designed to power the device only for short periods of up to an hour while anchoring.

Connect the supplied 12VDC Switching Power Supply to the DC power jack on the back of the Anchor Alarm then plug into a 110 VAC power source. If you use your own AC to DC power supply, ensure that the transformer supplies a minimum of 10 VDC and at least 250 mA current. Alternatively, plug the supplied DC Power Cable to the DC power jack then connect to a 10 to 15 VDC power source.

Note that the LCD display will show **Batt** in the UTC time position when the unit is running on the internal battery. Use this feature to verify that you have successfully connected the external DC power source.

Connecting the GPS Antenna

The Anchor Alarm's internal GPS receiver includes a built-in patch antenna. However, for best satellite reception, we recommend using the supplied external active GPS antenna for best results even while anchoring.



Connect the external GPS antenna to the SMA port on the back panel of the Anchor Alarm. The supplied antenna includes a 15-foot cable so you can locate the antenna's magnetic base in a suitable location for best satellite reception. When anchoring, wrap the antenna cable around the Anchor Alarm handle and secure with a Velcro tie.

Marking the Anchor Position

As depicted in Figure 1, the simplest geometry to detect a dragging anchor requires an accurate position of the anchor. With the position of the anchor known to the device, and the radius of the "circle of swing" with the anchor at its center point calculated, the Anchor Alarm will issue an audible alarm if your boat moves outside the imaginary circle.

To mark the anchor's position, we recommend disconnecting the Anchor Alarm from its external power and carrying it to the foredeck and placing it as close to the bow as possible. Consider hanging the Anchor Alarm over your bow flag's mast. After you stop the boat, mark the anchor position by

simultaneously pressing the green set buttons either just prior to lowering the anchor or immediately after the anchor touches bottom. Note that you cannot mark the anchor position while "Acquiring Satellites" appears on the display screen.

NOTE

The anchor's latitude and longitude position, which is displayed on the second row of the display screen, is saved to the Anchor Alarm's non-volatile memory. If you turn the Anchor Alarm off or it loses all power (external and internal battery), the anchor position is preserved and restored when you turn the device back on.

While an accurate anchor position is important, movement of the boat and movement of the anchor before it sets will result in a marked anchor position that may be some distance from the actual anchor. We call this the *anchor mark error* and we will include it when setting the alarm distance (see below). Unless you are in a very crowded or tight anchorage the anchor mark error is not a significant problem and it's one you can minimize with practice.

An alternative method to mark your anchor position is to add a float line to your anchor. After you have set your anchor, dinghy out to the float line carrying the Anchor Alarm and mark the position of the float. When wind, current, or poor holding are involved, this method can produce a more accurate anchor position than those marked from the bow.

Setting the Alarm Distance

If you mark the anchor position from the bow while anchoring (see above), it is important to observe the Anchor Alarm's **Dist:** display as you back down to set your anchor. As noted above, the anchor mark error will be roughly the difference between the length of anchor rode and the Anchor Alarm's calculated distance to the marked position.

For example, if you put out 100 feet of rode and the Anchor Alarm's **Dist:** display shows 120 feet (0.020 NM) as you back down on your anchor, your marked anchor position is about 20 feet away from the anchor so your anchor mark error is 20 feet. Similarly, if the **Dist:** display shows 80 feet with 100 feet of rode, your anchor mark error is also 20 feet. When calculating the alarm distance, add the anchor mark error to the length of rode. Following our example we would use 120 feet, which is the maximum distance we would see if we pivot 180 degrees with the Anchor Alarm still on the bow. If you mark your anchor position using your dinghy and a float line you can ignore the anchor mark error.

To determine the alarm distance, total the following:

1. Length of rode plus anchor mark error
2. Distance from the Anchor Alarm to the bow
3. 30 feet (10 meter) GPS error

Assuming the Anchor Alarm will be used in a stateroom that is 30 feet from the bow, following our example, we calculate the alarm distance as 120 feet (rode and anchor mark error) plus 30 feet (distance to bow) plus 30 feet (GPS error) for a total distance of 180 feet or 0.030 nautical miles.

Use the green up and down SET buttons to set the **Alrm:** distance in nautical miles. See Appendix A: Distances (page 15) for a handy table of distance values. If you are measuring distances in feet, simply divide the distance by six to obtain the nautical mile distance setting without the decimal point and ignore the decimal point and multiply the nautical mile distance by six to obtain the distance in feet.

The alarm distance is saved in the Anchor Alarm's non-volatile memory. When you turn the Anchor Alarm on, the previously set alarm distance is automatically displayed.

NOTE
An anchor mark error will also result in greater variations between the **Dist:** and **Alrm:** distance values as your boat moves around its circle of swing.

Enabling the Alarm

After marking the anchor position and setting the alarm distance, use the Alarm On/Off button to enable or disable the alarm. When the alarm is enabled, ***ON*** will appear in the lower right of the display screen and the red status LED on the front panel will be lit. The status LED is dimly lit so that it is noticeable in the dark but does not light the cabin. Use the Alarm On/Off button again to disable the alarm, which will turn off the status LED and show **OFF** in the lower right of the display screen.

Using the LCD Backlight

Use the LCD Backlight button to change the brightness of the LCD screen. Press the button to cycle through five backlight states: off, 25%, 50%, 75%, and full brightness. To conserve internal battery power when external power is lost, the backlight is automatically turned off.

A single short audible beep will sound if you use the LCD Backlight button to enable a brightness setting while running on the internal battery. The short beep is a reminder that battery life will be extended if the LCD backlight is turned off. In bright sunlight it may be difficult to determine the state of the backlight. For this reason, the short beep does not occur when the backlight state changes from full brightness to off.

Understanding the Display Screen

The LCD display screen includes four rows of data which are described below. When the Anchor Alarm is turned on the firmware version and date are displayed for two seconds before the normal display appears.

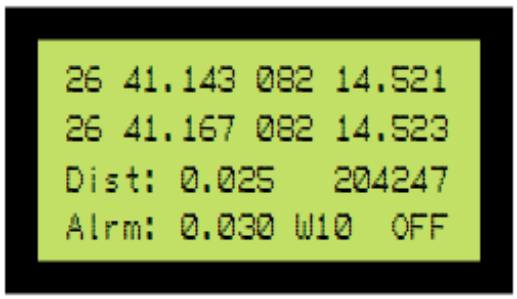


Figure 5 Display Screen

Row 1: Current Position

The first row displays the latitude and longitude of the current position. "Acquiring Satellites" will appear until the GPS receiver acquires its first position fix.

Row 2: Anchor Position

The second row displays the latitude and longitude of the anchor position marked by the User. The anchor position is saved in the Anchor Alarm's non-volatile memory so the last anchor position will automatically appear when the unit is powered on.

Row 3: Distance and UTC Time

The third row displays the distance between the current position on row one and the anchor position on row two. At startup, while the GPS receiver is acquiring satellites, the distance displayed will be zero. If the calculated distance exceeds 9.999 nautical miles **OVFLW** will appear.

The last six characters of row three displays Coordinated Universal Time (UTC) in HHMMSS format. If you know your current time zone's UTC offset you can add it to the UTC time to obtain the accurate current time. The UTC's seconds display also serves to verify the unit's firmware is running properly.

When external power is lost, for example while anchoring, and the Anchor Alarm is running on its internal battery **Batt** will appear in place of the UTC hour and minute values but the seconds will continue to display.

Row 4: Alarm Distance, Satellites, and Status

The fourth row shows the current alarm distance immediately below row three's calculated distance. If the alarm is enabled and row three's calculated distance equals or exceeds the set alarm distance the audible alarm will sound.

The number of satellites used for the last GPS position fix is displayed to the right of the alarm distance. Use the number of satellites to help you determine the best location for the GPS antenna. More satellites will yield more accurate positions. The number of satellites is preceded by a "W" (**W10**) when the Wide Area Augmentation System (WAAS) was used for the last fix. WAAS uses a network of ground-based reference stations to monitor the GPS satellites and send correction data back to the satellites for broadcast, which produces more accurate position data.

HDOP will appear in place of the number of satellites if the Horizontal Dilution of Precision (HDOP) value for the last GPS position fix exceeds a threshold value. Large HDOP values can produce inaccurate positions so the Anchor Alarm discards any positions with an HDOP greater than 3.0.

Finally, the end of row four displays either ***ON*** when the alarm is enabled or **OFF** when the alarm is disabled.

Understanding the Audible Alerts

The list below describes the various audible alerts issued by the Anchor Alarm.

One Very Short Beep: On Battery

The Anchor Alarm issues one very short audible beep once a minute while running on the internal battery. When the Anchor Alarm is running on its internal battery **Batt** will also appear on row three of the display screen.

One Short Beep: On Battery

The Anchor Alarm issues one short audible beep when external power is lost. When running on battery the Anchor Alarm will also issue the same short beep when the LCD backlight button is used to set the brightness to any state other than off. When the Anchor Alarm is running on its internal battery **Batt** will also appear on row three of the display screen.

One Long Beep: Can Not Mark Anchor

The Anchor Alarm issues one long audible beep when the green alarm distance set buttons are pressed simultaneously to mark the anchor position but there is no current position. This will occur when attempting to mark the anchor position while "Acquiring Satellites" is displayed.

Three Short Beeps: Anchor Position Marked

When the green alarm distance set buttons are pressed simultaneously to mark the anchor position, the Anchor Alarm will issue three short audible

beeps to confirm the position has been marked and saved. Use the three short beeps as confirmation without looking at the display screen.

Continuous Tone: Alarm

When the alarm is enabled and the calculated distance between the current position and the anchor position is equal to or exceeds the set alarm distance, the Anchor Alarm will issue a continuous alarm tone. When the alarm sounds, use the Alarm On/Off button to disable the alarm then immediately check your boat's position.

Rechargeable Battery Care

The Anchor Alarm uses an internal rechargeable 9-volt battery to allow the unit to operate for short periods while disconnected from an external power source. With the LCD backlight off, the Anchor Alarm will operate for at least one hour on a fully charged battery. Before using the Anchor Alarm on battery power for the first time, connect the unit to an external power supply for at least 24 hours.

The internal battery is slowly charged whenever the external power supply is connected even while the Anchor Alarm is powered off. The slow charge rate allows the Anchor Alarm to be connected continuously to an external power supply without damaging the internal battery. However, when the Anchor Alarm will not be used for extended periods, it is best to disconnect the unit from its power supply. The battery will self-discharge over extended periods so always connect the Anchor Alarm's external power supply for at least 24 hours before anchoring.

NOTE
When replacing the internal battery use only a Nickel Metal Hydride (NiMH) rechargeable battery. The charging current could cause damage to batteries with other chemistries.

Appendix A: Distances

Use the table below to convert Anchor Alarm distances in feet and meters to approximate nautical miles. A nautical mile is approximately one minute of latitude, 6076 feet, or 1852 meters.

Nautical Miles	Feet	Meters
0.001	6	2
0.002	12	4
0.003	18	6
0.004	24	7
0.005	30	9
0.006	36	11
0.007	42	13
0.008	48	15
0.009	54	17
0.010	60	19
0.011	66	20
0.012	72	22
0.013	78	24
0.014	84	26
0.015	90	28
0.016	96	30
0.017	102	31
0.018	108	33
0.019	114	35
0.020	120	37
0.021	126	39
0.022	132	41
0.023	138	43
0.024	144	44
0.025	150	46
0.026	156	48
0.027	162	50
0.028	168	52
0.029	174	54
0.030	180	56
0.031	186	57
0.032	192	59
0.033	198	61
0.034	204	63
0.035	210	65
0.036	216	67
0.037	222	69
0.038	228	70
0.039	234	72
0.049	294	91
0.050	300	93
0.060	360	111
0.070	420	130
0.080	480	148
0.090	540	167
0.100	600	185
0.200	1200	370
0.300	1800	556
0.400	2400	741
0.500	3000	926
0.600	3600	1111
0.700	4200	1296
0.800	4800	1482
0.900	5400	1667
1.000	6000	1852

Appendix B: Specifications

Physical

Dimensions:	3" H x 6" W x 2.5" D (7.5 cm x 15 cm x 6.5 cm)
Weight:	12.7 oz (360 g)

GPS Receiver

General

Chipset:	SiRF Star III
Frequency:	L1, 1575.42 MHz
C/A Code:	1.023 MHz chip rate
Channels:	20 channel all-in-view tracking
Sensitivity:	-159dBm

Accuracy

Position:	10 meters, 2D RMS 5 meters, 2D RMS, WAAS enabled
Velocity:	0.1 ms
Time:	1μs synchronized to GPS time

Datum

Default:	WGS-84

Acquisition Time

Reacquisition:	0.1 sec., average
Hot Start:	8 sec., average
Warm Start:	38 sec., average
Cold Start:	42 sec., average

Power

Main Power Input:	3.3VDC Input
Power Consumption:	75mA (continuous mode)

GPS Antenna

Antenna Specifications

Frequency:	1575.42+2 MHz
VSWR:	1.5 Max.
Bandwidth:	10 MHz Min.
Axial Ratio:	3 dB Typical
Impedance:	50ohm
Peak Gain:	4 dBic Min.
Gain Coverage:	-4dBicat -90°~ 90°(over 75% volume)
Power Handling:	1 watt
Polarization:	RHCP

Amplifier Module

Amplifier Gain w/o cable: 27 dB Typical

Noise Figure:	1.5 dB Typical
Filtering:	-25 dB (+ 100MHz)
Output VSWR:	2.0 Max.
Voltage:	DC 3 ~ 5.0V
Current:	22mA Max.@5VDC

Mechanical

Weight:	95 grams
Size:	1.77 x 1.46 x 0.51 inches (45 x 37 x 13 mm)
Cable:	RG174 15 Feet (4,572 mm long)
Connector:	SMA (male)
Mounting:	Magnetic base

Environmental

Operating Temp:	- 104°F - + 185°F (- 40°C ~ + 85°C)
Storage Temp:	- 104°F - + 185°F (- 40°C - + 85°C)
Water Resistance:	100% water resistant
Vibration:	Sine Sweep, 1G(0-P),10-150-10Hz each axis

External Power

Min. Voltage:	10.0 VDC
Max. Voltage:	15.0 VDC
Current:	200mA

Internal Battery

Type:	9V NiMH Rechargeable
Max. Current:	400mA continuous
Capacity:	Min. 250mAH
Nominal Voltage:	8.4 V
Standard Charge:	20mA for 21 Hours (0.1C Rate)
Quick Charge:	70mA for 6 Hours
Fast Charge:	270mA for 1 Hour (1C Rate)
Permanent Charge:	6mA to 10mA

Buzzer

Type:	Piezo Indicator, Internal Drive
Sound Pressure:	86dB @ 12V, 30cm
Frequency:	3.4kHz
Voltage Range:	3~20VDC
Current:	9mA
Dimensions:	24.50mm Dia x 16.50mm H